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Revision of EU Ecolabel criteria for Hard Coverings

Technical Report v.1.0: Draft criteria proposals.

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1 EXECUTIVE SUMMARY

This short summary brings together some key points about the project that should be borne in mind as well as a summary of the criteria proposals presented in this document.

Timeline

The EU Ecolabel criteria for hard coverings (HC) set out in Decision 2009/607/EC are now 9 years old and, via Commission Decision (EU) 2017/2076, have had their validity prolonged until 30 June 2021. As the last remaining Decision that still precedes the EU Ecolabel Regulation (EC) No 66/2010, its revision is overdue. The first Ad-Hoc Working Group (AHWG) meeting is scheduled as three separate webinars on the 10, 12 and 14 December 2018 for concrete products, ceramic products and natural/agglomerated stone products respectively. Assuming no delays, new criteria are expected to be officially published in the second half of 2020.

Scope and uptake

The scope of the existing criteria extend to floor and wall coverings made of natural stone, agglomerated stone, fired clay, ceramics and concrete. Moderate uptake of the criteria has been achieved with ceramic tiles (especially in Italy, where producers offer a range of high quality ceramic tile and slab products for export). With natural stone, only one quarry in Europe (in Spain) has been willing and able to demonstrate compliance with the applicable quarry scoring matrix. The authors are not aware of any current or expired EU Ecolabel licenses for agglomerated stone, clay or concrete-based products.

Potential scope expansion

In this report, the potential expansion of the product group to include kitchen countertops, roofing tiles and masonry units is considered. There are arguments for and against the expansion to these product categories. Although there may be some differences in the parameters that need to be respected in the production processes, they are fundamentally produced in the same way and are made of the exact same materials as the sub-products already covered in the scope for floor and wall tiles. The final decision on whether to include them or not will ultimately depend on stakeholder feedback.

The potential expansion to plasterboard was also considered but was not followed up due to time constraints and a lack of external input from the industry. Whether or not plasterboard will be reconsidered will also depend on stakeholder feedback.

Market considerations

The products covered by the existing EU Ecolabel hard coverings scope are dominated by B2B sales and this factor, coupled with the well-coordinated efforts of CEN-TC 350 have led to a substantial uptake of Environmental Product Declarations (EPDs) for these type of products. With the recent trend towards producing sectorial EPDs, where average data can be weighted over a large number of producers and product types, it can be said that around 70% of all ceramic production in the EU will soon be covered by sectorial EPDs.

Part of the reason for the successful uptake of EPDs is their recognition in Green Building Assessment (GBA) schemes such as BREEAM and LEED. The authors believe that the EU Ecolabel for hard coverings, as a Type I ecolabel covering a number of different construction products, and being based on criteria that target the main hotspots of LCA impacts, is also worthy of recognition by these same schemes and this will continue to be discussed as the project progresses.

Another part of the reason for the successful uptake of EPDs, in Italy in particular, is the recognition of EPDs and type I ecolabels when setting legislation supporting minimum environmental criteria for "*internal furniture, building and textile products*". A minimum environmental requirement of an EPD (specific or sectorial) or an EU Ecolabel is defined. Sectorial EPDs are much more economical when large groups of companies pool their data together. While it can be argued if a sectorial EPD should be recognised at all, let alone be considered as comparable to a product specific EPD or an EU Ecolabel product, this effect only serves to highlight the potential positive influence of GPP criteria on projects when regional or national public procurement legislation pushes for Ecolabels or EPDs.

A general shift towards a scoring approach for hard covering products

In the existing criteria, a scoring matrix was already present but only for natural stone quarries. In principal the idea is interesting and represents a move away from the rigid pass-fail approach that is normally employed. If applied to the entire criteria, it could give potential applicants an idea of how far away they might be from being able to obtain the EU Ecolabel, to identify one or more ways in which they could bridge the gap or to simply measure their own progress using these metrics without having to involve any LCA experts.

Particular effort has been made to set the criteria to focus on requirements and information that potential applicants already have or should be able to obtain. The only upstream requirements are on criteria linked to quarries for natural stone and cement for concrete. These could not be ignored because they are involved with significant LCA hotspots.

As a cautionary note, some EUEB members have requested that scoring should be supported by some mandatory requirements to act as a "*safety net*'' to prevent the possibility of an EU Ecolabel product being associated with very poor performance in one or two environmental aspects. This feedback has generally been taken into account and mandatory requirements are set together with potential ways in which an applicant can achieve points. Two common aspects that are promoted for all the sub-products, without making them mandatory, are EMAS certification and the installation of onsite CHP.

As a general rule, the points are based on quantitative data that is linked to maximum points for an arbitrary best practice threshold or are based on optional requirements where a yes achieves full points or a no achieves zero points.

Changes to the natural stone product criteria

The scoring matrix for the quarry has been removed due to the following points:

- Concern about the highly dynamic nature and dependence on the choice of sampling point for dust emissions to air and noise.
- Doubts about the relevance of water recycling ratio since the authors understand that water is recycled in a closed loop and only evaporative losses and losses in separated wet sludge are topped up (so a default ratio of 100% according to the method in the existing criteria is the norm).
- Leading from the water recycling practice, suspended solid emissions become irrelevant or highly intermittent and carrying also solids from diffuse sources (due to fact that water emissions are either zero or in overflow conditions due to rainfall.

- The weighting factors generally cannot be controlled by the quarry operator (e.g. population density of the surrounding population) and greatly influence the final score.

The highly dynamic and difficult to verify requirements relating to dust emissions, suspended solid emissions and noise have been converted into more tangible good management practices (for water and air) and the noise requirement has been set to a fixed maximum during working hours. There are no more weighting factors in the proposal. Mandatory requirements (and optional points) are set for the quarry impact ratio and the material efficiency due to their continued importance on land use impacts and resource efficiency. These are numbers which the quarry operator should be able to calculate as they are closely related to the core business.

Changes to the agglomerated stone product criteria

During the initial research period the JRC was unable to visit a production facility or establish dialogue with relevant experts. Consequently, there is some uncertainty associated with the relevance and ambition level of both the existing and proposed criteria. A decision needs to be made about whether cement-based agglomerated stone products should be covered by the EU Ecolabel or not. If so, then some sort of requirement on the cement binder would need to be proposed.

Due to a lack of information, the air emission limits have been maintained as they were although desk-based research has suggested that it would be possible to push for recycled/secondary material content (up to 40 points) and for a reduction in the organic binder content on a w/w basis (up to 25 points). Regarding specific energy consumption, there is very little data published and so further input will be needed. A tighter limit of 1.1 MJ/kg has been proposed with a view to prompting discussion on this matter. Independent of the specific energy consumption, recognition of efforts by potential applicants who need heat energy for their process and who manage to obtain it more efficiently is promoted by awarding points for the installation of CHP units onsite. Further points are available should the CHP unit be fed with biomass or waste fuels and/or from the renewables share of purchased electricity. The approach has been applied to all the sub-products and, if deemed suitable for all, could be moved to the horizontal criteria.

Changes to the ceramic product criteria

Specific energy consumption data and air emissions from the BREF Document published in 2007 for ceramics (specifically those data regarding floor and wall tile production) have been cross-checked against the current EU Ecolabel requirements. A direct comparison was complicated by the different units used (BREF focuses on mg/Nm^3 and EU Ecolabel focuses on mg/m^2). In the context of the BREF data from 2007, most of the requirements in the EU Ecolabel appear to be of a reasonable ambition level.

While it is unclear how much energy consumption and air emissions have improved in the last 10 years, a new type of ceramic tile product has emerged, the thin format tile. Thin format tiles can be as thin as 3mm, a significant decrease compared to the standard thickness of 10-12mm. Consequently, it has to be decided what to do with the units used for requirements relating to energy consumption (MJ/kg, which penalises thinner tiles) and air emission (mg/m^2, which favours thinner tiles). In the proposed criteria, two units have been proposed so that readers can see how they compare. One possible approach could be to set the units in a way that standard tiles can meet but which always favour thinner tiles, in order to recognise their superior material efficiency. This is a matter for in-depth stakeholder discussion.

With regards to points, the most important aspects are recognised as air emissions and specific energy consumption, although the advanced reuse of process waste solids and further reductions in specific freshwater consumption are fully encouraged too.

Changes to the concrete-based product criteria

Both the concrete paving blocks and the cement-based terrazzo tiles are made with the same production technology, namely dry-cast concrete using vibro-compression. Clear lines need to be drawn between cement-based terrazzo tile and cement-based agglomerated stone but this will require clarification from industry and relevant CEN/TC members. In this first proposal, the same criteria for terrazzo tiles and concrete paving blocks, flags and kerb units apply.

A significant number of potential new EU Ecolabel criteria arose during the background research carried out. Some potential criteria such as an optional award of points for high albedo concretes or the use of alternative fuels in cement kilns were not brought forward from the Background Report into the first draft proposal in this Technical Report due uncertainties about the delivery of environmental benefits. For example, there is still some uncertainty if surface albedo at the global level is actually an issue of environmental concern. With regards to alternative fuels, not all alternative fuels are equal and it may be challenging to estimate the calorific value input of alternative fuels in cases where they are heterogeneous by nature and variable from batch to batch delivered to site.

Still, there are a number of new criteria that are presented for stakeholder feedback and which apply at the level of the cement producer (i.e. clinker factor and gross CO2 emissions) or the concrete producer (recycled/secondary material content, plant energy consumption, photocatalytic surfaces and permeable pavements).

Restructuring of criteria

In Decision 2009/607/EC, the criteria were generally structured in the same sequence as a product life cycle, starting with raw material extraction, the processing, then the use phase. Sub-products were either natural or processed and the latter were either fired or hardened. From the perspective of a potential reader who is only interested in what criteria are relevant for e.g. ceramics, the document was not reader-friendly. Consequently, the criteria have been restructured as follows:

- Horizontal criteria for all sub-products;
- Specific criteria for natural stone;
- Specific criteria for agglomerated stone;
- Specific criteria for ceramic-based products, and
- Specific criteria for concrete-based products.

2 INTRODUCTION

The EU Ecolabel promotes the production and consumption of products with a reduced environmental impact along the life cycle and is awarded only to the best (environmental) performing products in the market.

The entire life cycle of the product, from the extraction of raw materials through to production, packaging, distribution, use and disposal is considered. The EU Ecolabel may define criteria that address environmental impacts from any of these lifecycle phases, with the aim being to target those areas of most significant impact preferentially. The criteria development process involves scientists, non-governmental organisations (NGOs), member state representatives, and industry stakeholders. The overall ambition level for criteria should aim to target 10% to 20% of the most environmentally friendly products currently on the market.

Since the life cycle of each product and service is different, the criteria are tailored to address the unique characteristics of each product type. They are revised to reflect upon technical innovation such as alternative materials or production processes, reductions in emissions and market advances. The development and revision processes are carried out in accordance with the EU Ecolabel Regulation (EC) No 66/2010. An important part of the process for developing or revising EU Ecolabel criteria is the involvement of stakeholders through publication of and consultation on draft technical reports and criteria proposals. This is achieved by working group meetings and written consultation processes managed via the BATIS online platform.

The overall aim of this project is to update existing criteria for the printed (Commission Decision 2009/607/EC). The project performs an evaluation of the existing criteria for the product groups by identifying which are still relevant and those who need revision, addressing existing concerns. It also examines whether any new criteria need to be introduced for areas of concern. The key factors to consider in this respect are:

- New technological development: either step-wise evolution of existing processes or completely new processes that become available, are economically viable and could mitigate environmental impacts;
- Stricter legal requirements: which may render existing EU Ecolabel criteria obsolete or of low ambition, or which may oblige the introduction of new restrictions;
- Developments in other ISO 14024 Type I ecolabels: to align where possible and where a clear rationale can be established;
- Published papers about LCA and non-LCA impacts with relevant processes and products: to help ensure that proposed criteria focus mainly on the environmental hotspots of the hard covering production.

This Technical Report aims to provide the background information and rationale for the revision of the EU Ecolabel criteria for the hard coverings product groups. The study has been carried by the Joint Research Centre (JRC Seville). The work is being developed for the European Commission's Directorate General for the Environment.

3 THE CRITERIA REVISION PROCESS

This project is intended to follow the standard procedure for the revision of EU Ecolabel criteria. A general illustration of the standard procedure is illustrated in Figure 1.

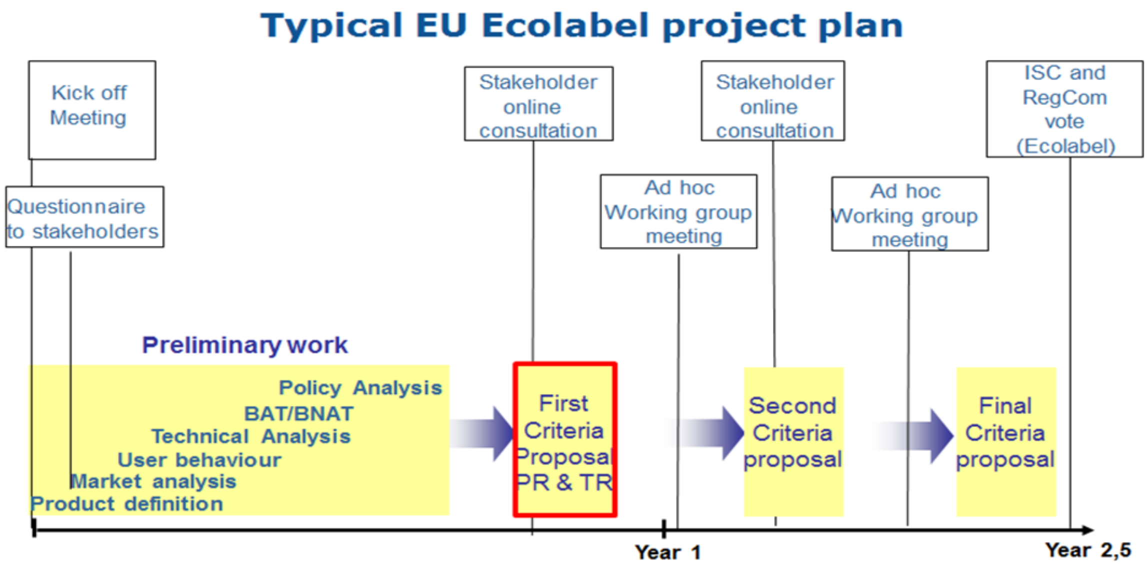

Figure 1. Overview of the typical EU Ecolabel revision process

The current stage in the process is highlighted in the red box. Although stakeholders have previously been invited to respond to a preliminary scoping questionnaire, their input to the process is now hoped to become more significant from this stage onwards.

Technical Report v.1.0 is published both in the BATIS online platform and the JRC website approximately one month ahead of the first ad-hoc working group (AHWG) meeting. The report presents the existing scope, definition and EU Ecolabel criteria and compares it to any new proposals brought forward by the JRC.

A number of discussion points are flagged up throughout the report where the JRC considers feedback to be especially important. However, stakeholders are free to offer their opinions about any part of the report. An html version of the Technical Report will also be uploaded to the BATIS online platform **before** the 1st AHWG meeting where registered stakeholders can upload their comments at any point up until around one month after the meeting.

Feedback received before, during and after the 1st AHWG meeting will then be considered when drafting Technical Report v2.0, and the whole process is repeated one more time.

Throughout the project, updates will be presented to the EU Ecolabelling Board when the board periodically meets in Brussels (3 times per year).

After the stakeholder consultation process has finalised, the proposed revisions are subjected to internal consultation with other DGs of the Commission and then formally voted by members of the EU Ecolabelling Board. Subject to a positive vote, the criteria are presented in the legal text format of a Commission Decision and subject to the scrutiny of the European Council and the European Parliament and translated into all of the official languages of the European Union.

4 SUMMARY OF PRELIMINARY REPORT

This section summarises the main conclusions of the PRs. The full text documents can be found on the BATIS platform and also at the project website:

http://susproc.jrc.ec.europa.eu/Hard_coverings/documents.html

3.1 Legal and Policy context

There are a number of relevant EU policy tools, Regulations and Directives that apply to this sector specifically and in an overarching manner as well. Arguably the most relevant is the Industrial Emissions Directive 2010/75/EU which defines best available techniques for major industrial sectors and sets requirements relating to emissions from the production site and sometimes on energy supply or consumption. For Portland cement production, emission limits have been formally implemented via Commission Decision 2013/163/EU and in the coming years it is expected that a Decision will be agreed about legally binding emission limits for ceramic production. The ceramic sector was investigated already under to old IPPC Directive, which assesses emissions but does not set any legally binding limits, but leaves any final conditions for the operating permit at the discretion of national authorities.

The use of secondary or recycled materials, and the reduction of waste production onsite are relevant to all sectors in different ways and are in line with the general aims of the Waste Framework Directive (2008/98/EC) and the EU Action Plan for the Circular Economy (COM(2015) 614).

As construction products, all are required to respect the harmonised requirements for the marketing of construction products as per Regulation (EU) No 305/2011. However, it is understood that these requirements would not apply to any products for use as kitchen countertops, since they would be considered as "furniture", which has no CE marking requirements, instead of construction products.

3.2. Market analysis

Market dimensions

The products covered in the current scope form part of major industrial sectors. The basic level relevant PRODCOM codes assessed are:

- 08.11 Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate.
- 23.31 Manufacture of ceramic tiles and flags
- 23.51 Manufacture of cement
- 26.61 Manufacture of concrete products for construction purposes

Natural stone production in Europe is dominated by Italy, Spain and Portugal, who together account for around two thirds of the total EU production of around 20 Mt.

With ceramics, production data is reported in m2 and EU production in 2016 was around 1350 Mm2. Spain and Italy are the two dominant producers in the EU, together accounting for over two thirds of total EU production. The Spanish and Italian sectors are characterised by production clusters, with the vast majority of producers concentrated into region districts (i.e. Castellon in Spain and Sassuolo in Italy).

The agglomerated stone market in the EU was reported to be 17 Mm2 in 2014 and is experiencing rapid growth worldwide (expected to be 24.5 Mm2 in the EU in 2019).

The production of concrete tiles and flags in the EU is dominated by Germany, Poland and the UK, who together account for around 50% of total European production volume and value. There are some large differences in the specific production value at Member State level, with ratios ranging from 25 to 200€/tonne at the Member State level (the EU average being 75 €/tonne). The total EU production of concrete tiles and flags, considered to be included in the scope already, accounts for around 69 Mt and €5500 million. Concrete blocks and bricks (i.e. masonry units), which are not included in the scope right now, but which are proposed for discussion, accounts for 77 Mt and €3900 million in production.

In general, all of these products have experienced a slump in production at the European level due to the economic crisis. Ceramics and natural stone are the sectors with greatest potential growth for exports out of the EU while concrete products in particular are limited to regional markets, even with cement supply (except in cases of white cement, which is a relatively niche product of potential relevance to this product group).

Environmental marketing strategies

In terms of other ecolabel schemes, an analysis of potentially relevant ISO 14024 Type I ecolabels revealed that these types of product are not covered by the main European ecolabel schemes (i.e. Blue Angel and Nordic ecolabel) but that outside of Europe there are a number of possible overlaps. The main examples are:

- The Korean Ecolabel (KEITI) with criteria for blocks, tiles, panels, recycled construction materials, aggregate and fine powder.
- Good Environmental Choice Australia (GECA) for cement, concrete and concrete-products as well as "hard surfacing".
- Environmental Choice New Zealand (ECNZ) of Portland cement and Portland cement blends and for ready-mixed concrete, pre-cast concrete, concrete products and dry-bagged mortars.
- Floor score (seeming global and operated by an independent party) which relates to VOC emissions for flooring materials.

It is worth mentioning some industry-led initiatives that attempt to define some level of environmental reporting and sustainability. In terms of environmental reporting, CEN/TC 350 has led the development of Product Category Rules for construction products in general, resulting in the publication of EN 15804. This standard has set the platform for carrying out EPDs for this type of products. While the number of product specific EPDs remains relatively small, there are some "sectorial" EPDs which claim to cover large parts of entire sectors at the national or international level. This is the case for Portland cement as well as ceramic tile producers in Germany, Italy and shortly, Spain.

In terms of sustainability initiatives at international level, the concrete industry have developed an early version of the Concrete Sustainability Council Certification System (version 1.0 ready in December 2017) and the ceramics industry are currently finalising an ISO standard on specifications for sustainable ceramic tiles.

Green Building Assessment schemes are a major demand-side influence on the sector and the current recognition of EPDs by LEED and BREEAM is considered to be helping drive the uptake of EPDs.

3.3. Technical analysis

The quarrying of ornamental or dimension stone has two broad techniques: dynamic splitting (using explosives for hard stone like granite) and cutting (wet or dry, for soft stone like marble). The processing of these blocks into natural stone tile or slab products involves further cutting (exact technique dependent again on stone type) and surface finishing (generally polishing but other techniques may be used to increase surface roughness as well). Resins may be used to treat stone surfaces in order to prevent water penetration and/or to achieve high gloss finishes.

With agglomerated stones, crushed rock (typically granite, marble or quartz) is set in a polyester or epoxy resin under vacuum in a mould under carefully controlled temperatures. The resultant slabs are then shipped to final producers who cut the pieces to shape for customers. Cutting to standard formats may also be carried out at the same site where slab production occurs.

Ceramic tile production involves the grinding (wet or dry) of clay and other raw materials like feldspars and quartz to optimise the behaviour of the green (unfired) body in the kiln and the final properties of the fired ceramic product. Atomisation of ground raw materials (i.e. spray drying) is a specialised operation that results in particles with good mechanical behaviour in the pressing and shaping operations. Due to economies of scale, only the largest ceramic producers will tend to have their own atomisation plant. Others will simply purchase atomised raw material to begin with. Ceramic tiles may be glazed or unglazed and may be fired once or twice, depending on the kiln technology onsite and the interaction between the glazing formulation and the "green" ceramic body. Firing temperatures of 1050 to 1300°C are typically required to produce the ceramic tile. The tile surface may then be cut, rectified, polished and optionally coated with a resin or wax, for the same reasons as this treatment may be applied to natural stone. Major innovations in this sector during the last 10 years have been the adaptation of production processes to facilitate large format and thin tiles and digital printing.

The concrete production technology for concrete paving blocks, flags and kerb units generally uses the dry-cast technology due to its improved economics over "wet" pre-cast techniques. This involves the mixing of a low or zero slump concrete (coarse aggregates, fine aggregates, filler, pigments, cement and water) which is dosed to a mould before it is vibrated to remove any entrained air and pressed under vibration. The production process is rapid (over the order of minutes) and the final product requires at least 24 hours to cure under controlled temperature conditions (normally 20 to 40°C) before it will have sufficient strength for handling and shipment. It is worth mentioning the production process of cement, the fundamental ingredient in concrete, which is a mixture of limestone (ca. 80%) and clay that is ground and fired at 1450°C in a rotary kiln to produce reactive clinker mineral phases. The clinker is then ground together with a minor amount calcium sulfate (normally gypsum and < 5% by weight) which acts as a set regulator when the cement will be mixed with water.

3.4. Life Cycle Assessment

The natural of the hard covering product group means that life cycle impacts will always be concentrated in the raw material supply and production stages.

With natural stone tiles and slabs, the impacts due to the quarrying operation are highly significant, arguably more so than the actual production of the product. A similar case exists for concrete products, where it is the production of cement that dominates more life cycle impact categories. The challenge here is to decide how best to reflect this in the approach to EU Ecolabel criteria, There is no incentive for the quarry operator or cement producer to even share certain data with their customers because they are not likely to be aware of or interested in the EU Ecolabel.

So is there some scope for these upstream actors in the supply chain to somehow be recognised by the EU Ecolabel?

With ceramic tile production, virtually all of the life cycle impacts are dominated by the kiln although there are important impacts associated with the atomisation of powder and the production of frits and glazes by upstream suppliers as well.

With agglomerated stone, the supplier has more scope with the choice of raw materials and the promotion of recycled or secondary materials is considered as a particularly interesting way to reduce life cycle impacts. Likewise, the reduction of the resin content and a shift from a fossil-based to a bio-based resin could be relevant. However, more specific information about the production process is needed and there is almost no LCA literature available about this type of products.

5 REVISION OF EXISTING DEFINITION AND SCOPE

Current definition and scope

The product group 'hard coverings' shall comprise — for internal/external use, without any relevant structural function — natural stones, agglomerated stones, concrete paving units, terrazzo tiles, ceramic tiles and clay tiles. For hard coverings, the criteria can be applied both to floor and wall coverings, if the production process is identical and uses the same materials and manufacturing methods.

This group can be divided into 'natural products' and 'processed products'.

'Natural products' includes the natural stones, that, as defined by CEN TC 246 are pieces of naturally occurring rock, and include marble, granite and other natural stones.

'Other' natural stones refer to natural stones whose technical characteristics are on the whole different from those of marble and granite as defined by CEN/TC 246/N.237 EN 12670 'Natural stones — Terminology'. Generally, such stones do not readily take a mirror polish and are not always extracted by blocks: sandstone, quartzite, slate, tuff, schist.

The group of 'processed products' can be further divided into hardened and fired products. Hardened products are agglomerated stones, concrete paving units and terrazzo tiles. Fired products are ceramic tiles and clay tiles.

'Agglomerated stones' are industrial products manufactured from a mixture of aggregates, mainly from natural stone grit ,and a binder as defined by JWG 229/246 EN 14618. The grit is normally composed of marble and granite quarry granulate and the binder is made from artificial components as unsaturated polyester resin or hydraulic cement. This group includes also artificial stones and compacted marble.

'Concrete paving units' are products for outer floor-coverings obtained by mixing sands, gravel, cement, inorganic pigments and additives, and vibro-compression as defined by CEN/TC 178. This group also includes concrete flags and concrete tiles.

'Terrazzo tiles' are a suitably compacted element of uniform shape and thickness, which meets specific geometrical requirements as defined by CEN/TC 229. The tiles are single or dual-layered. The single-layered are tiles completely made of granulates or chipping of a suitable aggregate, embedded in grey and white cement and water. The dual-layered tiles are terrazzo tiles made up of the first face or wear layer (with single-layered composition) and a second layer, known as backing or base concrete layer, whose surface is not exposed during normal use and which may be partially removed.

'Ceramic tiles' are thin slabs from clays and/or other inorganic raw materials, such as feldspar and quartz as defined by CEN/TC 67. They are usually shaped by extruding or pressing at room temperature, dried and subsequently fired at temperatures sufficient to develop the required properties. Tiles can be glazed or unglazed, are non-combustible and generally unaffected by light.

'Clay tiles' are units which satisfy certain shape and dimensional requirements, used for the surface course of pavements and manufactured predominantly from clay or other materials, with or without additions as defined by CEN 178.

Proposed definition and scope

The product group 'hard coverings' shall comprise floor coverings and wall coverings, for internal or external use and without any relevant loadbearing function for building structures.

Hard coverings shall be made of either: natural stone, agglomerated stone, unreinforced concrete, terrazzo tiles, ceramic tiles or clay pavers.

'Agglomerated stone products', according to EN 14618:2009, means industrial products mainly made of hydraulic cement, resin or a mixture of both, stones and other additions. They are industrially manufactured in geometrical shapes at fixed plants by moulding techniques. They are put on the market in the form of rough blocks, rough slabs, slabs, tiles, dimensional stone works, and any other cut to size products. The term 'agglomerated stone' is considered as synonymous with 'engineered stone' and 'manufactured stone'.

'Ceramic tile products', as defined by CEN/TC 67, means thin slabs made from clays and/or other inorganic raw materials, such as feldspar and quartz, which are usually shaped by extrusion or dry-pressing techniques, dried and subsequently fired at temperatures sufficient to develop the required properties. Tiles can be glazed or unglazed, are non-combustible and generally unaffected by light.

'Çlay pavers', as defined by EN 1344:2013, means pavers and accessories manufactured from clay for interior or exterior use that will be subjected to pedestrian and vehicular traffic and used in the flexible form of construction (pavers laid with narrow sand-filled joints on a sand bed) or in the rigid form of construction (pavers laid with cementitious mortar joints on a similar mortar bed, itself placed on a rigid base). It does not include clay floor tiles or masonry units.

'Concrete paving blocks', as defined by EN 1338, means precast, unreinforced cement bound concrete blocks and complimentary fittings for pedestrian use, vehicular use and roof coverings. These products are manufactured by mixing sands, gravel, cement, inorganic pigments and additives, and vibro-compression as defined by CEN/TC 178. This group also includes concrete paving flags and kerb units, as defined in EN 1339 and EN 1340 respectively.

'Natural stone' is defined by CEN TC 246 as pieces of naturally occurring rock, and include marble, granite and other natural stones.

'Other' natural stones refer to natural stones whose technical characteristics are on the whole different from those of marble and granite as defined by CEN/TC 246/N.237 EN 12670 'Natural stones — Terminology'. Generally, such stones do not readily take a mirror polish and are not always extracted by blocks: sandstone, quartzite, slate, tuff, schist.

'Terrazzo tiles' are suitably compacted elements of uniform shape and thickness formed via a vibro-compression similar technique and which meet specific geometrical requirements as defined by EN 13748. The tiles may be single or dual-layered. The single-layered are tiles completely made of granulates or chipping of a suitable aggregate, embedded in grey or white cement and water. The dual-layered tiles made up of the first face or wear layer (with single-layered composition) and a second layer, known as backing or base concrete layer, whose surface is not exposed during normal use and which may be partially removed.

Rationale and discussion:

Clarification about relevant structural function

The term "*without any relevant structural function*" has been replaced with "*without any relevant loadbearing function for building structures*" in order to be more precise about what exactly should be understood be structural function. It is obvious that all floor coverings and some wall coverings will transfer loads from one place to another within a structure during their normal use as part of a larger pavement or building structure, for example when people walk on floors, vehicles drive over pavements and items or shelves are hung from wall coverings. It has to be clear that none of these situations is considered as a "*relevant structural function*".

If kitchen countertops are to be included in the scope (CEN/TC 246 seems to be relevant for this), the proposed wording would also clarify that supporting the load of items placed on the countertop is definitely not considered as a "*structural loadbearing function at building level*". Likewise, if roofing tiles (CEN/TC 128) are included, it would be understood that these materials do not bear any load from the building structure.

'Clay tiles" becomes "clay pavers"

The existing definition referred to 'clay tiles' as per CEN/TC 178 but when checking the relevant standards covered by that technical group, the only one relating to clay products was EN 1344, which is specifically about clay pavers (i.e. floor covering) and not clay tiles (i.e. flor and wall coverings). So this has been corrected.

If there is a relevant market segment relating to clay wall coverings that should be included in the scope, stakeholders should inform the JRC.

The difference between terrazzo tiles and agglomerated stone

There is a broad similarity between the terrazzo tiles and agglomerated stone and the authors are not clear about how to best distinguish between one product and the other. This is not helped by the non-standard use of these terms when advertising products on the market.

Potential expansion of the scope to masonry units

Masonry units are generally used in non-structural applications in buildings and can be made of clay, aggregate concrete, autoclaved aerated concrete, 'manufactured stone' or natural stone (all recognised by the EN 771 series of standards). It could be argued that these products do not fit so well within the scope in the sense that it is rare that the ever end up facing the user under normal conditions (usually they would be plastered over. According to PRODCOM data in the preliminary report, including these materials in the scope would potentially increase the market share covered from 69 Mt to 146 Mt.

Potential expansion of the scope to include kitchen countertops

During the revision process for EU Ecolabel furniture, it was requested if criteria for kitchen countertops could be included within the scope. At the time it was decided that it would not be feasible to add criteria specifically for materials that would not otherwise be included in the furniture scope (e.g. ceramic slabs, agglomerated some, natural stone). The existing scope made specific reference to floor covering and wall covering, but in reality kitchen countertops are not intended to cover either.

With the debatable exception of clay and concrete, the other materials covered in the hard covering product group scope are highly relevant to kitchen countertop producers. Including kitchen countertops in scope would offer a more direct route to customers in a product groups that tends to be dominated by B2B dynamics. Furthermore, it would greatly increase the potential market, especially considering agglomerated stone, where "furniture" products account for about two thirds of the total agglomerated stone demand (around 47 Mm^2 in 2014). The same predominance of agglomerated stone demand being higher for kitchen countertops than in floor or wall tiles is the same in all difference global regions.

Points for discussion about scope and definition
Is it possible that clay pavers (i.e. thicker, bulkier units than clay tiles) might not meet the requirements set for ceramic (and clay) tiles? **Any suggestions for improvements to the current definitions? Especially to better define when a terrazzo tile stops being a terrazzo tile and might become an agglomerated stone.** **Opinions about the possible scope enlargement to masonry units, to roofing tiles and to kitchen countertops.**

6 REVISION OF EXISTING CRITERIA

Criteria structure

Within the product group scope there are four main sub-products and the criteria have been structured in such a way that the criteria relating to a particular sub-product can easily be identified and read:

1. **Natural stone products** (blocks are cut from a quarry and sold to processors who convert the blocks into finished products).
2. **Agglomerated stone products** (marble or quartz powder is mixed with resins under vacuum and pressure in a patented process to produce blocks and slabs that may be sold to processors or finished at the same site).
3. **Ceramic tiles** (clay and other raw materials are extracted from quarries before being pressed or extruded into specific shapes, treated with glazes and possibly being printed before firing at high temperatures (1050 to 1300°C) into solid and durable products.
4. **Concrete products** (aggregates are extracted from quarries and mixed with cement and water before being moulded and pressed into products of a specific shape before curing. The cement production process has higher environmental impacts due to the calcination of limestone and clay at high temperatures (1450°C) in a rotary kiln.

The criteria are set up to be read horizontally at first and then vertically, depending upon which sub-product is of relevance.

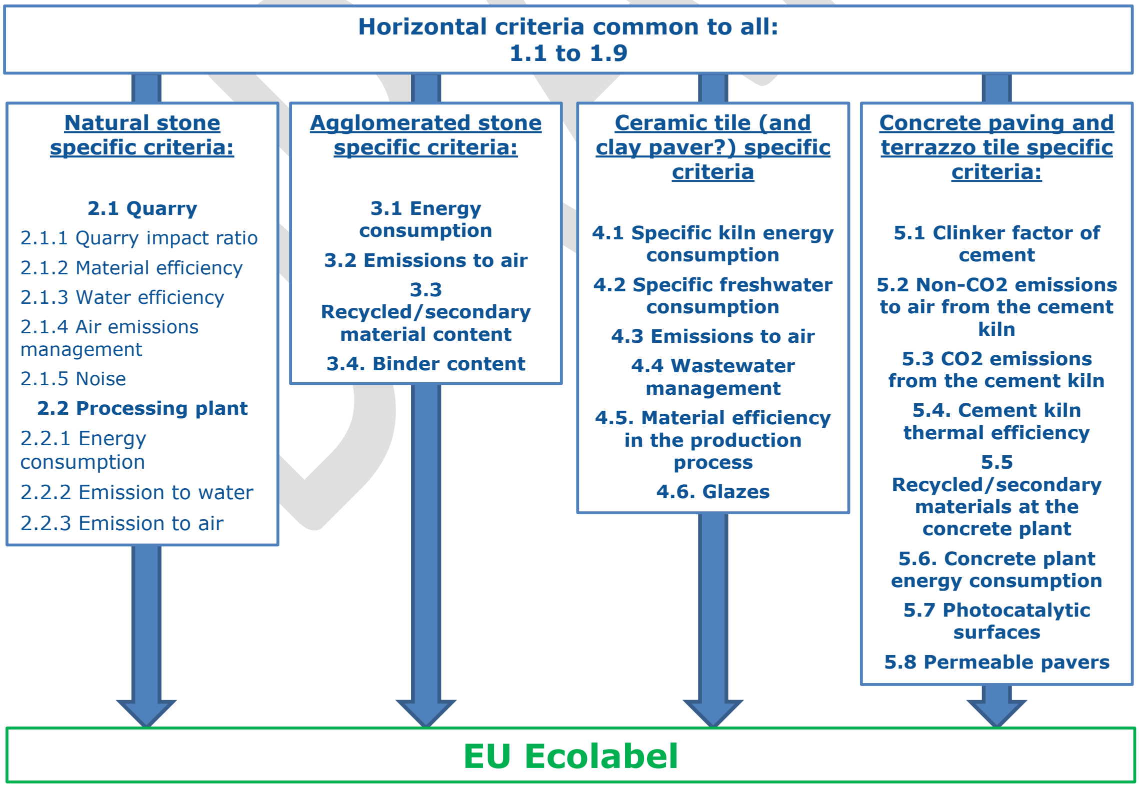

Figure 2. Criteria structure for the four sub-products currently included in the scope.

Some criteria rely on the upstream supply chain (i.e. the quarry for natural stone products and the cement supplier for concrete products and terrazzo tiles). In these cases, there is no obvious incentive for the suppliers to make any effort to comply so the possibility of a B2B type EU Ecolabel might be potentially interesting.

7 CRITERIA PROPOSALS

Horizontal criteria for all sub-products

1.1 – Environmental Management System

Existing criterion
No existing criterion
Proposed criterion 1.1. Quality management and environmental management
<u>Mandatory requirement</u> The applicant shall have a documented Environmental Management System in place. **<u>EU Ecolabel points</u>** The applicant shall have a documented environmental management system according to ISO 14001 in place and certified by an accredited organization (2 points). or The applicant shall have a documented environmental management system according to the EU Eco-Management and Audit Scheme (EMAS) in place and certified by an accredited organization (5 points). ***<u>Assessment and verification</u>:*** *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a copy of their own Environment Management System documentation.* *Where points are claimed for ISO 14001 or EMAS certification, the applicant shall provide a copy of the ISO 14001 or EMAS certificate, as appropriate, and provide the Competent Body with the details of the organization which carried out the accreditation.* *In cases where an applicant has both ISO 14001 and EMAS certification, only the points for the EMAS certification shall be awarded.*

Points for discussion about management requirements
Do you think it would be useful to also specifically mention waste management plans or energy management plans in this criterion or in other criteria? **Or can these be considered as automatically covered under the broader environmental management system?**

Rationale and discussion

An Environmental Management System is considered as a fundamental requirement to ensure that an organization has established some environmental goals and is taking measures to assess and reduce the environmental impact of its activities. Such a philosophy fits perfectly well with any company that may be interested in applying for the EU Ecolabel and can provide a framework for how to gather necessary data that would be relevant to certain EU Ecolabel criteria.

In many cases an Environmental Manager or Sustainability Director is appointed, whose role would be to develop and revise the Environmental or Corporate Sustainability Reports.

A minimum mandatory requirement of an "in-house" environmental system is provided so as not to exclude any organizations that have not yet invested in ISO 14001 or EMAS certification - this could especially apply to smaller organizations.

For companies that have made the effort to achieve external certification, bonus points are awarded for ISO 14001 and EMAS certification.

Extra points are awarded for EMAS because this is considered to have a broader reach and more concrete framework in its approach to environmental management. Some of the key differences between EMAS and ISO 14001 are summarized below.

Table 1. A comparison of EMAS and ISO 14001[1].

Elements	EMAS	ISO 14001
General aspects		
Legal status	•European Regulation (EC) No 1221/2009.	•International commercial standard under private law.
Participation	•Voluntary.	•Voluntary.
Geographical outreach	•Globally applicable.	•Globally applicable.
Focus and objective	•Focus on continual improvement of environmental performance of the organization.	•Focus on continual improvement of Environmental Management System.
Planning		
Environmental aspects	•Comprehensive initial environmental review of the current status of activities, products and services.	•Requires only a procedure to identify environmental aspects. •Initial review is recommended, but not required.
Legal compliance	•Proof of full legal compliance is required.	•Only commitment to comply with applicable legal requirements. •No compliance audit.
Employee involvement	•Active involvement of employees and their representatives.	•Not required (ISO 14001 and EMAS both foresee training for employees).
Suppliers and contractors	•Influence over suppliers and contractors is required.	•Relevant procedures are communicated to suppliers and contractors.
External communication	•Open dialogue with external stakeholders is required. •External reporting is required on the basis of a regularly published environmental statement.	•Dialogue with external stakeholders not required. •External reporting is not required.
Checking		
Internal environmental auditing	•Environmental Management System audit. •Performance audit to evaluate environmental performance. •Environmental compliance audit.	•Includes only the Environmental Management System audit of the requirements of the standard.
Verifier/Auditor	•Environmental verifiers are accredited/licensed and supervised by governmental bodies. •Independence of the environmental verifier is required.	•Certification bodies are accredited through a national Accreditation body. •Independence of the auditor is recommended.
Audits	•Inspection of documents and site visits to be carried out according to Regulation. •Check for improvement of environmental performance. •Data from environmental statement needs to be validated.	•No certification rules in standard (other standards for auditing and certification). •Check of Environmental Management System performance, but no frequency specified or required.
Derogations for SMEs	•Extension of verification intervals from three to four years. •Updated environmental statement needs to be validated only every two years (instead of every year). •Environmental verifier takes into account special characteristics of SMEs.	•No derogations foreseen.

[1] From the EMAS factsheet, published by the European Commission in December 2011.

Official registration by authorities	•Publically accessible register records each organization. •Each registered organization receives a registration number.	•No official register.
Logo	•Yes.	•No.

1.2 – Raw material extraction management activities

Existing criterion 1 Raw material extraction

1.2. Extraction management (for all hard covering products)

The raw materials used in the production of hard coverings shall comply with the following requirements for the related extraction activities:

The applicant shall provide a technical report including the following documents:

- *the authorisation for the extraction activity;*
- *the environmental recovery plan and/or environmental impact assessment report;*
- *the map indicating the location of the quarry;*
- *the declaration of conformity to Council Directive 92/43/EEC (habitats) and Council Directive 79/409/EEC (birds). In areas outside the Community, a similar technical report is required to demonstrate compliance with the UN conservation on biological diversity (1992) and provide information on any national biodiversity strategy and action plan, if available.*

Assessment and verification:

The applicant shall provide the related data and documents including a map of the area. If the extraction activity is not directly managed by the producers, the documentation shall always be requested to the extractor(s).

Proposed criterion 1.2. Industrial and construction mineral extraction

Mandatory requirement

The extraction of industrial and construction minerals (for example limestone, clay, aggregates, ornamental or dimension stone etc.) for to manufacture any EU Ecolabel hard covering product shall respect the following requirements, as appropriate.

Extraction activity carried out within the EU:

- If they are extracted from Natura 2000 network areas, composed of Special Protection Areas under Directive 2009/147/EC on the conservation of wild birds, and Special Areas of Conservation under Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora, extraction activities have been assessed and authorised in accordance with the provisions of Article 6 of Directive 92/43/EEC and taking into account the EC Guidance document on non-energy mineral extraction and Natura 2000.

Extraction activity carried out outside the EU:

- If they are extracted from areas officially nominated as candidates for or adopted as Areas of Special Conservation Interest, part of the Emerald network pursuant to Recommendation No. 16 (1989) and Resolution No. 3 (1996) of the Standing Committee of the Convention of the Conservation of the European Wildlife and Natural Habitats (Bern Convention), or protected areas designated as such under the national legislation of the sourcing / exporting countries, the extraction activities have been assessed and authorised in accordance with provisions that provide assurances equivalent to Directives 2009/147/EC and 92/43/EEC.

Assessment and verification:

In case industrial or construction mineral extraction activities have been carried out in Natura 2000

network areas (in the EU), the Emerald network or protected areas designated as such under the national legislation of the sourcing/exporting countries (outside the EU), the applicant shall provide a declaration of compliance with this requirement issued by the competent authorities or a copy of their authorisation issued by the competent authorities.

Points for discussion about industrial and construction mineral extraction
Opinions on the proposal?

Rationale and discussion:

Following consultation with Commission colleagues, it was agreed that the requirements relating to the extraction of industrial or construction minerals for EU Ecolabel hard coverings should follow the same wording as that which was voted for EU Ecolabel Soil Improvers and Growing Media (Decision (EU) 2015/2099).

1.3 – Hazardous substance restrictions

Existing criterion 2.1. Absence of risk phrases in raw materials
No substances or preparations that are assigned, or may be assigned at the time of application, any of the following risk phrases (or combinations thereof): *— R45 (may cause cancer),* *— R46 (may cause heritable genetic damage),* *— R49 (may cause cancer by inhalation),* *— R50 (very toxic to aquatic organisms),* *— R51 (toxic to aquatic organisms),* *— R52 (harmful to aquatic organisms),* *— R53 (may cause long-term adverse effects in the aquatic environment),* *— R54 (toxic to flora),* *— R55 (toxic to fauna),* *— R56 (toxic to soil organisms),* *— R57 (toxic to bees),* *— R58 (may cause long-term adverse effects in the environment),* *— R59 (dangerous for the ozone layer),* *— R60 (may impair fertility),* *— R61 (may cause harm to the unborn child),* *— R62 (possible risk of impaired fertility),* *— R63 (possible risk of harm to the unborn child),* *— R68 (possible risk of irreversible effects),* *as laid down in Council Directive 67/548/EEC (1) (Dangerous Substances Directive), and considering Directive 1999/45/EC of the European Parliament and of the Council (2) (Dangerous Preparations Directive), may be added to the raw materials.*

Alternatively, classification may be considered according to Regulation (EC) No 1272/2008 of the European Parliament and of the Council [(3)]. In this case no substances or preparations may be added to the raw materials that are assigned, or may be assigned at the time of application, with and of the following hazard statements (or combinations thereof): H350, H340, H350i, H400, H410, H411, H412, H413, EUH059, H360F, H360D, H361f, H361d, H360FD, H361fd, H360Fd, H360Df, H341.

Due to the environmental advantages of the recycling of materials, these criteria do not apply to the quota of closed-loop recycled materials [(4)] used by the process and as defined in Appendix A2. Assessment and verification: in terms of chemical and mineralogical analysis, the material formulation shall be provided by the applicant together with a declaration of compliance with the abovementioned criteria.

(1) OJ 196, 16.8.1967, p. 1.

(2) OJ L 200, 30.7.1999, p. 1.

(3) OJ L 353, 31.12.2008, p. 1

(4). Close loop recycling' means recycling a waste product into the same product. For secondary material arising from a manufacturing process (such as leftovers or remnants), 'closed loop recycling' means that the materials are used again in the same process.

A2 Raw materials selection

'Closed loop recycling' means recycling a waste product into the same kind of product; for 'secondary material' arising from a manufacturing process (such as leftovers or remnants), 'closed loop recycling' means that the materials are used again in the same process.

Proposed criterion 1.3. Hazardous substance restrictions

Mandatory requirement

a) Restrictions on Substances of Very High Concern (SVHC)

The product shall not contain substances that have been identified according to the procedure described in Article 59(1) of Regulation (EC) No 1907/2006 and included in the Candidate List for Substances of Very High Concern in concentrations greater than 0.10 % (weight by weight). No derogation from this requirement shall be granted.

Assessment and verification:

The applicant shall provide a declaration that the product does not contain any SVHC in concentrations greater than 0.10 % (weight by weight). The declaration shall be supported by safety data sheets of process chemicals used or appropriate declarations from chemical or material suppliers.

The list of substances identified as SVHC and included in the candidate list in accordance with Article 59(1) of Regulation (EC) No 1907/2006 can be found here:

http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp.

Reference to the list shall be made on the date of application.

Mandatory requirement

b) Classification, Labelling and Packaging (CLP) restrictions

Unless derogated in Table X, the product shall not contain substances or mixtures in concentrations greater than 0.10 % (weight by weight) that are classified with any of the following hazard statements in accordance with Regulation (EC) No 1272/2008:

- Group 1 hazards: Category 1A or 1B carcinogenic, mutagenic and/or toxic for reproduction (CMR): H340, H350, H350i, H360, H360F, H360D, H360FD, H360Fd, H360Df.

- Group 2 hazards: Category 2 CMR: H341, H351, H361, H361f, H361d, H361fd, H362; Category 1 aquatic toxicity: H400, H410; Category 1 and 2 acute toxicity: H300, H310, H330; Category 1 aspiration toxicity: H304; Category 1 specific target organ toxicity (STOT): H370, H372.

- Group 3 hazards: Category 2, 3 and 4 aquatic toxicity: H411, H412, H413; Category 3 acute toxicity: H301, H311, H331; Category 2 STOT: H371, H373.

The use of substances or mixtures that are chemically modified during the production process so that any relevant restricted CLP hazard no longer applies shall be exempted from the above requirement.

Table X. Derogations to the CLP hazard restrictions and applicable conditions

Substance / mixture type	Applicability	Derogated classification(s)	Derogation conditions
Titanium dioxide	All materials within scope	H350i	TiO2 is naturally occurring as an impurity in raw materials used and is present in concentrations less than 2.0% (w/w) of the product.
Titanium dioxide	Products with photocatalytic properties	H350i	TiO2 is intentionally added for the purpose of imparting photocatalytic properties to the product surface, which shall be demonstrated via testing according to ISO 22197-1 or equivalent methods.

Assessment and verification:

The applicant shall provide a list of all relevant chemicals used in their production process together with the relevant safety data sheet or chemical supplier declaration.

Any chemicals containing substances or mixtures with restricted CLP classifications shall be highlighted. The approximate dosing rate of the chemical, together with the concentration of the restricted substance or mixture in that chemical (as provided in the safety data sheet or supplier declaration) and an assumed retention factor of 100 %, shall be used to estimate the quantity of the restricted substance or mixture remaining in the final product.

Justifications for any deviation from a retention factor of 100 % or for chemical modification of a restricted hazardous substance or mixture must be provided in writing to the competent body.

For any restricted substances or mixtures that exceed 0.10 % (weight by weight) of the final hard covering product but are derogated, proof of compliance with the relevant derogation conditions must be provided.

Points for discussion about horizontal hazardous substance requirements

Are there any foreseen derogation requests (i.e. for hazardous substances not chemically modified and potentially present in the product >0.1% w/w)?

Possible issues may be borates, crystalline silica, heavy metal fluxing agents and colorants in glazes and titanium dioxide pigments…how do these compare in terms of % of total product weight?

Rationale and discussion:

The structure of the horizontal hazardous substance criteria follows the general recommendations of the EU Ecolabel Chemicals Task Force. The wording of the current proposal is based predominantly on the most recently voted product group which is an article (Graphic paper, Tissue paper and Tissue paper products, voted in June 2018).

Legal background

The existing EU Ecolabel criteria for the product group "Hard Coverings" were published in 2009, specifically in Commission Decision 2009/607/EC. This was prior to the publication of the revised EU Ecolabel Regulation in 2010.

Article 6(6) of EU Ecolabel Regulation (EC) No 66/2010 makes specific provision for a horizontal approach to hazardous substance restrictions for all product groups.

> Article 6(6): "*The EU Ecolabel may not be awarded to goods containing substances or preparations/mixtures meeting the criteria for classification as toxic, hazardous to the environment, carcinogenic, mutagenic or toxic for reproduction (CMR), in accordance with Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures nor to goods containing substances referred to in Article 57 of Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)*".

Nevertheless, the EU Ecolabel Regulation also recognizes also that in certain circumstances the restriction of some substances may not be technically or environmentally justifiable. Therefore, Article 6(7) of the Regulation states that:

> Article 6(7): *"For specific categories of goods containing substances referred to in paragraph 6, and only in the event that it is not technically feasible to substitute them as such, or via the use of alternative materials or designs, or in the case of products which have a significantly higher overall environment performance compared with other goods of the same category, the Commission may adopt measures to grant derogations from paragraph 6. No derogation shall be given concerning substances that meet the criteria of Article 57 of Regulation (EC) No 1907/2006 and that are identified according to the procedure described in Article 59(1) of that Regulation, present in mixtures, in an article or in any homogeneous part of a complex article in concentrations higher than 0,1% (weight by weight).".*

The term "containing" is highlighted above because legal clarity was needed regarding what particular content can be considered as relevant. In principle, contained could be considered as the presence of just one molecule of a particular restricted hazardous substance. An EU Ecolabel Chemicals Task Force was convened and it was agreed that for the purposes of interpreting Articles 6(6) and 6(7), the term "containing" should be considered as equating to a content exceeding 0.10% (weight by weight) of the entire product or its homogenous part. The concentration 0.10% was used instead of the 0.1% mentioned in REACH because it reduces the potential for convenient rounding down of concentrations.

As a general rule for applying the 0.10% rule, it is proposed to consider all the products covered by this product group as simple articles. Even though some products may not be homogenous (e.g. dual layered concrete pavers, dual layer terrazzo tiles or glazed ceramics) such a proposal is considered reasonable since these heterogeneous areas are bonded in such a way that they cannot be mechanically separated by simple means.

SVHC restrictions

Since Article 6(7) prevents any derogation of SVHCs above 0.1% and the Chemicals Task Force agreed that "contained" means greater than 0.10% by weight, it can be concluded that any products considered to "contain" any SHVC cannot qualify for the EU Ecolabel.

The 0.10% limit is particularly useful for SVHC declarations since it aligns perfectly with communication requirements that are stipulated in the REACH Regulation (specifically in Articles 7(2) and 33 of REACH).

Article 7(2) requires importers or producers to notify ECHA if an SVHC is present in articles they import or produce in concentrations exceeding 0.1% (w/w) and add up in total to more than 1 tonne of a particular SVHC per actor per year.

Article 33 is even more relevant, since any recipient (i.e. a business to business transaction) or consumer (business to consumer transaction) must, upon request, be informed within 45 days of the presence of any SVHC present in the article(s) they have purchased if the concentration of the SVHC exceeds 0.1% (w/w). The weak point of Article 33 is that this communication requirement is only triggered by a specific request and only if the answer is positive (i.e. that there is an SVHC present >0.1%). There is no obligation to respond if no SVHC is present >0.1% w/w, even if it is simply to confirm that there is no issue.

CLP restrictions

There is no longer any reference to risk phases (e.g. R45, R50 etc.) when mentioning the classification of substances and mixtures because these were linked to the Dangerous Substances Directive (67/548/EEC) which was repealed by the CLP Regulation as of June 2015. Instead, reference is exclusively made to hazard statements and classes (e.g. H350, H400 etc.).

The term "*toxic, hazardous to the environment, carcinogenic, mutagenic or toxic for reproduction (CMR)*" from Article 6(6) was translated into specific CLP hazard categories by the EU Ecolabel Chemicals Task Force and resulted in the Group 1, Group 2 and Group 3 hazards as listed in the criterion proposal.

Depending on the nature of the product group and its normal use, the potential to also restrict category 1 skin sensitizers (H317) or category 1 respiratory sensitizers (H334) may be considered. These particular hazards do not seem relevant to hard coverings and so H317 and H334 are not listed in the proposed CLP criterion.

Unfortunately REACH does not make any provision for communication requirements about non-SVHC substances in articles like hard coverings and the CLP Regulation is focussed on labelling of substances and mixtures, not articles. Consequently, in order to demonstrate compliance with the CLP restriction criteria, the EU Ecolabel applicant has to be aware of all of the chemical substances or mixtures that have been used during the processing of the hard covering product. The following pieces of information are needed:

- List of chemical substances or mixtures used.
- Safety data sheets or relevant supplier declarations.
- Information about dosing rates and chemistry of any reactions that take place.

Armed with the above information, each chemical product can then be cross-checked against the following flow chart:

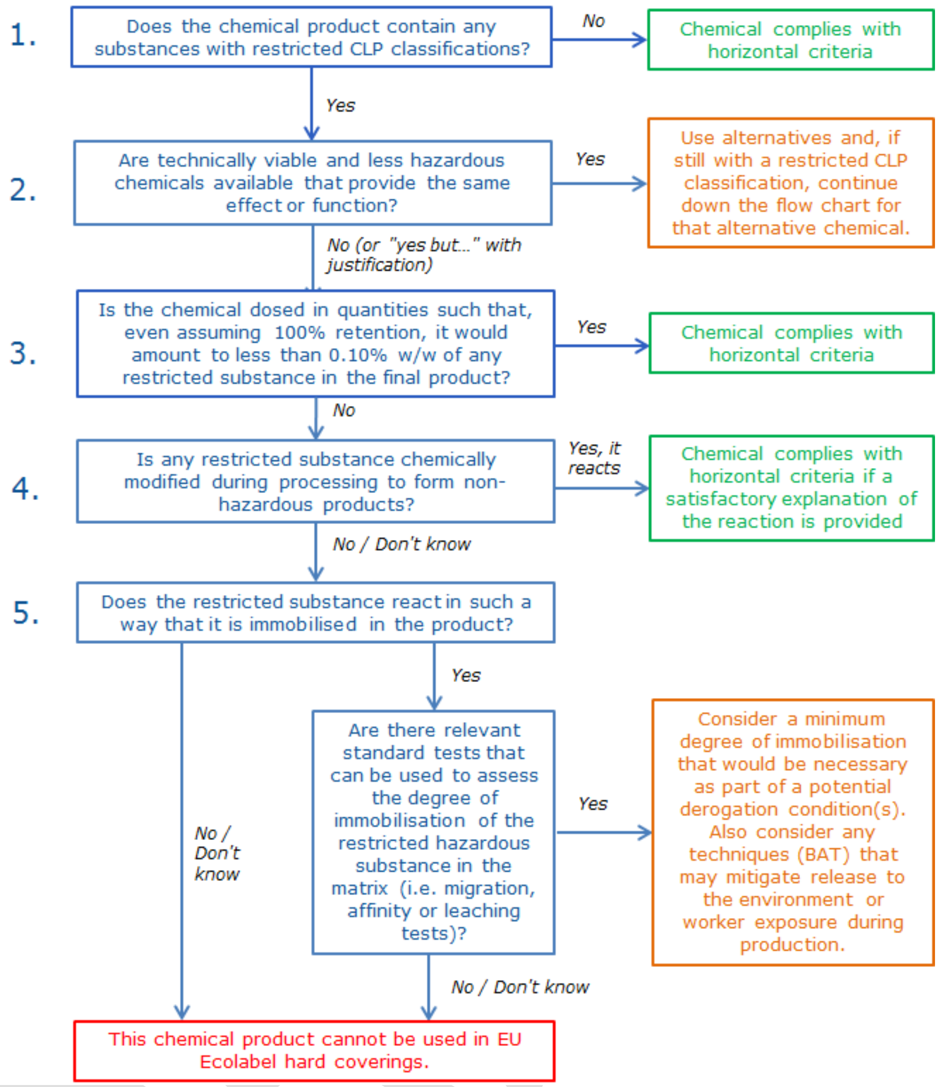

Figure 3. Flow chart for checking compliance with CLP restrictions.

According to the flow chart above, the easiest means to demonstrate compliance is simply not to use chemicals containing hazardous substances in the first place.

When considering whether or not it is technically feasible to substitute the chemical or not, consideration has to be given to the functionality that the chemical imparts (e.g. brightness, gloss, scratch resistance etc.). If less hazardous alternatives do exist, then a case has to be made for why the more hazardous chemical is used. Maybe it is more efficient, maybe its performance is better proven or similar reasons.

If the quantities of the restricted hazardous substance(s) involved are small then applicants should check their dosing rates and calculate if its use can be justified based on the fact that it would account for less than 0.10% of the final product weight.

The last chance for justifying the use of a chemical containing restricted hazardous substances without any specific derogation is to assess whether or not the substance reacts in such a way as to no longer be hazardous. Reactivity should be considered in terms of chemical reaction instead of physical immobilisation. For example, a monomer reacting to form a polymer is a clear example of a relevant chemical reaction but the depositing of a pigment in a coloured matrix is simply immobilisation, and thus not a relevant reaction.

Finally, if a restricted hazardous substance cannot comply with the previous four steps but its use is considered fundamentally important to specific products or desirable product functionalities, then a derogation request should be made by the industry to the JRC.

Any derogation request should explain clearly what substance(s) are involved, their CLP classification(s), why they should be derogated and suggested conditions that could be attached to any such derogation (e.g. worker exposure control, maximum dosing rate, minimum functionality imparted or minimum degree of immobilisation achieved etc.).

Derogation for Titanium Dioxide (TiO2)

Although this material has not been officially reclassified as H350i (carcinogenic via the inhalation route), the derogation is proposed anyway so that stakeholder opinions can be gathered in case the reclassification should happen. Even though TiO2 is expected to be well immobilised in all hard covering products, it is not expected to be chemically modified, which would otherwise exempt it from the requirements of the horizontal CLP restrictions for EU Ecolabel products.

Feedback from the Italian Ceramics association (Confindustria Ceramica) confirmed that raw material contents of TiO2 in Italian clays ranged from 0.16 to 0.38% w/w, i.e. always above the 0.1% threshold for the horizontal hazardous substance criteria. The same group also presented substantial arguments about why the reclassification of TiO2 might be based on flawed evidence although such matters are generally beyond the scope of the EU Ecolabel project.

1.4 – Asbestos

Existing criterion 2.3. Limitation of the presence of asbestos and polyester resins in the materials

No asbestos shall be present in the raw materials used for natural and processed products, as laid down in Council Directive 76/769/EEC (2).

~~*The use of polyester resins in the production shall be limited by 10 % of the total weight of raw materials.*~~

Assessment and verification:

In terms of chemical and mineralogical analysis, the material formulation shall be provided by the applicant together with a declaration of compliance with the abovementioned requirements.

Proposed criterion 1.4. - Asbestos

Mandatory requirement

No asbestos shall be present in the raw materials used for the manufacture of hard coverings products, as laid down in entry 6 of Annex XVII to Regulation (EC) No 1907/2006.

Assessment and verification:

The applicant shall provide a declaration of compliance with the criterion. In cases where natural stone is used, the applicant shall additionally specify the type of stone used. If the natural stone is one of the types at risk of containing naturally occurring asbestos, the Competent Body may request the applicant to provide a representative chemical and mineralogical analysis of the natural stone.

Rationale and discussion:

Due to their harmful health effects, the use of asbestos fibres and of articles and mixtures containing these fibres added intentionally was banned by entry 6 of Annex XVII of the REACH Regulation (EC) No. 1907/2006). It could be argued that naturally occurring asbestos fibres in natural stone are not "intentionally added" and so some safeguard against the possible occurrence of asbestos fibres in EU Ecolabel products is still considered necessary.

Asbestos is most commonly found in three rock types: serpentinites, altered ultramafic rocks, and some mafic rocks. Other rock types known to host asbestos include metamorphosed dolostones, metamorphosed iron formations, carbonatites, and alkalic intrusions. Contributing to asbestos formation is the faulting and fracturing of these rocks with increased temperatures, pressures, and the presence of water. The amount of asbestos or asbestiform minerals in these rocks can range in size from commercial-grade ore bodies to thin impure veinlets or low-grade occurrences. Asbestos can be released from these rocks if the rocks are broken or crushed.

Points for discussion about asbestos
Asbestos has a harmonised classification of H350 and H372 (both restricted to 0.10% in the product under criterion 1.3. Is it still necessary to have a specific criterion for asbestos?

1.5 – VOC emissions

Existing criterion 2.3. Limitation of the presence of asbestos and polyester resins in the materials

No existing criterion.

The requirement 2.3 about less than 10% polyester resins is assumed to be for agglomerated stones in particular, where polyester resin is the binder of the entire product, not a surface treatment.

Proposed criterion: 1.5. VOC (Volatile Organic Compound) emissions

Mandatory requirement

The applicant shall declare if the final product surface has been treated with any waxes, adhesives, coatings, resins or similar surface treatment chemicals.

In cases where treatment has been carried out, safety data sheets or supplier declarations for the waxes, adhesives or resins used shall be provided together with the approximate dosing rate used and an estimate of the total quantity of the resin or wax remaining in the final product.

No formaldehyde-based resins are permitted.

In cases where the VOC content of the wax or resin used exceeds 5% and the total quantity of wax or resin on the final product accounts for more than 1% of the final product weight, VOC emissions of the final product shall also be tested.

EU Ecolabel points

Up to a maximum of 5 points shall be awarded for applicants that can demonstrate compliance with the following aspects:

- Where the wax or resin used is less than 1% by weight of the final product (2 points).
- Where the wax or resin used has a VOC content less than 5% by weight (3 points).
- Where the results of a chamber test according to EN 16516 or ISO 16000 show that after 28 days the air concentration is: ≤ 0.01 mg/m3 formaldehyde; ≤ 0.3 mg/m3 TVOC, ≤ 0.1

mg/m3 TSVOC and ≤0.001 mg/m3 category 1A and 1B carcinogens (excluding formaldehyde); styrene 450 µg/m3 (5 points).

- Where no final surface treatment with VOCs has been applied (5 points).

Assessment and verification:

The applicant shall provide a declaration of the use or non-use of surface treatment chemicals used during product finishing operations.

In cases where such chemicals have been used, the safety data sheet or supplier declarations shall be provided regarding the VOC content. Furthermore, the applicant shall provide an estimate of the quantity of surface treatment chemicals used in the finishing operations (in g or ml per m^2) and how much remains in the final product (% w/w).

In cases where a VOC emission test is required, or where the applicant voluntarily wishes to obtain the extra 5 points for compliance with this requirement, the applicant shall provide a declaration of compliance, supported by a test report carried out according to EN 16516 or the ISO 16000 series or standards. If compliance with the chamber concentration limits specified at 28 days can be met at any other time between 3 and 28 days, the chamber test may be stopped prematurely.

A maximum of 5 points can be awarded under this criterion.

Points for discussion about VOC emissions from hard covering products.
Opinions about the proposed approach? **Could industry share SDS information about chemicals typically used in surface treatment?**

Rationale and discussion:

The overall objectives of this criterion are:

- to recognize the potential use of surface treatment agents on many of the hard covering products covered with the product group scope,
- to prevent the use of formaldehyde-based resins,
- to reward applicants that either do not use surface treatment agents or who use low amounts of VOC in the surface treatment operation.

The emission of VOCs is a serious environmental concern. From the broader environmental perspective, VOCs react with nitrogen oxides in the presence of sunlight to form harmful ground level ozone and ozone is well known to contribute to smog formation. Elevated ground level ozone and smog are well known to exacerbate asthma and other respiratory conditions.

From a product-specific perspective, the products covered by the EU Ecolabel hard coverings product group (e.g. natural stone, ceramics and concrete) are not considered to generate significant VOC emissions. However, in order to improve certain technical properties of the products, such as scratch resistance, stain resistance or water repellency, these products may be treated with waxes, resins or other surface treatment chemicals which may (or may not) have a significant VOC content.

Green Building Assessment schemes recognize the importance of VOC emissions from interior building products on indoor air quality. For example, the BREEAM International New Construction (Version sd233 1.0) offers up to 5 credits for flooring and wall materials (amongst others). The LEED v.4 criteria for building design and construction offer up to 3 credits for low emitting materials under its Indoor Environmental Quality criteria.

The main minimum requirement for the criteria is to basically know and declare any surface treatment chemicals have been used. An EU Ecolabel applicant will already have this information after demonstrating compliance with the horizontal CLP criterion (1.3b). The other minimum requirement is that any resins used must not be formaldehyde-based. Formaldehyde is now classified as a category 1 carcinogen and even if free-formaldehyde is consumed during the resin polymerization, small but continual amounts of free-formaldehyde can be released during the product use stage when the resin comes into contact with moisture or atmospheric humidity.

Depending on the VOC concentration and quantity of surface treatment chemical applied, VOC emission testing of the product is either voluntary or mandatory. The emission limits stated in the criteria are aligned with the exemplary performance level of BREEAM for building materials. One additional emission limit added is that of styrene, which could be significant in cases where polyester resins are used and which is highly relevant to agglomerated stone products.

1.6 – Business to consumer packaging

Existing criterion for packaging: 7: Packaging

Paperboard used for the packaging of the final product should be designed for reuse or be made out of 70 % recycled materials.

***Assessment and verification**:*

A sample of the product packaging shall be provided together with a corresponding declaration of compliance with all the requirements.

Proposed criterion 1.6. – Business to consumer packaging

Mandatory requirement

Packaging must be made out of one of the following:

- materials made out or recycled materials
- materials intended to be reusable;
- easily recyclable materials;

Assessment and verification:

A sample of the product packaging shall be provided together with a corresponding declaration of compliance with all the requirements.

Points for discussion
Can be comparable recycled or reused materials to those that are intended to be recycled or reused?

Rationale and discussion:

On average the weight of the packaging represents a very small percentage of the total environmental impact (packaging and transportation account for less than 2% of the GWP in most of the cases). Nevertheless, packaging has an improvement potential in reducing its contribution to the overall environmental impact of the product if the EU Ecolabel criterion is fulfilled as the use of single-use packaging in the flooring industry is common practice. In general, packages have a very short lifespan, being discarded immediately after distribution The amount of packaging material can vary according to the hard covering product, e.g. tiles, pavers, rough stones, thin tiles, etc. Tiles are normally packed in cardboard boxes, wrapped with polyethylene film and plastic straps and stacked on wooden pallets. Natural stone pavers are directly stacked in wooden crates. Any loose gaps are tightened with filling material like wood, hardboard, foamsheet, etc to protect stone slabs/tiles from colliding with each other. Some examples of the different packaging used for hard covering products are depicted in Figure 4.

Figure 4. Examples of packaging for different hard covering products (source Abimpex)

The main environmental problems related to packaging come from the consumption of raw materials and packaging waste. This environmental problem could be reduced by:

- Using packaging made from recycled or reusable materials and
- Using materials intended to be recyclable or reusable

Minimisation of the resources use for packaging is already mostly considered by the manufacturing companies as it also reduces the production costs. Manufacturing companies claim in their environmental policies high content values of recycled materials in their packaging in the range of 85-95%.

1.7 – Fitness for use

Existing criterion for fitness for use: 8 – Fitness for use

The product shall be fit for use. This evidence may include data from appropriate ISO, CEN or equivalent test methods, such as national or in-house test procedures.

An indication of the kind of use for which the product is fit for use has to be clearly specified: wall, floor or wall/floor if suitable for both purposes.

***Assessment and verification**:*

Details of the test procedures and results shall be provided, together with a declaration that the product is fit for use based on all other information about the best application by the end-user. According to Directive 89/106/EEC a product is presumed to be fit for use if it conforms to a harmonised standard, a European technical approval or a non-harmonised technical specification recognised at Community level. The EC conformity mark 'CE' for construction products provides producers with an attestation of conformity easily recognisable and may be considered as sufficient in this context.

Proposed criterion 1.7. – Fitness for use

Mandatory requirement

The applicant shall have a quality control and quality assessment procedure in place to ensure that products are fit for use. Where relevant, evidence demonstrating fitness for use may be provided. Any such evidence provided should be based on test results according to appropriate ISO or EN standards or equivalent test methods. An indicative list of potentially relevant standards is included below.

Assessment and verification:

The applicant shall provide a declaration of compliance with the criterion, supported by a description of their in-house quality control and quality assessment procedures.

In cases where test data according to EN or ISO standards, or equivalent methods is considered necessary, an indicative list of potentially relevant standards is indicated below:

- Natural stone: EN1341, EN1342, EN1343, EN1467, EN1468, EN 1469, EN12057, EN12058 or EN12059;
- Cement-based terrazzo tiles: EN13748
- Agglomerated stone: EN15285, EN15286, EN 15388 or EN16954
- Clay pavers and ceramic tiles: EN1344, EN13006 or EN 14411
- Concrete paving blocks, flags and kerb units: EN1338, EN1339 or EN1340

Points for discussion about fitness for use
Due to the large number of different products and use environments covered in this product group, does it make sense to have any requirements at all if they cannot be specific?

Rationale and discussion:

The highest environmental impacts caused by hard coverings are due to their raw material extraction and production stages. These impacts, especially those on the resource consumption, can be minimized provided that the service life of the product is extended. To guarantee a long durability of the finished products a design for fitness for use is needed. This criterion aims at ensuring these characteristics in the EU Ecolabel products.

Hard coverings are products are extremely durable, resulting in a long life expectancy. According to a study of Life Expectancy of Home Components prepared by the National Association of Home Builders (NAHB), the average life span of different coverings varies between 75 and more than 100 years. Despite the long life, the use stage causes negligible environmental impacts. This is due to the fact that the maintenance of hard coverings is quite simple and usually is limited to maintenance to seal the surface for natural stone products and cleaning operations, although it depends on the type of flooring, material and application (domestic, office, etc.).

EN standards and test methods are available for demonstrating appropriate levels of performance. The full titles of the standards are included here for reference.

Natural stone products

EN 1341, Natural stone — Slabs of natural stone for external paving.— Requirements

EN 1342 Sets of natural stone for external paving - Requirements and test methods

EN 1343 Kerbs of natural stone for external paving - Requirements and test methods

EN 1467, Natural stone — Rough blocks — Requirements

EN 1468, Natural stone — Rough slabs — Requirements

EN 1469, Natural stone products — Slabs for cladding — Requirements

EN 12057, Natural stone products — Modular tiles — Requirements

EN 12058, Natural stone products — Slabs for floors and stairs — Requirements

EN 12059, Natural stone products — Dimensional stone work — Requirements

Cement-based terrazzo tiles

EN 13748 — Terrazzo tiles - Part 1: Terrazzo tiles for internal use

EN 13748— Terrazzo tiles - Part 2: Terrazzo tiles for external use

Agglomerated stone

EN15285 — Agglomerated stone — Modular tiles for flooring and stairs (internal and external)

EN15286 — Agglomerated stone —Slabs and tiles for wall finishes (internal and external)

EN 15388 — Agglomerated stones — Slabs and cut to size products for vanity and kitchen tops

EN 16954— Agglomerated stone — Slabs and cut-to-size products for flooring and stairs (internal and external)

Clay and ceramic tiles

EN 1304 — Clay roofing tiles and fittings - Product definitions and specifications

EN13006 – Ceramic tiles – Definitions, classification, characteristics and marking

EN14411 — Ceramic tiles - Definition, classification, characteristics, assessment and verification of constancy of performance and marking

Concrete blocks, flags and tiles

EN1338 — Concrete paving blocks - Requirements and test methods

EN1339 —Concrete paving flags - Requirements and test methods

EN 1340 – Concrete kerb units – Requirements and test methods

1.8 – Consumer information

Existing criterion for consumer information: 9 – consumer information
The product shall be sold with relevant user information, which provides advice on the product's proper and best general and technical use as well as its maintenance. It shall bear the following information on the packaging and/or on documentation accompanying the product: *(a) information that the product has been awarded the Community eco-label together with a brief yet specific explanation as to what this means in addition to the general information provided by box 2 of the logo;* *(b) recommendations for the use and maintenance of the product. This information should highlight all relevant instructions particularly referring to the maintenance and use of products. As appropriate, reference should be made to the features of the product's use under difficult climatic or other conditions, for example, frost resistance/ water absorption, stain resistance, resistance to chemicals, necessary preparation of the underlying surface, cleaning instructions and recommended types of*

cleaning agents and cleaning intervals. The information should also include any possible indication on the product's potential life expectancy in technical terms, either as an average or as a range value;

(c) an indication of the route of recycling or disposal;

(d) information on the Community eco-label and its related product groups, including the following text (or equivalent):'for more information visit the EU eco-label website: http://www.ecolabel.eu'.

***Assessment and verification**:*

The applicant shall provide a sample of the packaging and/or texts enclosed.

Proposed criterion 1.8. Consumer information

Mandatory requirement

The product shall be sold with relevant user information, which provides advice on the product's proper and best general and technical use as well as its maintenance. It shall bear the following information on the packaging and/or on documentation accompanying the product:

(a) Recommendations for correct use and storage so as to maximise the product lifetime (e.g., whether the product needs coating or sealing, etc). As appropriate, reference should be made to the features of the product's use under difficult climatic or other conditions, for example, frost resistance/water absorption, stain resistance, resistance to chemicals, necessary preparation of the underlying surface, cleaning instructions and recommended types of cleaning agents and cleaning intervals. The information should also include any possible indication on the product's potential life expectancy in technical terms, either as an average or as a range value;

(b) Installation instructions including recommended techniques and materials. These instructions must not specify nor require the use of any component that does not comply with the materials requirements of this criterion.

(c) Maintenance instructions, if required. Maintenance instructions must not specify nor require the use of any chemical or coating limited by any part of this criterion.

(d) Recycling or environmentally preferable disposal instructions for the product end-of-life.

Assessment and verification:

The applicant should provide a sample of the packaging and/or texts enclosed.

Rationale and discussion:

The information requested to comply with this criteria is focused to the product itself, no more reference to the eco-label community, as this information is already provided to the consumer with the logo (see criterion 9). The information provided should cover the whole use life cycle: use and storage, installation and maintenance, and recycling and disposal.

The information given to the consumers can play an important role in the overall environmental performance of the product. In this sense, if the supplier, installers and consumers follow these recommendations an outstanding performance of the product is expected fulfilling both technical and environmental expectations.

A revision of other national schemes confirms this relevance. In general consumer information is based on the installation of the product including the recommended base or underlay, type of area to use the product or the moisture and temperature limits and on its maintenance including the cleaning agents and methods and the recommendations to extend the life of the product and finally recommendations.

1.9 – Information appearing on the ecolabel

Existing criterion for consumer information: 10 – Information appearing on the ecolabel
Box 2 of the eco-label shall contain the following text: ***Natural products**:* *— reduced impact of extraction on habitats and natural resources,* *— limited emission from finishing operations,* *— improved consumer information and waste management.* ***Processed products:*** *— reduced energy consumption of production processes,* *— reduced emissions to air and water,* *— improved consumer information and waste management.* ***Assessment and verification**:* *The applicant shall provide a sample of the packaging and/or texts enclosed.*
Proposed criterion 1.9. Information appearing on the ecolabel
The applicant shall follow the instructions on how to properly use the EU Ecolabel logo provided in the EU Ecolabel Logo Guidelines: http://ec.europa.eu/environment/ecolabel/documents/logo_guidelines.pdf If the optional label with text box is used, it shall contain the following three statements, as appropriate For natural stone products: - From limited landscape impact quarries; - Material efficient extraction and processing operations; - Reduced emissions to water and air. For agglomerated stone products: - Energy efficient production process; - Reduced emissions to air; - Maximum binder content xx% / minimum recycled or secondary material content yy% (as appropriate). For ceramic products: - Energy efficient production process; - Reduced emissions to air; - Material efficient product (in case of thin format tiles < 10mm thick or tiles with a high recycled content > 10%) / Material efficient production process (in all other cases). For concrete products:

- Reduced CO_2 footprint cement
- Reduced air emissions
- Minimum recycled or secondary material content xx% / energy efficient production / anti-NOx surface / permeable paving (as appropriate)

Assessment and verification:

The applicant shall provide a declaration of compliance with this criterion, supported by an image of the product packaging that clearly shows the label, the registration/licence number and, where relevant, the statements that can be displayed together with the label.

Rationale and discussion:

According to Article 8 (3b) of the EU Ecolabel Regulation 66/2010, for each product group, three key environmental characteristics of the ecolabelled product may be displayed in the optional label with text box. The guidelines for the use of the optional label with text box can be found in the "Guidelines for the use of the EU Ecolabel logo" on the website.

Information given to the consumers also ensures that end-users adopt an environmentally friendlier behavior, since the customer who is interested in buying the EU ecolabel products is generally interested in knowing the environmental performance of the products s/he buys. For this reason, a requirement about the logo and the number certification shall be included.

The information to be displayed is the same for all different hard covering products and provides an accurate reflection of the key issues addressed in the technical criteria, it also includes information on the restriction of hazardous substances.

Also instructions on the use of logo and license number are included.

Points for discussion about information appearing on the EU Ecolabel
Would it be useful to have the option to display the recycled/secondary material content (in cases where the applicant has calculated this)? With the current proposals, it is highly relevant for concrete and agglomerated stone products.

Natural stone and quarry criteria

LCA hotspots of natural stone products

As a simple snapshot, the natural stone EPD data below demonstrates that the main sources of impacts (ca. 70% for five impact categories) are from the raw material production (A1) and manufacturing (A3) processes covered by the A1-A3 values. Other potentially relevant impact categories that could be of particular relevance are abiotic depletion potential and water consumption.

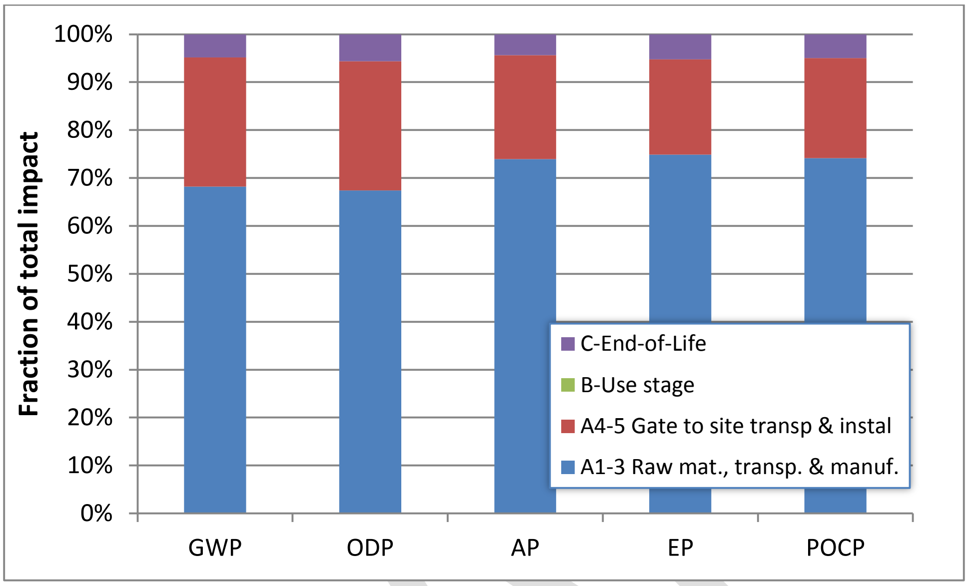

Figure 5. Split of LCA impacts between modules A (A1-A3 and A4-A5), B and C (Oppdal, 2015).

Consequently, it is justifiable to set criteria relating to the production stage, both at the quarry where the raw material (ornamental or dimension stone) is extracted (A1) and the processing plant, where blocks are processed into natural stone products (such as slabs and tiles) (A3).

Criteria applicability and scoring matrix

A combination of mandatory criteria and opportunities to gain EU Ecolabel points are detailed in this section for natural stone products.

Table 2. Natural stone-specific criteria structure and scoring system

Proposed criteria	Decision 2009/607/EC	Proposed criteria details	
		Mandatory?	Points?
1.1. Environmental Management System	No	Yes	5
1.5. VOC emissions	No	Yes	5
2.1 Quarry			
2.1.1 Quarry landscape impact ratio	Yes	Yes	15
2.1.2 Material efficiency	Yes	Yes	20
2.1.3 Water and wastewater management	Yes	Yes	5
2.1.4 Air pollution minimisation	Yes	Yes	-
2.1.5 Noise control	Yes	Yes	-
2.2. Processing plant			
2.2.1 Energy consumption	No	Yes	30
2.2.2 Emissions to water	Yes	Yes	-
2.2.3 Recycling of waste from processing operations	Yes	Yes	20
TOTAL points available in proposed criteria			**100**
MINIMUM points needed in proposed criteria			**50**

Points for discussion
How better to encourage quarry operators to comply with requirements?
Any interest in a B2B EU Ecolabel license for the quarry? Or for a list of "inspected quarries" to be managed by CBs, analogous to the situation with pulps?
Opinions about the choice of criteria? Any should be deleted? Any new ones to be considered?
Opinions about the points allocation and thresholds required?

2.1 – Quarry requirements

2.1.1 – Quarry Landscape Impact Ratio

Existing criterion 1. Raw material extraction: 1.1. Extraction management (for natural products only; I2 Quarry Impact Ration

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

Here only copy of the relevant part

Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.2. Quarry impact ratio	$\frac{m2\ affected\ area\ (quarry\ front + acti}{m2\ authorised\ area}$ [%]	<15	15-30	31-50	>50	W1, W2 (*)

) **W1. Soil protection: (weightings: 0,3 — 0,8, see table) — for quarry impact ratio (I.2) and water quality (I.5) indicators, three different values of weights are considered, as a function of land use potentialities (see Technical appendix — A1 for details):*

Soil protection	Classes I-II	Classes III-IV-V	Classes VI-VII-VIII
Weight	0.3	0.5	0.8

__Assessment and verification:__ the applicant shall provide appropriate documentation, including a map, of the land capability classification of the quarry site.

A1 W1. Soil protection/land capability classification

According to the European Soil Bureau's indication, land is graded on the basis of its potentialities and the severity of its limitations for crop growth into eight capability classes. An indicative description of the classes is as follows:

- *Class I soils have slight limitations that restrict their use,*
- *Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices,*

- *Class III soils have severe limitations that reduce the choice of plants or require special conservation practices, or both,*
- *Class IV soils have very severe limitations that restrict the choice of plants or require very careful management, or both,*
- *Class V soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forest land, or wildlife food and cover,*
- *Class VI soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forest land, or wildlife food and cover,*
- *Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forest land, or wildlife,*
- *Class VIII soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for aesthetic purposes.*

W2. Population density of settlements *which lie within a 5 km radius (distance) from the quarry site: (weightings: 0,5 —0,9, see table) quarry impact ratio (I.2), air quality (I.4), water quality (I.5) and noise (I.6) indicators are weighted in function of three density ranges:*

Population density	*<100 hab /km^2*	*20 to 100 hab/km^2*	*<20 hab/km^2*
Weight	*0.5 (0.6)*	*0.7 (0.84)*	*0.9*

Assessment and verification*: the applicant shall provide a map and appropriate documentation to verify the population density of settlements lying within 5 km radius (distance) from the quarry border (authorised area). In the case of existing quarries and expanding settlements in the area concerned, the weight factor indicated in brackets shall be used. This does not refer to major extensions of the already authorised area of such quarries (> 75 %).*

Assessment and verification:

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A3. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

Proposed criterion 2.1.1. Quarry landscape impact ratio

The applicant shall identify the quarry from which the dimension stone or ornamental stone blocks have been procured. The impact of the quarry on the landscape shall be evaluated according to the following metrics:

$$quarry\ footprint\ ratio = \frac{\boldsymbol{QF_S}\ (\boldsymbol{m^2}) + \boldsymbol{EWDA}\ (\boldsymbol{m^2}) + \boldsymbol{BPDA}(\boldsymbol{m^2})}{\boldsymbol{total\ authorized\ area}\ (\boldsymbol{m^2})}$$

Where:

- QFs is the active quarry front as observed from a satellite view.

- EWDA is the Extractive Waste Deposition Area, including the Extractive Waste Facility.

- BPDA is the By-Products Deposition Area occupied for storage of materials that may, in principle, qualify as by-products/products.

Authorized Area is the total surface area authorized in the permit for extraction activity.

$$quarry\ visual\ impact = \frac{\boldsymbol{QF_V}\ (\boldsymbol{m^2})}{\boldsymbol{QF_S}\ (\boldsymbol{m^2})}$$

Where:

QF_V is the vertical profile surface area of the active quarry front. Any active quarry surface that is underground shall not be counted towards QF_V but will be counted towards QF_S.

EU Ecolabel points

Points shall be awarded for applicants that can prove the following

- Quarry footprint ratio of less than 0.6 and as low as 0.2 (Up to 5 points)
- Quarry visual impact of less than XX and as low as 0 (Up to 5 points).
- Demonstrate progressive rehabilitation activities during the operational phase (5 points).

***Assessment and verification*:**

The applicant shall provide declare the quarry from which the material used to produce the EU Ecolabel natural stone tiles or slabs has been sourced, supported by delivery invoices.

Furthermore, a declaration from the quarry operator shall be provided together with documentation including maps or satellite images in which the QF_S, EDWA, BPDA and the authorized area are outlines and estimations of the surface area of each provided.

The quarry operator shall also declare a value for the QF_V value, which shall only count vertically exposed rock that has been cut and which is included in the same area as the QF_S. The estimation of QFV shall be supported by photographic evidence.

Any points shall be awarded in proportion to how closely the result reaches the minimum threshold value (e.g. quarry footprint ratio of 0.51 = 0 points, quarry impact ratio of 0.2 = 5 points).

Points for discussion about quarry landscape impact ratio

The Quarry Footprint Ratio is presented as a better explained version of what the authors understand to be the original quarry impact ratio. Opinions?

The Quarry Visual Impact is supposed to reward underground mining but it is uncertain what range of QFV/QFS values exist in reality. It could be >1.0. Would be useful to be able to look at some quarry metrics to determine a range of values.

Would it be interesting to have any requirement for a rehabilitation/restoration plan?

Rationale and discussion:

What is the criterion trying to achieve?

Quarrying is an inherently invasive process that can endanger human health and uses processes that could harm the environment, creating particular potential risks to water, air, soil and fauna and flora and drastically affect the landscape both within the quarry and the surrounding area. The effects of this damage can continue years after a quarry has closed, especially due to erosion processes and inhospitable habitats for flora and fauna.

The main purpose of this criterion is to recognise the efforts of quarries that:

- try to minimise these impacts by occupying less land area for quarrying and storage of extractive waste and by-products (indirectly encouraging more efficient extraction practices and/or use of extractive waste and by-products);
- Avoid certain impacts to flora, fauna and visual landscape altogether by conducting extractive activities underground, and
- Undertake progressive rehabilitation activities during the operational period in order to reduce the risk of erosion.

The type of rock and strata defines the architecture of the quarry. Generally, marble, granite and massive limestone quarries have a high-step architecture, where the primary cut is approximately 8 metres high. Quarries in sandstone, slate and other rocks, where smaller sized blocks are extracted, have low-step architecture.

Ideally, an open cast quarry looks almost like an amphitheatre, where production can take place simultaneously on several levels. Some of the best planned quarries for large granite and marble deposits approximate this situation, with a high yield per area and volume of extracted rock. A "good" situation in an efficient quarry could be an annual production of 1000 – 2000 m^3 of commercial blocks per hectare. However, in many cases the deposits are narrow, inclined and/or occur beneath layers of non-exploitable rocks. A steeply inclined slate or marble deposit, for instance, causes a trench or well-shaped quarry layout, which have a lower productivity. The productivity is also depending on the internal structures of the rocks – e.g. cutting angles.

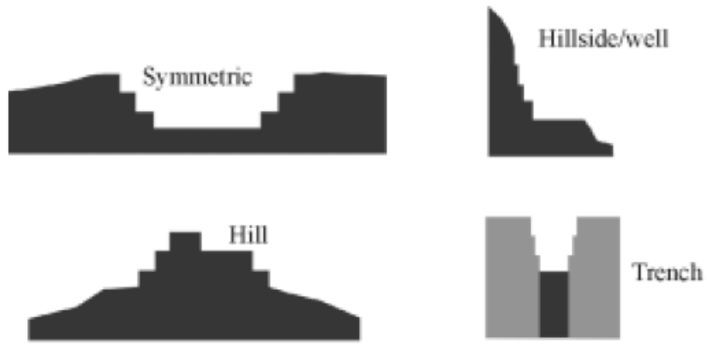

Figure 6. Different open quarries structures (Schematic view. Source: Arvantides et al)

In recent years, the technological development of quarrying equipment has made large scaled underground operations profitable, especially for soft rocks such as marble. Especially, the improvement of chain saws and diamond belt saws has made this possible. Underground quarrying has several advantages, of which less impact on the local environment perhaps is the most important reason for moving underground. The possibility of selective quarrying, leaving the poorest rock quality in pillars, is also important. Furthermore, local morphological conditions (steep terrain) and the occurrence of overburden, also favours underground operations.

Generally, underground quarrying produces less waste-rock than open-cast. The disadvantages (or rather challenges) of underground operations mainly relate to their higher cost, especially in the early stage of opening. A good knowledge of site specific conditions (e.g. deposit type, deposit size, rock characteristics and quality) is even more crucial with underground extraction activities. In addition, stress monitoring of fractures, pillars or walls is of great importance for safe operation. Underground quarrying has proven to be economically viable only for soft rocks to date (e.g. marble, limestone and slate). Approximately 30% of the marble production in the Carrara Basin occurs, at present, underground. For granite and other hard rocks, the technology still needs improvements.

A rehabilitation/restoration plan is a mandatory requirement (see Criterion 1.2) but, as stated in the soon to be published BAT Reference Document on the management of waste from the extractive industries, if the progressive restoration is carried out during the operational phase adverse environmental effects are minimized. For example, if the extractive waste facility is progressively revegetated erosion is reduced. The same logic for mining waste also applies to extraction of ornamental or dimension stone.

For clarity, the definition of an Extractive Waste Facility, for the purposes of these proposed EU Ecolabel criteria, should be considered as the same as that provided in Directive 2006/21/EC, which states:

> *"'waste facility' means any area designated for the accumulation or deposit of extractive waste, whether in a solid or liquid state or in solution or suspension, for the following time-periods:*
>
> *— no time-period for Category A waste facilities and facilities for waste characterised as hazardous in the waste management plan;*
>
> *— a period of more than six months for facilities for hazardous waste generated unexpectedly;*
>
> *— a period of more than one year for facilities for non-hazardous non-inert waste;*
>
> *— a period of more than three years for facilities for unpolluted soil, non-hazardous prospecting waste, waste resulting from the extraction, treatment and storage of peat and inert waste.*
>
> *Such facilities are deemed to include any dam or other structure serving to contain, retain, confine or otherwise support such a facility, and also to include, but not be limited to, heaps and ponds, but excluding excavation voids into which waste is replaced, after extraction of the mineral, for rehabilitation and construction purposes;"*

The criterion is established in such a way that a responsible use of the land, regardless of the nature of the material or the typology of the quarry, is rewarded.

2.1.2 – Material efficiency

Existing criterion quality management and environmental management practices

1. Raw material extraction

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

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Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.3. Natural resource waste	$\frac{m3\ usable\ material}{m3\ extracted\ material}$ [%]	>50	50-35	34-25	<25	-

Proposed criterion 2.1.2. Material efficiency

<u>Mandatory requirement</u>

The quarry operator shall, for the most recent calendar year provide data relating to the extraction activities and provide the following information:

- **A:** Total quantity of material extracted (m^3).
- **B:** Yield of saleable blocks sold (m^3).
- **C:** Total quantity of extractive waste and materials that qualify as by-products (i.e. irregular blocks, stones and fine fraction) that is sold or used internally for useful purposes by replacing other materials which otherwise would have been used to fulfil that particular function (m^3).
- **D:** Total quantity of extractive waste and materials that qualify as by-products (i.e. irregular blocks, stones and fine fraction) that is stored from excavation that are stored or deposited onsite (m^3).

In cases were data is available in tonnes, it should be converted to m^3 using a fixed bulk density factor for the rock material being extracted.

a) Extraction efficiency ratio

Mandatory requirement

The minimum extraction efficiency ratio that must be achieved is 0.25, calculated as:

$$extraction\ efficency\ ratio = \frac{\boldsymbol{B}}{\mathbf{A}}$$

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate a higher extraction ratio up to best practice target of 0.50. (Up to 10 points).

b) Useful by-product/waste ratio

No minimum ratio is set. The ratio shall be calculated as:

$$Useful\ by - product/waste\ ratio = \frac{\boldsymbol{C}}{\mathbf{C+D}}$$

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate a higher useful by-product/waste ratio up to a best practice target of 0.60. (Up to 10 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by a declaration from the quarry operator. The quarry operator should provide values of A, B, C and D, expressed in m^3 *, to allow the calculation of the extraction efficiency ratio and useful by-product/waste ratio. For calculation purposes, it should be assumed that A-B = C+D. For any material calculated under C that was sold, invoices of the material delivery to the other sites shall be provided.*

a) Points shall be awarded in proportion to how closely the data reaches the maximum value (e.g. extraction efficiency ratio of 0.25 = 0 points and of 0.50 = 10 points).

b) Points shall be awarded in proportion to how closely the data reaches the maximum value (e.g. secondary material reuse ratio of 0.00 = 0 points and 0.60 = 10 points).

Points for discussion about quarry indicators for material efficiency in the quarry
Opinions about this approach?

Rationale and discussion:

The extraction efficiency is arguably the most important indicator relating to a quarry for ornamental stone or dimension stone. From a life cycle perspective, the functional unit will undoubtedly be the tonnes or m3 output of saleable blocks. A better extraction efficiency implies a reduced production of by-products and extractive waste, meaning that less area of the quarry will be taken up by these materials, thus improving the quarry footprint ratio.

From an economical perspective, the value of saleable blocks dominates the quarry output. Marble from the Carrara region, which can be considered to be at the top end of the market, can be worth over 1600 €/m3 while irregular blocks are not generally economical to transport (7€/m3) and extractive waste has no significant market value at all. With Gneiss rock, regular blocks may command prices of around 265 €/m3, and similar values for irregular blocks and extractive waste as for marble (Bianco, 2018).

There is no economic incentive for quarry operators to find some useful application for extractive waste or by-products beyond their site. The mass deposition of these materials onsite will have a negative effect on the quarry footprint ratio but the use of these materials onsite for a "useful purpose" can deliver the twin environmental benefits of reducing land occupation of by-product or extractive waste material and avoiding the need for other materials to achieve that particular "useful purpose".

Some examples of useful purposes may include the construction of access ramps for vehicular and individual access to certain parts of the quarry and the construction of berms for the onsite storage of fine extraction waste to reduce the possibility of fine material being blown off-site. However, it would not be considered acceptable for a quarry operator to pile the by-product or extractive waste in a heap and claim that this heap is somehow providing a useful purpose.

Due to the difficulties of finding external markets and demand for by-products and extractive waste for ornamental and dimension stone quarries, no minimum requirement is set for the useful/by-product/waste ratio but any acceptable internal use or external sale is still encouraged via the awarding of points.

2.1.3 – Water and wastewater management

Existing criterion water efficiency
1. Raw material extraction *1.1. Extraction management (for natural products only)* *General requirements* *The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.* *The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.* ***Here only copy of the relevant part***

Matrix for scoring raw material extraction management for natural stones

Indicator	*Notes*	*Score*				
		5 (excellent)	*3 (good)*	*1 (sufficient)*	*Threshold*	*Relative weights*
I.1 Water recycling ratio	$\frac{Waste\ Water\ Recycled}{TotalWater\ Leaving\ the\ Process} * 100$ *See Technical appendix - A3*	*<80*	*80-70*	*69-65*	*<65*	*W3 (*)*

(*) W3 (weightings: 0,5) — If the quarry interferes with surface water bodies (average flow < 5 m 3 /s) there is a weight of 0,5 on both the indicators about water recycling ratio (I.1) and water quality (I.5).

<u>Assessment and verification</u>: the applicant shall provide appropriate documentation to show whether or not there is any interference between the quarry and the surface water body.

<u>Assessment and verification:</u>

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A3. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

A 3: Water recycling ratio

The calculation of the water recycling ratio shall be consistent with the following formula based on the flows highlighted in Figure A1.

$$Recycling\ ratio = \frac{Waste\ Water\ Recycled}{Total\ Water\ Leaving\ the\ Process} * 100 = \frac{R}{W1} * 100$$

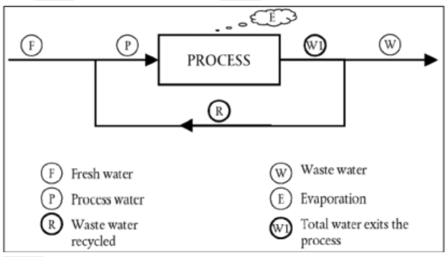


Figure A1: Water flow scheme that shall be used to calculate water recycling ratio (1)

For waste water is meant only the water used in processing plants, not comprehensive of the fresh water coming from rain and subsoil water.

Proposed criterion 2.1.3. Water and wastewater management

<u>Mandatory requirement</u>

Note: This requirement only applies in cases where wet stone cutting techniques are used in the extraction phase.

The applicant shall provide a description of water use in quarrying operations including strategies and methods for recirculation and reuse of water. The following conditions shall be met:

- Water used by the cutting equipment shall be stored in an impermeable container (for example a tank, lined pond or an excavated pond set in impermeable rock).
- The site shall make provisions for the opportune collection of water run-off to compensate for

water lost in wet sludge and evaporation.

- The site shall make provisions for the diversion of water run-off via a drainage network to prevent the surface flow of rainwater across the working area carrying suspended solid loads into the impermeable container which supplies water to the cutting equipment.
- The separation of solids from cutting wastewater shall be achieved by sedimentation systems, retention basins, cyclone separators inclined plate clarifiers, filter presses or any combination thereof. Clarified water shall be returned to the impermeable container which supplies the cutting equipment.
- Settled sludge shall be dewatered prior to: internal use for useful purposes, external use for useful purposes or transport offsite to a suitable waste disposal facility.

EU Ecolabel points

The non-use of organic flocculants in the solids separation process or the use of readily biodegradable organic flocculants (5 points).

***Assessment and verification*:**

The applicant shall provide a declaration of compliance with this criterion, supported by a declaration from the quarry operator and relevant documentation. The documentation should include details of the water management system, sludge separation and sludge disposal operations and destinations.

Points for discussion
Opinions about the proposals?

Rationale and discussion:

Water is used to dissipate the heat produced by the stone cutting process. It is still the most economical method.

Why no longer any requirement for water recycling ratio proposed?

During discussions with experts, it was revealed that the reuse of water for stone cutting in the extraction phase was the norm and that, as a general rule, all of the settled water was reused, which would mean a recycling ratio of 100%. The only losses from the system were due to possible seepage into the ground via cracks in basins or ponds, via evaporation and via wet sludge.

By requiring that all supernatant water after solids separation is returned to the container which supplies water to the cutting equipment, a recycling ratio of 100% is essentially being requested.

Why the specific requirements?

There are other factors that are important as well, and which are covered by the requirements in the proposal.

First of all, it is important to specify that the water container is impermeable. The main justification is that no matter how well wastewater is recycled or recirculated, the specific consumption rate of water can increase significantly due to losses via infiltration from the container or basin to the surrounding ground area.

Secondly, it is important to make the optimum use of water run-off so that it can top up the container to compensate for evaporative losses and water lost as moisture content in removed sludge. However, uncontrolled inflow of water run-off must be avoided because this could result in significant suspended solid loads being carried into the water that supplies the cutting equipment.

About wastewater treatment

Another important aspect is to require some minimum treatment of the wastewater from cutting equipment before it is returned – otherwise the solids load and other pollutants will just gradually build up if water is to be recirculated.

Methods for the recirculation and reuse not only lessen the environmental impacts of production but also lead to cost savings. According to the Natural Stone Council (NSC, 2011) solids separation (i.e. primary water treatment) and reuse of clarified water at the quarry or processing facility can be accomplished by a number of ways: filter presses, cyclone separators, sedimentation systems, retention basins, and combinations of these systems.

The selection of the most appropriate option depends on several factors such as, site topography, local climate, water demand, available footprint as well as water and solid loading rates to be processed. Quarries with high water demand use settlement ponds to supply the needed water as well as to provide a sufficient storage area for effluent. If space is limited or other obstacles exist, filter presses, inclined plate clarifiers, or cyclone separators (hydrocyclones) may be the best option for filtration followed by storage in a tank or basin. These machines utilize a much smaller footprint than a series of ponds or basins and avoid the need for excavation as they are installed on the ground surface.

The use/non-use of flocculants

The suspended solids in wastewater from stone cutting operations generally have the same surface charge, which reduces the possibility of them colliding and sticking together. Since sedimentation rates are a function of particle size, the use of flocculants can greatly accelerate sedimentation processes by providing opposite surface charges which attract suspended solids into larger agglomerations.

There are two main types of flocculants: inorganic and organic. The inorganic type is typically alum ($Al_2(SO_4)_3$) or ferric ($FeCl_3$) and they react in water in normal pH ranges to precipitate as $Al(OH)_3$ and $Fe(OH_3)$ respectively. The new solids and their surface charges can, when dosed optimally, optimise the solids settling rate. The organic flocculants are typically based on polyamide polyelectrolytes that are available with cationic and/or anionic surface groups.

During site visits it was not possible to establish what flocculants were being used but operators were complaining about the stickiness imparted to the sludge in cases were the sludge was being used as a filler/binder of loose aggregates for site roads. While this property was good for the road stability, it was not good when sticking to vehicle tyres.

In conclusion, the use of inorganic flocculants significantly increases the quantity of sludge. With organic flocculants, it is recommended to only use those organic flocculants that are readily biodegradable, to minimise the possible deterioration of nearby surface water, which follows the same logic as BAT Conclusion 42(e) of the BAT Reference Document for the management of waste from the extractive industries.

2.1.4 – Air pollution minimisation

Existing criterion 1. Raw material extraction: 1.1. Extraction management (for natural products only; I4 Air quality

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

Here only copy of the relevant part

Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.4 Air quality	Yearly limit value measured along the border of quarry area. PM 10 suspended particles [µg/Nm3] Testing method EN 12341	<20	20-100	101-150	>150	W2 (*)

*(*) **W2. Population density of settlements** which lie within a 5 km radius (distance) from the quarry site: (weightings: 0,5 —0,9, see table) quarry impact ratio (I.2), air quality (I.4), water quality (I.5) and noise (I.6) indicators are weighted in function of three density ranges:*

Population density	<100 hab /km^2	20 to 100 hab/km^2	<20 hab/km^2
Weight	0.5 (0.6)	0.7 (0.84)	0.9

***Assessment and verification**: the applicant shall provide a map and appropriate documentation to verify the population density of settlements lying within 5 km radius (distance) from the quarry border (authorised area). In the case of existing quarries and expanding settlements in the area concerned, the weight factor indicated in brackets shall be used. This does not refer to major extensions of the already authorised area of such quarries (> 75 %).*

Assessment and verification:

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A3. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

Proposed criterion 2.1.4. Air pollution minimisation

Mandatory requirement

The applicant shall:

- focus dust control water sprays close to any dry cutting activities or other activities that are likely to generate significant quantities of dust. - regularly assess meteorological and air quality monitoring data and have a plan developed for the relocation/modification/stoppage of operations onsite to prevent or minimise dust emissions to air during normal and adverse weather conditions; - to include wind protection systems in the quarry design that aim to reduce wind speed and thus minimise dust emissions and soil erosion onsite (e.g. wind fences or windbreaks consisting f one or more rows of plants along the border of the extractive waste deposition area, including the extractive waste facility and/or extractive was handling area). ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with this criterion, supported by a declaration from the quarry operator and relevant documentation.*

Points for discussion about air pollution minimization in the quarry
Opinions about the proposal.

Rationale and discussion:

Why no longer monitoring for PM emissions

Monitoring of dust emissions is much more practical in chimneys, where all dust emissions are channelled through a central point and where air flow rates are well controlled.

When any attempt to quantify diffuse emissions of dust in an outdoor environment is made, it is virtually impossible to obtain what could be considered as a representative sample. This is due to facts such as: air flow rates and directions are highly variable but the sampling point is fixed; the source of dust emissions onsite is highly variable in both time and specific location; impossibility to distinguish dust from neighbouring sites and dust from monitored site.

The need for measures to minimise dust emissions

The minimisation of dust emissions is a key environmental issue and operational plans and equipment should be designed to reduce dust emissions both for worker health and safety and local residents.

Dust is managed on site through a variety of potential control measures. The exact combination of measures required at a site can vary widely, and depends on the production and shipping rates, size of the site, and distance to neighbouring residents. Therefore the criterion does not require a specific technique or measure to be implemented but the assessment and implementation of the most convenient techniques to minimise the air quality impacts.

Practical mitigation measures and best management practices must be implemented to prevent or mitigate impacts on the air quality within the local areas. Examples of potential control measures can include:

- Spraying, washing, vacuum sweeping and paving of haul roads, parking areas, entrances and exits.
- Reducing haul trips and limiting speeds on unpaved roads.
- Wetting material prior to processing or loading.

- Covering stock piles, conveyor belts, and loads in trucks.
- Locating stock piles in locations that limit their exposure to wind.
- Scheduling loading, unloading and blasting activities on days when there is less wind
- Proper loading of trucks.
- Lowering the drop distances at transfer points.
- Re-vegetating disturbed areas as soon as possible to reduce erosion and minimize dust.

Additionally, education, awareness and training of staff on dust prevention, control measures, monitoring and reporting are important in reducing dust emissions at a quarry operation.

2.1.5 – Noise control

Existing criterion for noise: 1- Raw material extraction, 1.1. Extraction management (for natural products only), I6 Noise

1. Raw material extraction

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

Here only copy of the relevant part

Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.6 Noise	Measured along the border of quarry area (dB(A)) Testing method ISO 1996-1	<30	30-55	56-60	>60	W2 (*)

*(*) **W2. Population density of settlements** which lie within a 5 km radius (distance) from the quarry site: (weightings: 0,5 —0,9, see table) quarry impact ratio (I.2), air quality (I.4), water quality (I.5) and noise (I.6) indicators are weighted in function of three density ranges:*

Population density	<100 hab /km^2	20 to 100 hab/km^2	<20 hab/km^2
Weight	0.5 (0.6)	0.7 (0.84)	0.9

__Assessment and verification__: the applicant shall provide a map and appropriate documentation to verify the population density of settlements lying within 5 km radius *(distance) from the quarry border (authorised area). In the case of existing quarries and expanding settlements in the area concerned, the weight factor indicated in brackets shall be used. This does not refer to major extensions of the already authorised area of such quarries (> 75 %).*

Assessment and verification:

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A1. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

A 1: I.6. Noise

This indicator considers the noise level recorded along the border of the quarry area. Non-impulsive noises are to be measured. The calculation of I.6 consists in the measurement of the noise using the test method reported in ISO 1996-1.

Proposed criterion 2.1.5. Noise control

Mandatory requirement

The applicant shall provide a noise management plan which, as a minimum, covers the following aspects:

- A map of the site with agreed monitoring points and whether the monitoring is to be continuous or during random periods by the competent authority.
- Identification of the main sources of noise and an estimate of the average and maximum dB(A) during working hours on site or in specific parts of the site.
- Identification of any measures taken to reduce noise emission.
- Provision of adequate ear protection for all employees and visitors.

In cases where there is a residential population within a 5km distance of the quarry site the noise level from the operation must not exceed an average of 80dB (A) during working hours, measured at the perimeter of the quarry.

Assessment and verification:

The applicant should provide a map and appropriate documentation to verify the conditions in which the noise is measured.

Points for discussion on noise control from the quarry

Opinions? Is there any added value to this criterion?

How much residential population within 5km is considered significant enough to trigger a limit on noise?

Rationale and discussion:

The primary source of noise from quarrying is from onsite vehicles and machinery, cutting operations, deposition and optional screening of by-product material and extractive waste and breaking up of larger irregular blocks into smaller, more manageable pieces. The truck traffic carrying staff and materials or equipment to be delivered or collected is also a significant source of noise.

The impacts of noise on humans are highly dependent on the noise frequency, site topography, ground cover of the surrounding site, and climatic conditions. Topographic barriers or vegetated areas can shield target areas or absorb noise.

An important factor in determining a person's tolerance to a new noise is the ambient (background) noise to which one has adjusted. In general, the more a new noise exceeds the existing background noise level, the less acceptable the new noise will be. In an urban or industrial environment, background noise may mask noise from a quarry operation, whereas the same level of noise in a rural area or quiet, residential neighbourhood may be more noticeable to people.

The impacts of noise can be mitigated through various engineering techniques:

- Landscaping, berms, and stockpiles can be constructed to form sound barriers.
- Noisy equipment (such as crushers) can be enclosed in sound-deadening structures.
- Conveyors can be used instead of trucks for onsite movement of materials.
- Noisy operations can be scheduled or limited to certain times of the day.
- The proper location of access roads, the use of acceleration and deceleration lanes, and careful routing of trucks can help reduce truck noise.
- Workers can be protected from noise through the use of enclosed, air-conditioned cabs on equipment and, where necessary, the use of hearing protectors.

In Europe, the Directive 2002/49/EC relating to the assessment and management of environmental noise is the main instrument to identify noise pollution levels and to trigger the necessary action both at Member State and at EU level. It focuses on three action areas:

- the determination of exposure to environmental noise
- ensuring that information on environmental noise and its effects is made available to the public. It requires the requires MS to prepare and publish, every 5 years, noise maps and noise management action plans for large population areas (>100,000 inhabitants)
- preventing and reducing environmental noise where necessary and preserving environmental noise quality where it is good

The Directive applies to noise to which humans are exposed but does not apply to noise that is caused by the exposed person himself, noise from domestic activities, noise created by neighbours, noise at work places or noise inside means of transport or due to military activities in military areas.

It is important to note, however, that the Directive does not set limit or target values, nor does it prescribe the measures to be included in the action plans, thus leaving those issues at the discretion of the competent Member State authorities.

The European Union's Seventh Environment Action Programme (7th EAP) sets the objective that by 2020 noise pollution in the EU will have significantly decreased, moving closer to World Health Organization (WHO) recommended levels. The WHO recommends that for a good night's sleep, continuous background noise should stay below 30 dB and individual noises should not exceed 45dB.

In the Carrara site, where there are almost 200 individual quarries in operation, it was explained that permits for extraction activities are based on noise limits during working hours of three general classes: <80dB(A); 80-85dB(A) and >85dB(A). The criterion addresses the fact that noise is an inherent impact from the quarrying activities but it can be mitigated through different techniques depending also on the location of the quarry. Therefore a conditional maximum value is established that aligns with the lower limit that was mentioned during initial discussions with experts.

2.2 – Processing plant requirements

Processing operations on natural products shall be made according to the following requirements:

2.2.1 – Energy consumption

Existing criterion for energy consumption
New criterion
Proposed criterion 2.2.1. Energy consumption
Mandatory requirements The applicant shall assess and document the electricity consumption (kWh) and fuel consumption (L diesel, etc.) of the process plant equipment (including for lifts and trucks used for onsite transport) for a defined period of 12 months. The total production during the same 12 months shall be expressed in terms of kg of final product sold. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate the following aspects: - Up to 30 points can be awarded in proportion to how much of the energy consumed is from renewable sources (i.e. 0 points for 0% renewable electricity, 30 points for 60% renewable electricity). ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the mandatory requirement for energy consumption and any relevant declaration regarding the onsite CHP and renewable energy sources and use of electric vehicles.* *For continuously operating production, data shall be collected over a 12 month period. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.*

Points for discussion
How much of the total energy consumption of a stone processing plant is due to cutting of blocks? **What is the difference in specific cutting energy requirement for a) same technology with different rocks or b) different technology (e.g. wire cutter vs gang saw) for the same rock.** **Is there sufficient use for waste heat onsite for CHP to be an added-value approach to energy management in natural stone processing plants?**

Rationale and discussion:

The processing of blocks of ornamental or dimension stone into natural stone slabs or tiles requires a significant amount of energy for squaring and cutting of blocks and polishing of slab or tile surfaces. There are significant environmental and financial benefits from ensuring that the use of energy is optimised.

<u>Energy consumption during cutting</u>

There are a number of different cutting techniques available such as: diamond mono-wire; diamond mono-blade; giant disk saw; steel grid gang saw; diamond blade multi-saw; diamond blade multi-wire and diamond disk. The choice of which technique is most appropriate will largely be determined by the type of rock to be cut, the slab dimensions that need to be cut (i.e. standard or custom) and, in the case of more recent techniques, if it is economical for the operator to upgrade to the newer technique.

<u>Energy consumption during finishing</u>

The degree of surface finishing required depends not only on the final product specifications that must be met but also on the effect of the cutting technique on the rock surface. In this sense, gang saw cutting of hard stone will produce a rougher surface than say, diamond saw blade cutting of soft stone, and the former will require much more polishing than the latter to meet the same surface smoothness.

The simplest surface finishing operation is polishing although, depending on the surface characteristics that are desired, other techniques such as bush hammering, flaming, waterjet or sand blasting may be used to impart a certain texture or roughness.

Another potential treatment of blocks and slabs is impregnation with an epoxy or polyester resin in order to maximise the yield from fragile or partially fractured slabs and ensure that they will be protected from water infiltration. The resin treatment process involves drying the slab at a moderately elevated temperature (ca. 35°C), applying the resin and then drying again at a similar temperature to allow the resin to cure. This process could take a few hours.

Due to the great variety of cutting and finishing techniques that can be used and the general lack of specific energy consumption data, it was decided to not set any specific process energy requirement for natural stone slab and tile products. Nonetheless, it is recognised that energy consumption in the processing plant is an important issue and so applicants should be monitoring energy consumption closely. Such monitoring would undoubtedly already be a part of any Environmental Management System in place in the organization.

Points are available for any applicant that can demonstrate a share of renewables (onsite or via supplier) in the energy (presumably only electricity) they use. Unlike ceramic tile or concrete production, the potential use for waste heat from any onsite CHP was not considered as particularly relevant for ornamental and dimensional stone processing operations.

2.2.2 – Emissions to water

Existing criterion for emissions to water : 3. Finishing operations (for natural products only)

Part of current Criterion 3 : Finishing operations (for natural products only)

Finishing operations on natural products shall be made according to the following requirements:

Parameter	*Limit (to pass)*	*Test method*
~~*Particulate emission to air*~~	~~*PM10 < 150 µg/Nm³*~~	~~*EN 12341*~~
~~*Styrene emission to air*~~	~~*< 210 mg/Nm³*~~	

~~*Water recycling ratio*~~	~~$= \frac{\text{waste water recycled}}{\text{total water leaving process}} .100 \geq 90\%$~~	~~*Technical appendix A3*~~
Suspended solid emission to water	*< 40 mg/l*	*ISO 5667-17*
~~*Cd emission to water*~~	~~*< 0,015*~~	~~*ISO 8288*~~
Cr(VI) emission to water	*< 0,15 mg/l*	*ISO 11083*
Fe emission to water	*< 1,5 mg/l*	*ISO 6332*
~~*Pb emission to water*~~	~~*< 0,15 mg/l*~~	~~*ISO 8288*~~

Assessment and verification:

The applicant shall provide the corresponding analysis and test reports for each emission parameter measured at all emission points. Where no test method is specified, or is mentioned as being for use in verification or monitoring, competent bodies should rely as appropriate on declarations and documentation provided by the applicant and/or independent verifications

Proposed criterion 2.2.2. Emissions to water

Mandatory requirement

Effluent water discharged to the environment from processing operations must not exceed the following limits. These limits apply after waste water treatment, whether on-site or off-site.

Parameter	Limit (mg/l)
Total Suspended Solids (TSS)	35
COD (mg/l O_2)	100
Cr(VI)	<0.15 mg/l
Fe	<1.5 mg/l

If the settled wastewater is discharged to a municipal sewage works or other third party operated treatment plant, the applicant shall be exempted from demonstrating compliance with the emission limits defined above.

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, clearly state if process wastewater is discharged to local watercourses or to the sewerage network.

In cases where treated process wastewater is discharged to local watercourses and it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant and provide test reports based on weekly analysis of the discharged wastewater according to the standard test methods defined above or equivalent in-house laboratory methods. Less frequent testing may be permitted in cases where the operating permit sets less frequent testing requirements.

Points for discussion on emissions to water from natural stone processing

Do you agree with the potential exemption if wastewater is treated by a third oarty?

In cases of direct discharge, are these limits reasonable?

Where do the specific limits in the Decision 2009/607/EC come from exactly?

Rationale and discussion:

Sources of wastewater.

Wastewater is produced by any one of several processing operations which require water, for example:

- Cutting. Water can be used for cooling, for transport of abrasive particles or used under high pressure to directly deliver the cutting action.
- Finishing. Water can be used to shape and blast the stone and is again necessary for cooling purposes when certain tools are implemented, such as a CNC (computer numerically controlled) drill.

Both operations result in water carrying away solid particles from the rock and from cutting or polishing media. Solids separation (i.e. primary water treatment) at the processing facility is different than the quarry in the sense that there is always much less available footprint at the processing site than the quarry. Consequently, more intensive solids separation techniques are used such as inclined plate clarifiers and/or flocculant dosing are more likely to be employed. The separated sludge is highly likely to be dewatered to reduce the sludge volume prior to collection and transport offsite (for obvious economic reasons).

Why no limits for emission of Cd and Pb to wastewater?

The authors are not aware of any potential sources of Pb and Cd and suspect that this was carried over from the equivalent criteria for ceramic tiles, where Pb and Cd could be provided via certain glaze formulations.

Why a limit for COD emissions?

The stone cutting and finishing operations involve a lot of moving parts which need to be lubricated and some greases can be expected to be transmitted to the wastewater. Since the COD is associated with dissolved organics or fats, oils and grease that will float (i.e. not generally settle with suspended solids) it was considered relevant to propose this type of emission testing, in cases where wastewater is discharged directly to local watercourses. In general, the two most common pollutants that are to be tested from most wastewater discharges are suspended solids and COD (or some proxy measure of COD).

Why no limits for air emission from the natural stone processing plant?

The natural stone processing site is considerably different to a major industrial installation like a Portland cement kiln or ceramic production facility where plants. Major industrial installations must run continuously and above a minimum capacity in order to be economically viable. These facilities produce continuous and relatively stable emissions whose monitoring has been discussed in detail by Technical Working Groups and concluded upon in terms of define what is acceptable in terms of emissions monitoring at the EU level.

This is simply not the case with natural stone processing plants, which may be highly intermittent in their activity and which do not tend to run all potential sources of dust or styrene emissions through a central chimney. The representative monitoring of emissions to air is simply not considered practical for a natural stone processing plant.

2.2.3 – Recycling of waste from processing operations

Existing criterion 5.2. Recovery of waste (*for processed products only*)
The applicant shall provide an appropriate documentation on the procedures adopted for the recycle of the by-products originated from the process. The applicant shall provide a report including the following information: *— kind and quantity of waste recovered,* *— kind of disposal,* *— information about the reuse (internally or externally to the production process) of waste and secondary materials in the production of new products.* *At least 85 % (by weight) of the total waste generated by the process or the processes (2) shall be recovered according to the general terms and definitions established by Council Directive 75/442/EEC (3).* *Assessment and verification: the applicant shall provide appropriate documentation based on, for example, mass balance sheets and/or environmental reporting systems showing the rates of recovery achieved whether externally or internally, for example, by means of recycling, reuse or reclamation/regeneration.* *(2) Process wastes do not include maintenance wastes, organic wastes and urban wastes produced by auxiliary and office activities.* *(3) OJ L 194, 25.7.1975, p. 39.* *(4) OJ L 40, 11.2.1989, p. 12.*
Proposed criterion 2.2.3 Recycling of waste from processing operations
<u>Mandatory requirement</u> At least 70% by mass of the process waste* generated from natural stone processing operations onsite shall be diverted from landfill. *i.e. sludge from polishing and other finishing operations, cutting operations, broken specimens and off-cuts from squaring, rectification and any customized shaping. **<u>EU Ecolabel points</u>** Points shall be awarded for applicants that can demonstrate higher reuse rates of process waste up a maximum of 90% reuse by mass (up to 20 points). ***<u>Assessment and verification:</u>*** *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a calculation of total production process waste (in kg or t). Details about the destination of these process wastes shall also be provided with clarifications about whether it is external use in another process or sent to landfill. For any external use or landfill disposal, shipment notes shall be presented.* *In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.* *Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. process waste reuse rate of 70% = 0 points and 90% = 20 points).*

Points for discussion
Do you agree with the lower mandatory reuse of process waste of 70% for natural stone processing since, unlike ceramic tiles, which has an 85% minimum reuse requirement, it cannot be

reclaimed into the same process that generated it?

Rationale and discussion:

Solid wastes generated by cutting and polishing operations are removed by cooling water and rinsing water respectively. These wastewater streams may be treated separately or be combined into a single sedimentation tank. The use of a flocculant can increase sedimentation rates and result in a smaller footprint wastewater treatment plant onsite or improved suspended solid removal. However, the flocculant will also increase the quantity of sludge generated, especially if inorganic ferric chloride or alum sulphate are used, which react in water streams to form Fe(OH)3 and Al(OH3) precipitates respectively.

During the site visit to Carrara, the use of flocculants was common practice in process wastewater treatment, although the operators were not aware of the type of flocculant that was being used. Regardless of the type of flocculant used, its presence in the settled sludge may complicate its potential reuse or at least the market value of the waste material.

Unlike ceramic tile production, there is no real opportunity for the process waste to be reincorporated into the natural stone production process, although some sludges, if of a sufficiently high purity, may be suitable in the fabrication of agglomerated stone products.

The normal practice is that a plant may process blocks from a large number of quarries, resulting in a high heterogeneity of the process waste.

Some more details about resin impregnation to reduce material waste

Generally, the systems commonly used in marble processing are not satisfactory for granite processing lines. Granite is much harder, with microscopic fissures and a different absorption rate. No polyester resin would have the capability to deeply penetrate in the very thin cracks of the granite stone, harden up and give a sufficient strength to the material but epoxy resins have shown the capability to fill all of the pits and micro-fissures present in the granite. Additionally, its long hardening time allows the glue to penetrate deeply into the stone before the complete curing will occur. Before being treated, the surface of a granite slab has to be honed; to allow the surface of the material to evenly absorb the resin. This process requires special convection ovens or two to three days in favorable dry working conditions. After being mixed in the right ratio (either using a scale or an automatic mixing dispenser), the resin is then spread on the whole surface. After the system is completely cured (usually it takes up to 24 hours, depending on the system and the equipment used) the slab is ready to be polished. During the polishing process, the first steps are focused on removing all excess resin poured on top of the slab, leaving only the resin that has filled into the cracks or the pits. In this way, the epoxy resin will not form a film on top of the granite, and it will be present only in the interspaces and in the micro-fissures

The use of the sludge from natural stone processing may be used in road base or backfill. With higher value applications, it is not yet clear if levels sludge from marble processing would be pure enough for recycling in the paper or food sectors.

Agglomerated stone criteria

LCA hotspots of agglomerated stone products

As a simple snapshot of the typical LCA impacts of an "engineered stone" product (synonymous with the term agglomerated stone when organic binders are used), is shown below.

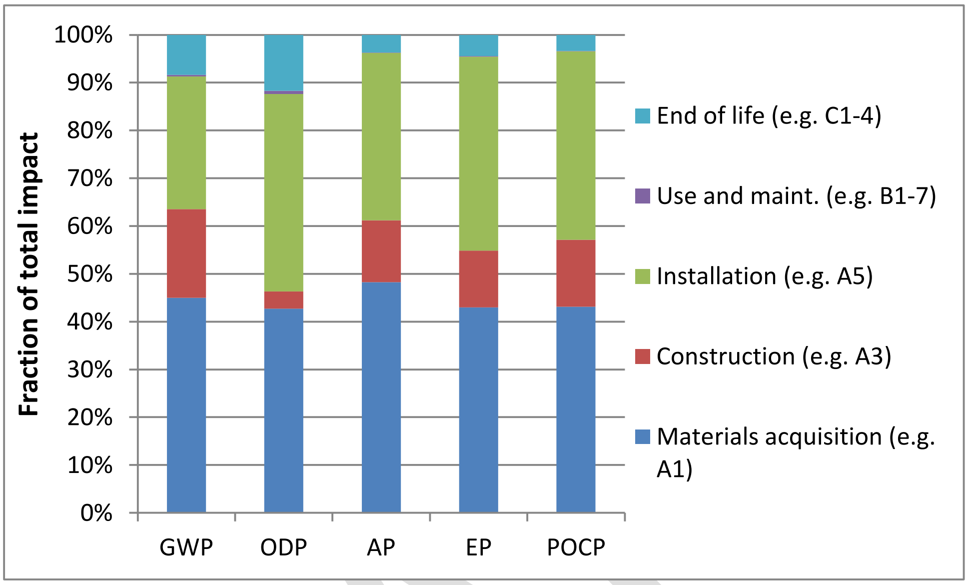


Figure 7. Split of LCA impacts between different life cycle stages of an "engineered stone" product (Corian Quartz)

Only a few EPDs for engineered stone products have been published online and this particular example does not follow the EN 15804 framework because it is an American product. Nevertheless, it is possible to approximate which EN 15804 modules the American life cycle stages correspond to when reading their descriptions:

- **Material acquisition (and pre-processing):** This stage includes the extraction of materials from nature, processing required to create the raw materials used in surfaces production, and transportation of the materials to the construction stage. Any processing of secondary materials used in surfaces production is also included.
- **Construction:** During construction, raw materials for the countertop are processed into slab. The stage also includes production and inbound transport of packaging materials.
- **Installation:** The installation stage starts with the transportation of the slab to a warehouse, distributor, and/or fabricator. The fabricator, who is responsible for customizing the slab, is assumed to travel to the installation site to take initial measurements. These measurements are used to customize the slab back at the fabrication facility. Since Corian® Quartz is used for more than residential countertops, a 10% scrap rate is assumed. Lastly, the customized slab is transported to the installation site and installed with Corian® joint adhesive.
- **Use and maintenance:** Use includes product maintenance—typically cleaning with tap water and soap—over the 10-year timeframe. No sealing or additional maintenance is needed.

- **End-of-Life:** The end-of-life stage includes the disposal of the surface, as well as the disposal of packaging from installation. Corian® Quartz is assumed to be disposed entirely to landfill or incinerated.

The so called A1-A3 stages account for 45 to 65% of the total impacts for each impact category, which is a reasonable justification for setting EU Ecolabel requirements at the production stage. It is interesting to note how significant the LCA impacts are at the installation stage because the nature of the "engineered stone" material (uniform microstructure and relative ease of shaping/cutting) these product lend themselves well to cutting **after** the slab has been finished. These customisation procedures are assumed to result in 10% of the material being scraped at this stage. This scrap rate and the need for a specialised joint adhesive are no doubt the main reasons behind the significant influence of the installation stage on LCA impacts.

Comparison of existing and proposed criteria

The criteria specifically for ceramic tiles set out in Decision 2009/607/EC and the current proposals are compared below. A combination of mandatory criteria and opportunities to gain EU Ecolabel points are detailed in this section for agglomerated stone products.

Table 3. Agglomerated stone-specific criteria structure and scoring system

Proposed criteria	Decision 2009/607/EC	Proposed criteria details	
		Mandatory?	Points?
1.1. Environmental Management System	No	Yes	5
1.5. VOC emissions	No	Yes	5
3.1 Energy consumption	Yes	Yes	25
3.2 Emissions to air	Yes	Yes	-
3.3 Recycled/secondary material content	No	No	40
3.4 Binder content	Yes	Yes	25
TOTAL points available in proposed criteria			**100**
MINIMUM points needed in proposed criteria			**50**

Points for discussion
Opinions about the choice of criteria? Any should be deleted? Any new ones to be considered?   **Opinions about the points allocation and thresholds required?**

3.1 – Energy consumption

Existing criterion for energy consumption: 4.1: Energy consumption, (a) Process energy requirement (PER) limit

4.1. The energy consumption shall be calculated as process energy requirement (PER) for agglomerated stones and terrazzo tiles.

(b) Energy requirement for firing (ERF) limit

The process energy requirement (PER) for agglomerated stones and terrazzo tiles manufacturing processes shall not exceed the following levels:

	Requirement (MJ/kg)	Test method
Agglomerated stone	1.6	Technical appendix — A4

Note: requirement expressed in MJ per kg of final product ready to be sold.

Assessment and verification:

The applicant shall calculate the PER according to the Technical appendix — A4 instructions and provide the related results and supporting documentation.

A4 Energy consumption calculation (PER, ERF)

When providing a calculation of process energy requirement (PER) or energy requirement for firing (ERF), the correct energy carriers shall be taken into account for the entire plant or for the firing stage only. Gross calorific values (high heat value) of fuels shall be used to convert energy units to MJ (Table A1). In case of use of other fuels, the calorific value used for the calculation shall be mentioned. Electricity means net imported electricity coming from the grid and internal generation of electricity measured as electric power.

Evaluation of PER for agglomerated stone production shall consider all energy flows entering the production plant both as fuels and electricity.

~~Evaluation of PER for terrazzo tiles production must consider all energy flows entering the production plant both as fuels and electricity~~.

~~Evaluation of ERF for ceramic tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.~~

~~Evaluation of ERF for clay tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.~~

~~Evaluation of PER for cement production shall consider all energy flows entering the production system both as fuels and electricity~~.

Table A1

Table for calculation of PER or ERF (see text for explanations)

Production period	Days	From	To	
Production (kg)				
Fuel	Quantity	Units	Conversion factor	Energy (MJ)
Natural gas		kg	54,1	
Natural gas		Nm^3	38,8	
Butane		kg	49,3	
Kerosene		kg	46,5	
Gasoline		kg	52,7	
Diesel		kg	44,6	
Gas oil		kg	45,2	
Heavy fuel oil		kg	42,7	
Dry steam coal		kg	30,6	
Anthracite		kg	29,7	
Charcoal		kg	33,7	
Industrial coke		kg	27,9	
Electricity (from net)		kg	3,6	
			Total energy	
Specific energy consumption (MJ/kg of product)				

Proposed criterion 3.1. Energy consumption

Mandatory requirement

The specific energy consumption for agglomerated stone production shall not exceed 1.1 MJ/kg.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the following aspects:

- Installation of onsite CHP (10 points)
- Up to 15 points can be awarded in proportion to how much of the supplied electricity is from renewable sources (i.e. 0 points for 0% renewable electricity, 15 points for 20% renewable electricity).

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirement for energy consumption and any relevant declaration regarding the onsite CHP and renewable energy sources *and use of electric vehicles.*

For continuously operating, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.

Points for discussion
Is a near 33% reduction in specific emergency consumption (from 1.6 to 1.1 MJ/kg) for agglomerated stone production justifiable?

Rationale and discussion:

A great amount of energy is consumed and dissipated during the entire manufacturing process from crushing the natural stone to the required size to the compacting and hardening processes and final polishing. The manufacturing process is highly standardised and no major changes in the production technologies have occurred however progress and improvements in the already existing technologies processes led to a decrease in energy consumptions.

The first step to prepare the mixture is to crush the aggregate to the desired size. The crushing facility consists of feeders, crushers, conveyors and screens. Figure 8 shows that the crushers are the largest electricity end-use, followed by the conveyors and screens.

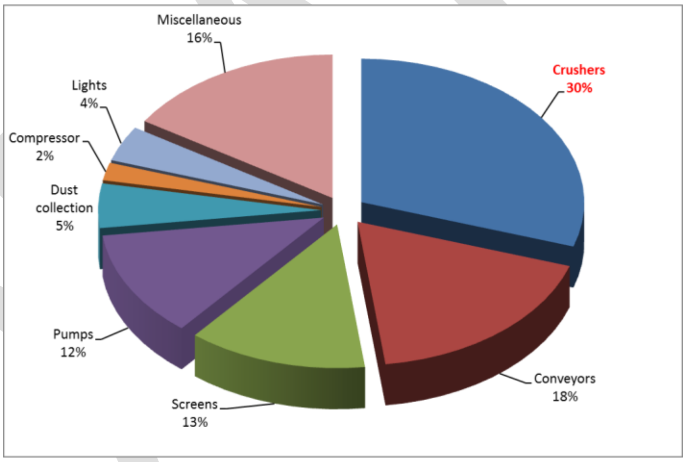


Figure 8.- Electric energy use breakdown in a crushing facility

Crushers mechanically break the stone into smaller pieces. Reduction in size is generally accomplished in several crushing stages, as there are practical limitations on the ratio of size reduction through a single stage. Crusher selection is based on rock type, required size reduction, output rock shape and production rate. A significant number of facilities have older crushers with inefficient controls that present a significant potential for increasing production efficiencies. System optimisation in terms of number of crushing stages, use premium efficiency motors and cogged V-belts (savings can range from 5 to 15%) maximum load capacity, elimination of the re-circulating load circuits or simply shut off the equipment when not needed results in crushing facility optimization and energy savings.

3.2 – Emissions to air

Existing criterion 4.3 Emissions to air

(a) Agglomerated stones

The emissions to air for the following parameters for the whole manufacturing process shall not exceed the following:

Parameter	*Limit (mg/m^2)*	*Test method*
Particulate matter (dust)	*300*	*EN 13284-1*
Nitrogen oxides (as NO x)	*1200*	*EN 14792*
Sulphur dioxide (SO 2)	*850*	*EN 14791*
Styrene	*2000*	*-*

***Assessment and verification**:*
The applicant shall provide appropriate documentation and test reports for each emission parameter mentioned above, following the indications of the Technical appendix — A6. Where no testing method is specified, or is mentioned as being for use in verification or monitoring, competent bodies should rely, as appropriate, on declarations and documentation provided by the applicant and/or independent verifications.

A6 Emissions to air (for processed products only)

The air pollutant emission factors shall be calculated as follows:

- *the concentration in the exhaust gas emitted to the environment of each parameter considered in the tables shall be calculated,*
- *the measurements used for the calculation must be made following the testing methods indicated in the tables,*
- *the samplings shall be representative of the considered production.*

Proposed criterion 3.2. Emissions to air

Mandatory requirement

The emissions to air in the following parameters for the entire manufacturing process shall not exceed the following values

Parameter	**Limit (mg/m^2)**
Particulate matter (dust)	300
Styrene	2000
Nitrogen oxides (as NOx)	1200
Sulphur dioxide (SO2)	850

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by site data in mg/Nm^3 and expressed as an annual average value calculated from daily average values. The data shall have been generated via continuous monitoring according to EN 13284-1 for dust, EN 14792 for NOx and EN 14791 for SO_2.

The air pollutant emission factors shall be calculated as follows:

- *the concentration in the exhaust gas emitted to the environment of each parameter considered in the tables shall be calculated,*
- *the measurements used for the calculation must be made following the testing methods indicated in the tables,*

- *the samplings shall be representative of the considered production.*

Rationale and discussion:

Dust is generated also during the manufacturing process, both in the mixture preparation and in the finishing operations. Finishing operations, specifically, are mostly performed wet, creating mainly sludge. The main concern, during the manufacturing process, is the emission to air of toxic substances, such as those used in the resins preparations (e.g. styrene, formaldehyde and other VOC), and CO_2.

The mixture used to manufacture agglomerated stone contains resins, therefore VOC emissions should be also considered (see Chapter 1. Criterion 1.5). VOC emissions from polyester resin operations occur when the cross-linking agent (monomer) contained in the liquid resin evaporated from fresh resin surfaces into air during application curing. Styrene and methyl methacrylate are by far the principle and the most common monomers used in cross linking agents. Since emissions result from evaporation of monomer from the uncured resin, they depend upon the amount of resin surface exposed to the air and the duration of exposure. Thus the potential for emissions varies with the manner in which the resin is mixed, applied, handled, and cured among the different fabrication processes. Thus, the emission potential in closed moulding operations is considerably low compared with atomisation operations, because of the lower monomer content in the casting resins and of the enclosed nature of the mouldings.

Points for discussion
Are NOx and SO2 emissions significant in the agglomerated stone productions process since high temperatures (and thus onsite fuel combustion) are not expected in the process?

3.3 – Recycled/secondary material content

Existing criterion
No existing criterion
Proposed criterion 3.3. Recycled/secondary material content
Mandatory requirement The applicant shall assess and document the regional availability of recycled or secondary aggregates, including fillers. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate the incorporation of recycled/secondary materials into the agglomerated stone product up to 40% w/w content (Up to 40 points). The incorporation of returned or rejected agglomerated stone product into new product shall not be considered as recycled content if it is going back into the same process that generated it. ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a copy of their company policy for the identification of potential sources of recycled materials.* *An inventory of all sold or stored agglomerated stone production, existing raw materials in stock and raw material deliveries (virgin, secondary and recycled origin) to the manufacturing plant shall be*

provided, supported by production reports for a period of 12 months. *In cases of manufacturing plants that only produce one type of product and specification, results should be averaged across the entire production. Where the EU Ecolabel products are produced in specific batches only, any secondary or recycled materials should be allocated according to batch mix compositions used.*

Points for discussion
Opinions about this approach?

Rationale and discussion:

What is meant exactly by "recycled material"?

The ISO 14021 definition of the term "recycled content" and related terms are as follows:

- ***Recycled content****: Proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content, consistent with the following usage of terms.*
- ***Pre-consumer material****: Material diverted from the waste stream during a manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.*
- ***Post-consumer material****: Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.*
- ***Recycled material****: Material that has been reprocessed from recovered [reclaimed] material by means of a manufacturing process and made into a final product or into a component for incorporation into a product.*
- ***Recovered [reclaimed] material****: Material that would have otherwise been disposed of as waste or used for energy recovery, but has instead been collected and recovered [reclaimed] as a material input, in lieu of new primary material, for a recycling or a manufacturing process.*

So unless the agglomerated stone product has previously been transferred to other actors in the distribution chain, it cannot be considered as recycled content when it comes back to the concrete factory. Especially in the case of fresh concrete returns or reject batches, this would normally be considered as being a waste of the production process.

Within the agglomerated stone manufacture sector there is the common practice to use, in the mixture, a fair amount of pre-consumer recycled materials, intended as derivate and by-products of natural stones quarrying operations; secondly, the recurrence of high ratios of natural stones' gravel in the mixture to which correspond a general low use of artificial binding agents, both resins and cement.

There are commercial products with high content of recycled content, from 5 % up to 30% in weight. These products qualify for LEED (*Materials ¬ Resources (MR) Credit 4: Recycled content)* which requires materials with recycled content such that the sum of post-consumer recycled content plus 1 /2 of the pre-consumer content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project. The minimum percentage materials recycled for each point threshold is as follows:

3.4 - Binder content

Existing criterion 2.3. Limitation of the presence of asbestos and polyester resins in the materials

~~*No asbestos shall be present in the raw materials used for natural and processed products, as laid down in Council Directive 76/769/EEC (2).*~~

The use of polyester resins in the production shall be limited by 10 % of the total weight of raw materials.

Assessment and verification: in terms of chemical and mineralogical analysis, the material formulation shall be provided by the applicant together with a declaration of compliance with the abovementioned requirements.

Proposed criterion 3.4. Binder content

Mandatory requirement

The use of polyester, epoxy or other resins in the production shall be limited to 10% of the total weight of raw materials.

EU Ecolabel points

- Where the content of resin used is less than 10% by weight of the final product, towards a benchmark of 5% (up to 20 points).
- Where the resin used is at least 10% bio-based or from recycled plastics (5 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of the criterion, supported by a calculation of the total use of resin binder(s) as a function of total raw material consumption.

In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. a resin use rate of 10% = 0 points and a resin use rate of 5% = 15 points).

Rationale and discussion:

The binder as defined in EN 14618 is an organic or inorganic chemical product used to bind via an irreversible process the aggregates and the filler in an agglomerated stone. A typical agglomerated stone material will consist of 85 -93% stone aggregates by weight and 15-7% resin. Different types of resins are used by different manufacturers, the most common types are:

- Hydraulic cement (see criterion 5)
- Unsaturated polyester resins that is usually a polyester, epoxy or acrylic type thermoset organic resin and, in any case, a petrochemical polymer, with an amount of synthetic diluents such as styrene, toluene, Xylene, etc., and other additives,

The nature and content of binder have a large influence on the mixture. For example, the use of polymeric resins as binding agents, instead of hydraulic cement, results in the weight percentage of natural stones' gravel in the mixture being significantly higher (from 76-78% with cement to 90-96% with resin). There are also documents in the state of the art which describe the use of resins that are less aggressive with the environment, or in which the reactive solvent which usually contains said resin is removed. Polyester resins free of reactive diluents (without styrene) with satisfactory physico-mechanical properties have been successfully prepared by the reaction between an epoxidized triglyceride and at least one carboxylic anhydride and in which the necessary triglycerides can be obtained starting from vegetable or animal fats (Consentino, 2012). However, this would require to have the process infrastructure suitable epoxidizing the fatty acids Furthermore, the catalytic system needed for polymerizing this resin is completely different from the systems which are used today, which would make it necessary to make substantial mechanical changes in the already implemented processes, with the economic investment this involves, and eliminating the possibility of being able to reuse current systems

In recent years, an important part of research has been focused to searching for components which come from renewable and/or recycled raw materials that are more environmentally friendly and make the overall process cleaner and more efficient, and at the same time allow manufacturing a material with excellent mechanical and aesthetic features. In this respect, major advancements have been done in the use of bio-resins made from renewable plant sources (for instance from no-food vegetable oil produce no volatile emissions to the atmosphere). Bio-based resins (or bioresins) offer comparable mechanicals to petro-based resins, thus introduce sustainable materials reducing the dependence on petroleum based products and expanding options for end-of-life recycling and reuse. Products manufactured with bioresins have the potential compliance with initiatives such as LEED program which encourages use of recycled or bio-based materials (LEED BD+C: New construction. Materials and Resources (MR) Credit: Building product disclosure and optimization – sourcing of raw materials).

Points for discussion
How common is the use of cement as a binder in agglomerated stone products instead of resins? **Should we set criteria for the cement binder in agglomerated stones as well?** **Or should we maintain a split between organic binder (agglomerated stone) and inorganic binder (concrete pavers and dry-cast terrazzo tiles).**

Ceramic criteria

LCA hotspots of ceramic tile products

As a simple snapshot of the typical LCA impacts of ceramic tile products, data from a sectorial EPD covering a total of 84 plants in Italy that represent over 82% of Italian ceramic tile production is presented below.

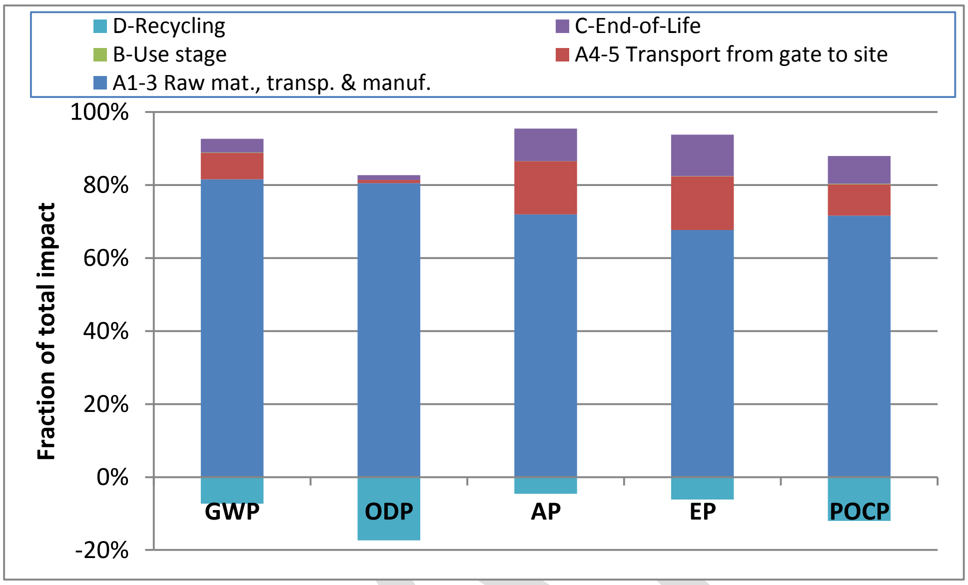


Figure 9. Split of LCA impacts between modules A (A1-A3 and A4-A5), B, C and D (Confindustria Ceramica, 2016).

According to interpretation of the LCA data by the owners/authors of the Italian sectorial EPD, energy use dominates the GWP impacts (70%) and has a significant influence on POCP (46%), ODP (33%) and EP (20%). The emissions of acidic gases such as SO2, NOx and HF will without a doubt be the dominant influences on AP impacts.

Importance of the draft ISO 17889 standard

The ISO 17889 standard is global in its reach and aims to define sustainability requirements for the ceramic sector. The term sustainability is intended to cover the three pillars: economic, environmental and social. The standard is still under development but the environmental criteria are broadly split into 4 areas:

- Energy consumption (kiln firing).
- Emissions to air (dust and HF).
- Water consumption and reuse.
- Waste recycling and recycled content.

Ceramic floor and wall tiles have traditionally been around 10mm thickness. However, due to the relatively new thin format tiles (as thin as 3mm), there is the possibility of significant differences in values when expressed as per unit mass. Consequently, one important aspect in the draft ISO 17889 is the attempt to set some limits as a function of production in terms of product surface area (i.e. per m2) **AND** in terms of product mass (i.e. per t).

The draft criteria also present a specific approach to testing VOC emissions that may be of interest for the EU Ecolabel, especially in terms of defining the chamber loading rates and the acceptable levels of VOCs in the air.

Importance of the BAT Reference Document for the Ceramic Manufacturing Industry

Although the BAT Reference Document (BREF, 2007) was published in 2007, the general process technology, energy consumption and sources of emissions remains very similar today. The BREF Document not only covers the wall and floor tiles that are relevant to the current scope of EU Ecolabel Hard Coverings, but also another 8 sectors which in total, essentially represent all of the ceramic manufacturing industry in Europe.

The main areas addressed by the research for the BREF exercise are:

- Emissions to air (dust, CO, CO2, NOx, SO2, HF, HCl, VOCs & heavy metals).
- Emissions to water (suspended solids, AOX, Pb, Zn and Cd)
- Process losses/waste (re-use sludge in body preparation up to 1.5%)
- Energy consumption (for kiln firing and spray drying).

Although a new revision of the BREF for ceramics is due to start in 2019 or 2020, it is unlikely that any data will be published in time to aid the justification of ambition levels for emissions and energy consumption during the revision of the EU Ecolabel criteria for hard coverings.

Nevertheless, if stakeholders have already gathered data ahead of the anticipated launch of the BREF project for ceramics, they are welcome to share any data for the purposes of assessing the appropriateness of EU Ecolabel ambition levels.

Comparison of existing and proposed criteria

The criteria specifically for ceramic tiles set out in Decision 2009/607/EC and the current proposals are compared below. A combination of mandatory criteria and opportunities to gain EU Ecolabel points are detailed in this section for ceramic tiles.

Table 4. Cement- and concrete-specific criteria structure and scoring system

Proposed criteria	Decision 2009/607/EC	Proposed criteria details	
		Mandatory?	Points?
1.1. Environmental Management System	No	Yes	5
1.5. VOC emissions	No	Yes	5
4.1. Specific kiln energy consumption	No	Yes	25
4.2. Specific freshwater consumption	Yes	Yes	10
4.3. Emissions to air	Yes	Yes	30
4.4. Wastewater management	Yes	Yes	5
4.5. Material efficiency in the production process	Yes	Yes	10
4.6. Glazes	Yes	Yes	10
TOTAL points available in proposed criteria			**100**
MINIMUM points needed in proposed criteria			**50**

**consider that it could be justifiable to remove requirement in proposals, either due to doubts about availability of information from suppliers or if impacts are indirectly covered by other criteria already.*

Points for discussion
Opinions about the choice of criteria? Any should be deleted? Any new ones to be considered? **Opinions about the points allocation and thresholds required?**

4.1 – Specific kiln energy consumption

Existing criterion for energy consumption. 4.1: Energy consumption, (b) Energy requirement for firing (ERF) limit

4.1. The energy consumption calculated as energy requirement for firing (ERF) ceramic tiles and clay tiles shall not exceed the following limit.

(b) Energy requirement for firing (ERF) limit

The energy requirement for firing (ERF) stages for ceramic tiles and clay tiles shall not exceed the following requirements:

	Requirement (MJ/kg)	Test method
Ceramic and clay tiles	3.5	Technical appendix — A4

Note: requirement expressed in MJ per kg of final product ready to be sold.

Assessment and verification:

The applicant shall calculate the ERF according to the Technical appendix — A4 instructions and provide the related results and supporting documentation.

A4 Energy consumption calculation (PER, ERF)

When providing a calculation of process energy requirement (PER) or energy requirement for firing (ERF), the correct energy carriers shall be taken into account for the entire plant or for the firing stage only. Gross calorific values (high heat value) of fuels shall be used to convert energy units to MJ (Table A1). In case of use of other fuels, the calorific value used for the calculation shall be mentioned. Electricity means net imported electricity coming from the grid and internal generation of electricity measured as electric power.

~~*Evaluation of PER for agglomerated stone production shall consider all energy flows entering the production plant both as fuels and electricity.*~~

~~*Evaluation of PER for terrazzo tiles production must consider all energy flows entering the production plant both as fuels and electricity.*~~

Evaluation of ERF for ceramic tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.

~~*Evaluation of ERF for clay tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of PER for cement production shall consider all energy flows entering the production system both as fuels and electricity.*~~

Table A1

Table for calculation of PER or ERF (see text for explanations)

Production period	*Days*	*From*	*To*	
Production (kg)				
Fuel	*Quantity*	*Units*	*Conversion factor*	*Energy (MJ)*
Natural gas		*kg*	*54,1*	
Natural gas		*Nm^3*	*38,8*	
Butane		*kg*	*49,3*	
Kerosene		*kg*	*46,5*	
Gasoline		*kg*	*52,7*	
Diesel		*kg*	*44,6*	
Gas oil		*kg*	*45,2*	
Heavy fuel oil		*kg*	*42,7*	
Dry steam coal		*kg*	*30,6*	
Anthracite		*kg*	*29,7*	
Charcoal		*kg*	*33,7*	
Industrial coke		*kg*	*27,9*	
Electricity (from net)		*kg*	*3,6*	
			Total energy	
Specific energy consumption (MJ/kg of product)				

Proposed criterion: 4.1. Specific kiln energy consumption

Mandatory requirement

The specific energy consumption for ceramic tile production shall not exceed 3.5 MJ/kg or, for tiles <10mm thick, 70 MJ/m^2.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the following aspects:

- Non-use of coal, petroleum coke, light fuel oil and heavy fuel oil for kiln firing (2 points).
- Installation of onsite CHP (3 points).
- Meeting up to 10% of total fuel requirement for kiln firing via gas, liquid or solid fuels from renewable sources (up to 5 points).
- Reduction of specific kiln firing energy production towards a best practice of 1.9 MJ/kg (up to 15 points).

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirement for specific kiln firing energy consumption and any relevant declaration regarding the non-use of fuel oils in kiln firing, onsite CHP and renewable energy sources.

The applicant shall calculate all inputs of fuel to the kiln system. The total thermal energy of the fuel input (in MJ) shall be calculated by multiplying the mass of fuel consumed in a defined production period (in kg, t, L or Nm3) by a specific or generic calorific value for the same fuel (in MJ/kg, t, L or Nm3).

The specific thermal energy consumption (MJ/t) shall be determined by dividing the total fuel input (MJ) by the total ceramic tile output (in kg or m^2, as appropriate) during the same production period.

For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.

In cases where points are awarded for renewable fuels or lower kiln energy consumption, these shall be awarded in proportion to the maximum benchmark set (i.e. for renewable fuels: 0% = 0 points and 10% = 5 points; for specific kiln energy consumption: 3.5 MJ/kg = 0 points and 1.9 MJ/kg = 15 points).

Rationale and discussion:

Information from the BREF Document for ceramics

The energy consumption during kiln firing (1.9 – 4.8 MJ/kg) is the single largest energy consuming process during ceramic tile production. Spray drying is also a significant source of energy consumption (1.1 – 2.2 MJ/kg). However, since spray drying is not carried out by all ceramic tile producers, but is instead produced by specialised, large-scale atomisation plants, it is not something that will always be under the direct control of the ceramic tile producer (only the largest ceramic tile producers will have their own atomisation plant). Consequently, mandatory energy requirements are restricted to those for kiln firing, which should always be under the direct control of any potential EU Ecolabel applicant.

The production of ceramic floor and wall tiles requires firing at temperatures of around 1050 to 1300°C depending on the mineral composition of the green body and the final desired products of the tile. Tiles may be glazed or unglazed and may be fired in single or double stage process. In the double firing process, the first firing is commonly referred to as "biscuit firing" and this takes place before the glazing operation. The type of kiln technology employed is either a tunnel kiln or a roller hearth kiln. Whether tiles are glazed or not, whether the firing is single or double stage, the final desired water absorption of the tile and the choice of kiln technology can greatly influence the specific energy consumption requirement.

Table 5. Operating data of tunnel kilns and roller hearth kilns (Source: BREF, 2007)

		Tunnel kiln with biscuit firing	Roller hearth kiln		Tunnel kiln	Roller hearth kiln	
			Final firing	Single firing	Unglazed	Unglazed	Glazed
Product type		Tiles with higher water absorption			Tiles with lower water absorption		
Throughput	t/h	2.8	1.2	1.6	1.2	2.1	2.1
Kiln length	m	120	60	80	130	80	60
Cross-section	m^2	1.5 – 2.0	0.8 – 1.2	0.5 – 1.0	1.5 – 2.0	1.2	0.8 – 1.0
Setting density	kg/m^3	500 - 700	10 - 30	10 – 30	700-1000	20 - 30	20 - 30
Firing temp.	°C	1100	1250	1300	1200	1220	1230
Specific energy requirement	kJ/kg	3500	2900	2200	3900	2900	2500
Flue-gas volume flow	m^3/h	15000	10000	13000	15000	10000	13000
Flue-gas temp.	°C	180	160	200	220	160	160

Some data ranges provided for kilns producing wall and floor tiles in BREF (2007) was as follows:

- Double-pass tunnel kiln: 5920 – 7300 kJ/kg
- Single-pass tunnel kiln: 5420 – 6300 kJ/kg
- Double-pass roller hearth kiln: 3400 – 4620 kJ/kg
- Single-pass roller hearth kiln: 1900 – 4800 kJ/kg

In the context of the numbers above, the EU Ecolabel reference value of 3500 kJ/kg (i.e. 3.5 MJ/kg) seems appropriate for allowing both single and double-pass roller heath kilns to comply, although only allowing the very best double-pass systems to be compliant. Tunnel kiln technology does not appear to be sufficiently energy efficient by some margin.

Work conducted under the ISO standard 17889 for sustainable ceramic tile production

The main fuel used by the ceramic sector in general is natural gas. Other relevant fuels are liquefied petroleum gas (LPG), landfill-generated methane, bio-based fuels and possibly light or heavy fuel oils. Each of these fuels have been assigned standard net calorific values and carbon emission factors in Annex VI of Regulation (EU) No 601/2012 for the purposes of standardising energy and carbon emission accounting. It is necessary to adapt any relevant fuel calorific values in Technical Annex A4 of the existing criteria to those stated in Regulation (EU) No 601/2012.

A number of other aspects are considered which could potentially be recognised, such as the % renewable energy used, the avoidance of carbon intensive fuels and the installation of onsite CHP units. It is proposed to recognise these same aspects in an optional manner under the proposed scoring approach for EU Ecolabel criteria.

The use of less carbon intensive fuels and the promotion of renewable fuels have obvious associated benefits with reductions of carbon emissions. According to Regulation (EU) 601/2012, the calorific values and carbon emission factors for fuels of high relevance to the ceramics sector are:

Table 6. Selected fuel emission factors and calorific values from Regulation 601/2012

Fuel type	Emission factor (t CO2/TJ)	Net calorific value (TJ/Gg)
Anthracite (coal)	98,3	26,7
Other bituminous coal	94,6	25,8
Sub-bituminous coal	96,1	18,9
Lignite	101,0	11,9
Liquified petroleum gas	63,1	47,3
Natural gas	56,1	48,0
Landfill gas	-	50,4
Sludge gas	-	50,4

For the purposes of the EU Ecolabel criteria for ceramic products, any fuel that is listed with no emission factor in Annex VI to Regulation (EU) 601/2012 can potentially be considered as counting as a "renewable" fuel source.

The installation of onsite CHP brings clear environmental benefits for any industry where the waste heat from the CHP unit can be beneficially reused. As a general rule of thumb, grid electricity can be considered to represent no more than a 40% efficient conversion of primary energy into useful energy (i.e. electricity) due to losses of heat and transmission losses across the grid. However, CHP can generally be considered as an 80% efficient conversion of primary energy into useful energy (i.e. electricity plus heat) because the demand for the heat is located next to the CHP unit.

Why the distinction between specific energy consumption units for tiles <12mm thickness?

The limit of 3.5 MJ/kg for firing energy was originally set for tiles that were around 10mm thick, which was the most common thickness over 10 years ago. However, since then the range of thicknesses has begun to vary a lot, especially towards the thinner end of the spectrum, where tiles as thin as 3mm may now be produced. Overall, the thickness may vary from 3-30mm. It is important to consider how a ceramic tile oven operates and how the thickness may affect the specific energy consumption. The ovens are never switched off due to the challenges of start-up and the time it takes to achieve a steady operation. Instead, the oven is also maintained at a baseline temperature and has firing sections where higher temperatures are applied that depend on the mineral composition of the tile and the final properties that are desired. With thinner tiles, there is the possibility for some energy savings in the firing stage, since the material might need less time to be fully fired. However, these savings are generally not enough to compensate for the decrease in kg of the tile.

With some simple assumptions, it is possible to illustrate how a single specific energy consumption requirement in terms of per kg can effectively discriminate against thinner format tiles.

Points for discussion
Opinions about the ambition level for specific kiln energy consumption – is 3.5 MJ/kg still relevant? **Clarification on scope of kiln firing needed. Is onsite CHP to be included or not? Default position is that it should not be included since the primary purpose is electricity generation but perhaps the ETS approach has a different way of interpreting this?** **Is the ambition level of 70 MJ/m2 appropriate for thinner format tiles? (Additional input about the**

relationship between kg/m2 and tile thickness would be particularly welcome).

Opinions about the proposals for points?

Should all calorific values be according to Regulation 601/2012 or is it necessary to also allow for specific calorific values of fuels?

4.2 – Specific freshwater consumption

Existing criterion: 4.2. Water consumption and use

(a) The water consumption at the manufacturing stage, from raw material preparation to firing operations, for the fired products shall not exceed the following requirement:

(litres/kg of product)

Parameter	Requirement
Fresh water specific consumption (Cw_{p-a})	1

Assessment and verification: the applicant shall provide the calculation of fresh water specific consumption as indicated in the Technical appendix — A5. For fresh water, only groundwater, shallow water or water from the aqueduct should be considered.

A5 Water consumption calculation

The fresh water specific consumption shall be calculated as follows:

$Cw_{p-a} = (W_p + W_a)/P_t$

Cw_{p-a} = fresh water specific consumption. The results are expressed in m^3/tonnes, equivalent to l/kg;

Pt = total stored production in tonnes;

Wp = water from wells and intended for exclusive industrial use (excluding water form wells for domestic use, irrigation and any other non-industrial use), in m 3 ;

Wa = water from aqueduct and intended for exclusive industrial use (excluding water form aqueduct for domestic use, irrigation and any other non-industrial use) in m 3 .

The system boundaries are intended from raw materials to firing operation.

(b) The waste water produced by the processes included in the production chain shall reach a recycling ratio of at least 90 %. The recycling ratio shall be calculated as the ratio between the waste water recycled or recovered by applying a combination of process optimisation measures and process waste water treatment systems, internally or externally at the plant, and the total water that leaves the process, as defined in the Technical appendix — A3.

Assessment and verification: the applicant shall provide the calculation of the recycling ratio including raw data on total wastewater produced, water recycled and the quantity and source of fresh water used in the process.

A3 Water recycling ratio

The calculation of the water recycling ratio shall be consistent with the following formula based on the flows highlighted in Figure A1.

$$\text{Recycling ratio} = \frac{\text{Waste water recycled}}{\text{Total water exists the process}} \cdot 100 = \frac{R}{WI} \cdot 100$$

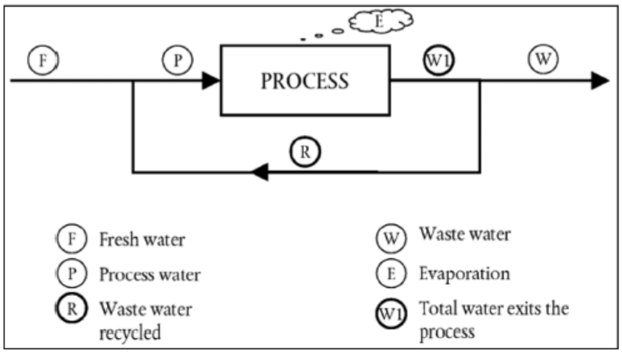


Figure A1: Water flow scheme that shall be used to calculate water recycling ratio (1)

Proposed criterion: 4.2. Specific freshwater consumption

Mandatory requirement

The specific freshwater consumption, from grinding of raw material, spray drying, shaping, glazing and firing processes shall not exceed 1.0 L/kg or 20.0 L/m2.

For plants where grinding and spray drying operations are not carried out because spray dried material is purchased, the specific water consumption shall not exceed 0.5 L/kg or 10.0 L/m2.

EU Ecolabel points

Points shall be awarded in proportion to how much the applicant can reduce the specific freshwater consumption to 50% of the applicable limit (up to 10 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirement, supported by the total freshwater consumption data (in L or m3) for the most recent calendar year or 12 month period and the total ceramic tile production data (in kg or m2) for the same period.

In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.

Water consumption due to toilets, canteens and other activities not directly relevant to tile production should be metered separately and not be included in the calculation.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. for plants where grinding and spray drying is carried out: 1.0 L/kg = 0 points and 0.5 L/kg = 10 points).

Rationale and discussion:

The importance of specific freshwater consumption

According to the European Environment Agency, a total of 36 river basins in Europe, covering 19% of Europe's territory, suffered from water scarcity in the summer of 2015. An arbitrary definition of a water scare region is when more than 20% of the natural freshwater resources are abstracted for human activities (i.e. agriculture, power generation, manufacturing, service industries and urban consumption). The total abstraction of water for human activities as a fraction of the total available freshwater resources is expressed as the Water Exploitation Index (WEI).

Water scarcity, that is to say WEI, is measured at the level of the river basin by the European Environment Agency. It is interesting to consider the data for the river basins in which the two dominant ceramic producing regions in Europe are located: Castellon in Spain and Sassuolo in Italy.

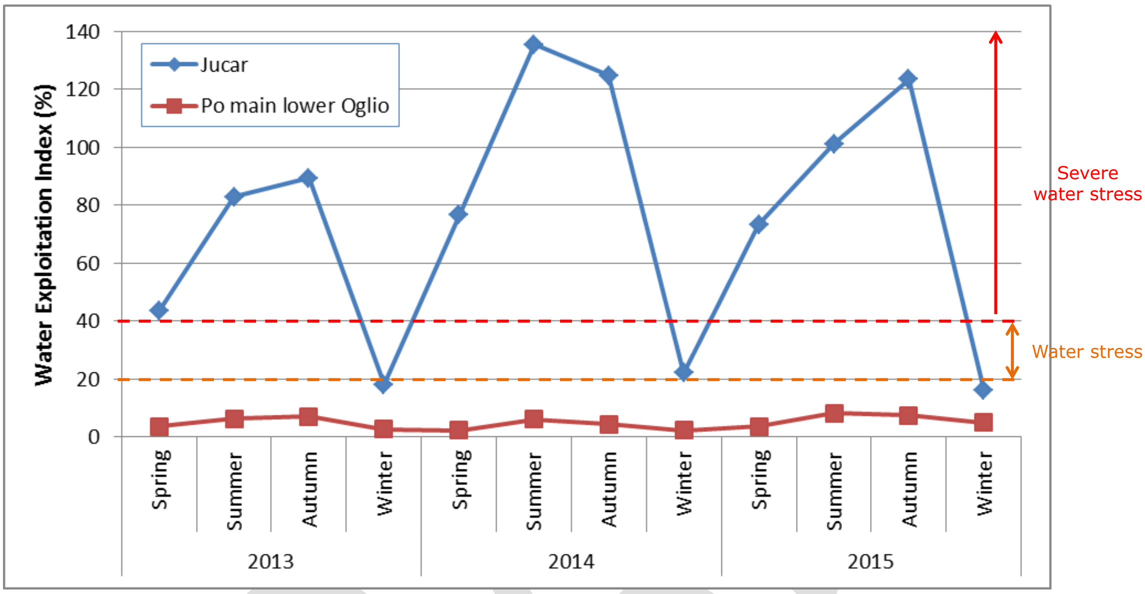


Figure 10. Trends in wáter stress in the Castellon and Sassuolo district river basins (Jucar and Po respectively). Source: EEA.

The data in Figure 10 show that the Jucar basin has been almost continually classified as being under water stress during the last 3 years, even during winter periods when demand for irrigation water for agriculture is greatly reduced. In some cases the human abstraction of freshwater actually exceeded 100%, which is either a methodological flaw or represents the tapping into not normally available freshwater reserves such as deep aquifers. In either case, the numbers serve to highlight the importance of efficient water consumption in the Castellon region, via ceramic tile production or any other water demanding activity.

On the other hand, the Po (main lower Oglio) river basin in which the Sassuolo ceramic cluster is located does not suffer from any obvious water stress. Even in this case, water recycling is important in order to lower costs associated with water abstraction and wastewater discharge.

Ceramic tile production requires a significant quantity of water for wet grinding, to prepare clay and glaze slips, to obtain the correct plasticity of clay bodies prior to pressing or extrusion and for general washing and cooling purposes.

Two separate limits have been specified depending on what processes are carried out at the applicant's plant. In cases where grinding and spray drying of raw materials is not carried out, because they instead purchase the spray dried material, there is a significantly reduced water demand. According to some industry stakeholders, this could be reflected by a 50% reduction in specific freshwater consumption rates.

Why no longer any requirement for water recycling ratio proposed?

One of the concerns about the water recycling ratio is that it will be easier to meet a high recycling ratio when large amounts of water are consumed in the first place. By having a fixed requirement on specific freshwater consumption only, potential applicants have a more flexible choice: either use dry processes in the first place or use wetter processes and recycle the water in an efficient manner. To illustrate this point, the dry and wet grinding processes can be considered.

The grinding stage consumes a significant quantity of water. Even with dry grinding, it is necessary to soak the ground powder to a moisture content of 7-12% prior to optimised drying of the moistened granules, which will carry a moisture content of around 6-7%. Wet grinding is generally considered to consume around 4 times as much water (wet ground raw materials will have a moisture content of 42-50%) which is then dried to a moisture content of 5-6%. Consequently, there is a much higher quantity of water available for recycling when wet grinding processes are used.

Points for discussion
Should harvested rainwater be specifically exempted from the freshwater calculation or can it already be assumed to be excluded based on the current criterion formulation? **Should the applicant be given a choice between the L/m2 or L/kg unit or should the former apply to standard thickness tiles (e.g. ≥10mm) and the latter to thinner format tiles (e.g. <10mm)?** **How might onsite CHP affect the specific freshwater consumption?** **Do you agree with the arguments to justify no longer requiring the water recycling ratio?**

4.3 – Emissions to air

Existing criterion: 4.3. Emissions to air, (b) Ceramic tiles

The total emissions to air of particulates for pressing, glazing and spray drying ('cold emissions') shall not exceed 5 g/m^2.

Assessment and verification: the applicant shall provide appropriate documentation and test reports, following the indications of the Technical appendix — A6.

The emissions to air for the firing stage only shall not exceed the following:

Parameters	*Limit value (mg/m2)*	*Test method*
Particulate matter (dust)	*200*	*EN 13284-1*
Fluorides (as HF)	*200*	*ISO 15713*
Nitrogen oxides (as NOx)	*2500*	*EN 14792*
Sulphur dioxide (SO2) *Sulphur content in raw material is ≤ 0.25%*	*1500*	*EN 14791*
Sulphur dioxide (SO2) *Sulphur content in raw material is > 0.25%*	*5000*	*EN 14791*

Assessment and verification: the applicant shall provide appropriate documentation and test reports for each emission parameter mentioned above, following the indications of the Technical appendix — A6.

A6 Emissions to air (for processed products only)
The air pollutant emission factors shall be calculated as follows:
— the concentration in the exhaust gas emitted to the environment of each parameter considered in the tables shall be calculated,

— the measurements used for the calculation must be made following the testing methods indicated in the tables,
— the samplings shall be representative of the considered production.

Proposed criterion 4.3. Emissions to air

Mandatory requirement

The following emissions to air limits shall be respected.

Parameters		Limit value	Test method
Particulate matter (dust) from cold processes in ceramic production.		0.125 g/kg	EN 13284-1
Particulate matter (dust) from glaze application and kiln firing.		0.2 g/m2* or 0.01 g/kg**	EN 13284-1
Fluorides (as HF) from firing		0.2 g/m2* or 0.01 g/kg**	ISO 15713
Nitrogen oxides (as NOx)		2.5 g/m2* or 0.125 g/kg**	EN 14792
Sulphur dioxide (SO2)	If S content of clay is < 0.125%	0.75 g/m2* or 0.0375 g/kg**	EN 14791
	If S content of clay is 0.125% < 0.25%	1.5 g/m2* or 0.075 g/kg**	
	If S content of clay is ≥ 0.25%	3.0 g/m2* or 0.15 g/kg**	

**for ceramic tile of 10mm thickness or more. **for tile formats of thickness less than 10mm.*

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the following aspects:

- Reduction of dust emissions from the kiln towards a best practice limit of 0.1g/m2 for tiles that are ≥10 mm thick, or 0.005 g/kg for tiles < 10 mm thick (up to 10 points).
- Reduction of HF emissions towards a best practice limit of 0.1g/m2 for tiles that are ≥10 mm thick, or 0.005 g/kg for tiles < 10 mm thick (up to 10 points).
- Reduction of SO2 emissions towards a best practice limit of 0.4g/m2 for tiles that are ≥10 mm thick, or 0.02 g/kg for tiles < 10 mm thick (up to 10 points).

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by site data in mg/Nm^3 and expressed as an annual average value calculated from daily average values. The data shall have been generated via continuous or periodic monitoring according to EN 13284-1 or -2 for dust, EN 14792 for NOx and EN 14791 for SO_2.

To convert exhaust gas monitoring results from mg/Nm^3 into g/t of clinker, it is necessary to multiply by the specific gas flow volume (Nm^3/t ceramic tile). One Nm^3 refers to one m^3 of dry gas under standard conditions of 273K, 101.3 kPa and 10% O_2 content.

For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. for dust from kiln firing: 0.2g/m2 = 0 points and 0.1g/m2 = 10 points).

General points for discussion about air emissions

Is it normal practice to continually monitor dust, HF, NOx and SO2 emissions from ceramic kilns?

Clarification needed about whether Nm3 refers to 18% O2 or 10% O2 in the ceramic sector.

How common is non-continual production in the ceramic sector?

Opinions about the proposals for points? (The general logic is basically maximum points for being about 50% of the allowable emission or lower).

Rationale and discussion:

Information from the BREF Document for ceramics

The data values reported in BREF for emissions to air are normally reported as mg/Nm3 and to convert them into specific emissions; it is necessary to multiply by a specific airflow rate in terms of Nm3/kg or product or Nm3/m2 of product. Data from tables 3.27 and 3.28 of BREF (2007) is presented below for more information about air emissions.

Source of emission	Roller hearth kiln
Flue-gas volume flow (m^3/h)	5000 – 15000
Flue-gas temperature (°C)	130 – 300
Moisture (m^3_{water}/m^3_{total})	0.05 – 0.1

Emission component	Concentration (mg/m^3)
Dust	5 – 30
NO_X stated as NO_2	5 – 150
SO_X stated as SO_2	1 – 300
CO	1 – 15
Fluorine compounds stated as HF	5 – 60
Chlorine compounds stated as HCl	20 – 150
Boron	<0.5
Lead	<0.15
CO_2	1.5 – 4.0 vol-%

Table 3.27: Operating data and raw gas values in firing

Gaseous emissions from		Specific flowrate (Nm^3/kg)	Pollutant emission factors PEF (g/kg)					
			Dust (particulate matter)		Lead compounds (Pb)		Fluorine compounds (HF)	
Phase	Operation		UC	C	UC	C	UC	C
Body preparation	Dry grinding	6	40 – 60	0.05 – 0.1				
	Wet grinding	6	10 – 20	0.02 – 0.1				
	Spray drying	5	5 – 10	0.1 – 0.2				
Shaping	Pressing	5	5 – 10	0.01 – 0.05				
Glaze preparation and application		5	0.5 – 1.0	0.02 – 0.03				
Firing		3 – 6	0.1 – 0.5	0.01 – 0.02	0 – 0.1	0.001 – 0.01	0.1 – 0.5	0.01 – 0.05
UC = Uncontrolled emission; C = Controlled emission								

Table 3.28: Gaseous emissions from the various phases of wall and floor tile manufacturing processes. Pollutant emission factors for uncontrolled (UC) and controlled (C) emissions

Figure 11. Reported data ranges for air emissions from ceramic production (BREF, 2007).

The blue box in Figure 11 provides data that is relevant to the dust criteria only, but throughout the entire ceramic tile production process while the red boxes provide data that is relevant to all emissions, but only for the firing stage.

Dust emissions

The data about dust emissions implies that if emissions of dust are uncontrolled, they could amount to a total of 60 to 100 g/kg of product, some 10% of the total material input. The most significant losses are associated with the "cold process" body preparation (55 to 90 g/kg), which is associated with the atomisation plant and which, as mentioned earlier, is often owned and operated by third parties. Only a relatively small amount of dust emissions (around 1.5% of uncontrolled emissions) would be associated with the processes that are common to all ceramic tile producers (i.e. shaping, glaze preparation/application and firing).

Such significant loss of material can be reduced by 99% via the implementation of dust control techniques such as cascade type bed adsorbers, filters or dry or wet flue gas scrubbing. For plants with fully controlled dust emissions, specific dust emission levels of 0.2 to 0.5 g/kg might be expected, again emissions due to the firing stage(s) are relatively insignificant (0.01 to 0.02 g/kg).

The existing EU Ecolabel criteria set out in Decision 2009/607/EC set a requirement of 5 g/m2 for "cold processes" and 0.2g/m2 for firing. In order to translate the BREF values into the EU Ecolabel units, it is necessary to multiple by a density factor for the tile (kg/m2), which will vary significantly as the thickness of the tile varies. A typical 10-12 mm thick ceramic tile might have a density of around 20kg/m2 whereas a 3-5mm thick tile could have a density of less than 10kg/m2, at least a factor of two difference. So the conversion between these units could be as follows:

- Cold stage emissions: 0.2-0.5 g/kg becomes 4-10 g/m2 for 10-12mm thick tiles or 2-5 g/m2 for thin format tiles (the current EU Ecolabel limit of 5 g/m2 seems reasonable).
- Firing stage emissions: 0.01-0.02 g/kg becomes 0.2-0.4 g/m2 for 10-12mm thick tiles or 0.1-0.2 g/m2 for thin format tiles (the current EU Ecolabel limit of 0.2 g/m2 seems reasonable).

For cold stage emissions, most of the emissions are associated with grinding and spray drying (i.e. atomisation). It may not be possible to know the dust emissions associated with a specific product in terms of g/m2 if the atomised powder is used in multiple products of varying thicknesses and densities, if atomised powder is imported (no data) and especially if some atomised powder is sold externally. Consequently it is considered most appropriate to simply express cold process emissions in terms of g/kg of material processed. This would have the added advantage of avoiding any discrepancies between thin format and thicker tile production. There is also a clear advantage here if a producer purchases atomised powder, since they have avoided a major source of potential dust emissions onsite.

Regarding dust emissions at the firing stage, thin format tiles have a certain advantage if the specific firing stage dust emission is expressed as g/m2 because less material in total is shaped per m2 of product. A factor of around 0.05m2/kg has been proposed by some industry experts when converting limits for standard thickness tiles in g/m2 to limits for thin format tiles in g/kg. Thus the current limit for firing stage dust emissions would be 0.2g/m2 for standard tiles and 0.01 g/kg for thin format tiles.

Points for discussion about dust emissions
Opinions approach to dust emission limits. Is shaping an example of a "cold process"? **Opinions about the general two-pronged approach to specific emission limits (i.e. g/kg and g/m2)?** **Is there more recent dust emission data that could be shared?**

HF emissions

The source of fluoride emissions is the raw material, which contains traces of fluoride as it can substitute for hydroxyl groups in clay minerals and depends greatly on the geological history of the clay deposit (e.g. marine sediment, alluvial sediment etc.). Emissions of HF are only relevant at the firing stage because a high temperature is required to release fluorides from clay minerals. For a given fluoride content in the raw material, a number of factors influence the potential for HF emissions:

- Temperature: mineral-F is released as HF at temperatures around 550 to 700°C and CaF2 hydrolyses to HF + CaO at temperatures exceeding 900°C.
- Moisture content: the main reactions for HF formation require the presence of moisture.
- Setting and specific surface area of the ware to be fired: this will increase or decrease the rate of diffusion of H2O into the ware and HF out of the ware.
- Glazing: acting as a physical barrier to HF emission from the glazed surface area in any firing after glazing application.

The BREF data summarised in Figure 11 report a wide range of gas concentrations (5 to 60 mg/m3) and a factor of two difference in possible specific flow rates for the firing stage (3 to 6 Nm3/kg). The two extremes of emissions based on these ranges would therefore by 0.015 to 0.36 g/kg in the uncontrolled gas. It should be noted that these emission ranges correspond to a clay with a fluoride content of 500 to 800 mg/kg and that data collected in the BREF study reported on ranges from < 100 mg/kg to 1600 mg/kg F in clays (albeit in brick clays). Specifically with Italian brick clays, most samples reported data in the 600 to 1100 mg/kg range.

Concentrations of HF in exhaust gases can typically be reduced by 90-99% via the implementation of abatement techniques such as cascade type bed adsorbers, filters and wet flue gas scrubbing. The BREF data conclude that final specific emissions of 0.01 to 0.05 g/kg are possible.

The existing EU Ecolabel criteria set out in Decision 2009/607/EC set a requirement of 0.2 g/m2 for firing. In order to translate the BREF values into the EU Ecolabel units, it is necessary to multiple by a density factor for the tile (kg/m2), which will vary significantly as the thickness of the tile varies. A typical 10-12 mm thick ceramic tile might have a density of around 20kg/m2 whereas a 3-5mm thick tile could have a density of less than 10kg/m2, at least a factor of two difference. So the conversion between these units could be as follows:

- 0.01 to 0.05 g/kg becomes 0.2 to 1.0 g/m2 for 10-12mm thick tiles or 0.1 to 0.5 g/m2 for thin format tiles (the current EU Ecolabel limit of 0.2 g/m2 seems reasonable).

Points for discussion about HF emissions
Opinions approach to HF emission limit ambition level? **Is there more recent emission data that can be shared?**

Opinions about the general two-pronged approach to specific emission limits (i.e. g/kg and g/m2)?

NOx emissions

The data in Figure 11 about NOx emissions implies a huge range of concentrations (5 to 150 mg/m3) which is further widened when considering the factor of 2 variation in specific air flow rates (3 to 6 Nm3/kg). Based on the data in Figure 11, the maximum possible range of specific emissions would theoretically be in the range of 15 mg/kg to 900 mg/kg, a factor of 60 difference. It is not clear what exactly are the reasons behind this wide range of values for ceramic floor and wall tile production, however it will probably be related to kiln technology, choice of fuel and burner technology.

The existing EU Ecolabel criteria set out in Decision 2009/607/EC set a requirement of 2500 mg/m2 for NOx emissions from firing. In order to translate the BREF values into the EU Ecolabel units, it is necessary to multiple by a density factor for the tile (kg/m2), which will vary significantly as the thickness of the tile varies. A typical 10-12 mm thick ceramic tile might have a density of around 20kg/m2 whereas a 3-5mm thick tile could have a density of less than 10kg/m2, at least a factor of two difference. So the conversion between these units could be as follows:

- Firing stage emissions: 15-900 mg/kg becomes 300-18000 mg/m2 for 10-12mm thick tiles or 150-9000 mg/m2 for thin format tiles (the current EU Ecolabel limit of 2500 mg/m2 seems somewhere firmly in the lower half of this wide range).

Unlike SO2 and HF emissions, NOx emissions from ceramic tile production are not dominated by impurities in the raw material or fuel used. Both clays and natural gas, the main fuel used in ceramic kilns, have very low N contents. Instead, the main source of NOx emissions is the thermal reaction between N2 and O2 from the combustion air in the regions close to the flame:

- $N_2 + O \rightarrow NO + N$
- $N + O_2 \rightarrow NO + O$
- $N + OH \rightarrow NO + H$

Thermal NOx formation becomes significant when the flame temperature and the excess oxygen in the combustion air.

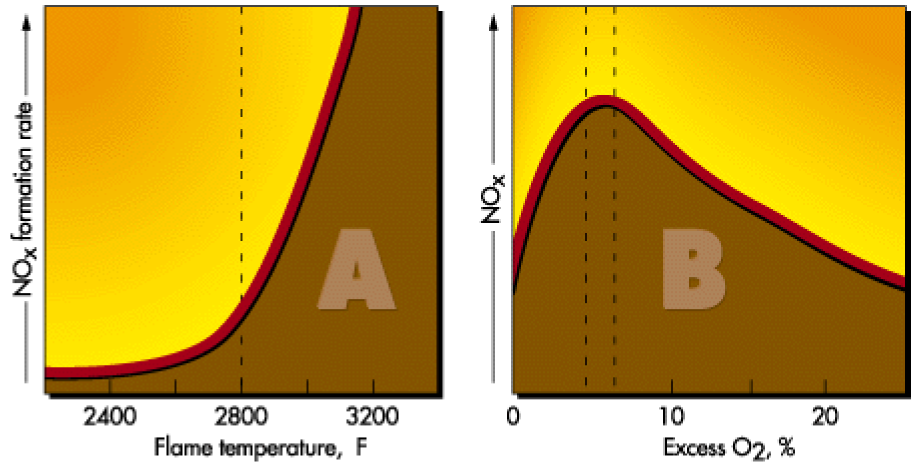


Figure 12. NOx formation as a function of flame temperature and excess O2 (Source: Alentecnic).

The data above clearly show that as the flame temperature rises above 1300°C, and especially from 1500°C (2800 F) onwards, thermal NOx formation increases. For a given situation, the potential for thermal NOx formation is highest when the excess oxygen content is 5-7% (i.e. 25-45% excess air). A lower oxygen excess starves the NOx formation reaction of oxygen while oxygen levels above 7% lower the flame temperature.

Care should be taken with the substitution of natural gas for any other fuels with a careful consideration of their nitrogen content, since this could result in a significant increase in NOx emissions from the kiln.

The flue gas abatement techniques presented in the BREF exercise focussed on dust, HCl, HF and SO2 emissions rather than NOx emissions. Regardless, it is relevant to briefly mention some of the NOx emission reduction techniques here, which can be split into pre-combustion and post-combustion types.

Pre-combustion techniques are likely to be the most economically viable solution but may require a significant re-design and modification of existing kilns, leading to expensive downtime. Pre-combustion techniques basically refer to low-NOx burners, which aim to control the air and fuel mixing in such a way that the flame temperature is reduced via changes to its structure and permanence. Longer flames with more branched structures and possible intermittent burning tend to result in lower flame temperatures. This is an important consideration for ceramic manufacture since the required kiln temperature for floor and wall tile manufacture will not exceed 1300°C, where thermal NOx formation is not so rapid. The closer the flame temperature can approximate the maximum ceramic kiln temperature, the lower will be the NOx emissions.

Post-combustion techniques relate to flue gas recirculation (FGR) or selective catalytic or non-catalytic reduction of NOx (SCR or SNCR). The principle behind of FGR is to increase the concentration of inert gases in the air, which should reduce flame temperature by moving to a lower excess oxygen content (i.e. below 5%). However, FGR will increase electricity consumption in most plants to one extent or another due to the need to use fans forcibly reintroduce the flue gas back into the kiln. The principle behind the SCR and SNCR technique is to dose ammonia or urea (which forms ammonia and CO_2 upon reaction with water) into the combustion area where it will react as follows:

$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$

However, there are a number of limitations to the SNCR and SCR techniques such as the importance of accurate dosing and the limited temperature range where it functions efficiently (typically 750 to 1050°C). At temperatures above 1093°C, ammonia reacts as follows to generate more NOx:

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

The SNCR technique requires significant operating costs due to the continual consumption of ammonia and the SCR technique has the additional cost of further replacement of spent catalyst.

Points for discussion about NOx emissions
What are the reasons behind such large variations in NOx emission concentrations (5-150mg/m3)?
BREF does not seem ambitious, but maybe EU Ecolabel is too ambitious. Opinions?
What improvements can be made to emissions by low-NOx burners, flue gas recirculation or even SCR/SNCR? Are any of these measures being implemented by the ceramics industry?
Is there more recent NOx emission data that can be shared?
Does CHP have an influence on NOx emissions? Especially if biomass-based CHP?
Any important inputs of N from auxiliary chemicals in glaze preparation?
Opinions about the general two-pronged approach to specific emission limits (i.e. g/kg and g/m2)?

SO2 emissions

The data in Figure 11 about SO_2 emissions demonstrate the largest range of concentrations (1 to 300 mg/m3) of all the pollutants listed, which is further widened when considering the factor of 2 variation in specific air flow rates (3 to 6 Nm3/kg). Based on the data in Figure 11, the maximum possible range of specific emissions would theoretically be in the range of 3 mg/kg to 1800 mg/kg, a factor of 600 difference. The two main reasons for this variability is the difference in S content of raw material and the S content of fuels. Since natural gas is the main fuel used in the ceramic industry and is virtually free of S, the variation will mainly be due to S content in the raw materials.

It should be noted that the BREF document reported S contents in (brick) clay ranging from less than 0.01% S to as high as 2.05% S (i.e. from <100 mg/kg to around 20000 mg/kg). This corresponds to a factor of 200 difference. Sulphur containing impurities in clay may be pyrite (FeS) and, to a lesser extent, as Ca or Mg sulphates.

The concentrations of SO_2 in kiln exhaust gases can be reduced by 80 to 85% via cascade type bed adsorbers, by 92 to 96% via wet gas scrubbing or by 98 to 99% via dry scrubbing with $NaHCO_3$. Assuming a 90% reduction in SO_2 emissions is achieved, the BREF data range is reduced from 3-1800 mg/kg to 0.3-180 mg/kg in the clean gas.

The existing EU Ecolabel criteria set out in Decision 2009/607/EC set a requirement of 1.5 g/m2 and 5.0 g/m2 for firing, with the higher limit applying in cases where the S content exceeds 0.25%. In order to translate the BREF values into the EU Ecolabel units, it is necessary to multiple by a density factor for the tile (kg/m2), which will vary significantly as the thickness of the tile varies. A typical 10-12 mm thick ceramic tile might have a density of around 20kg/m2 whereas a 3-5mm thick tile could have a density of less than 10kg/m2, at least a factor of two difference. So the conversion between these units could be as follows:

- 0.3 to 180 mg/kg becomes 6 to 3600 mg/m2 for 10-12mm thick tiles or 3 to 1800 mg/m2 for thin format tiles (the current EU Ecolabel limit of 1500 or 5000 mg/m2 seems quite realistic when assuming a 90% removal of S from kiln gas).

However, the split between high and low S content raw materials seems quite arbitrary (i.e. above or below 0.25%) considering that in reality the range is from <0.01% to 2.05% for European (brick) clays. Consequently, the applicable ranges of allowable S emissions have been expanded to three bands. The central band has the same ambition level as before (1.5 g/m2) and for clays with less than half the S content, the allowable S emission is halved and for clays with more than double the S content, the allowable S emission is doubled. Such an approach ensures that the applicant is generally encouraged to choose low-S content clays where there is a choice to be made.

Points for discussion about SO2 emissions
Is there more recent SO2 emission data that can be shared? **Does CHP have an influence on SO2 emissions? Especially if biomass-based CHP?** **Opinions about the general two-pronged approach to specific emission limits (i.e. g/kg and g/m2)?**

General comparison of BREF limits and EU Ecolabel limits in selected Spanish tiles

A very interesting study that investigated the actual air emissions from ceramic kilns (for HF, HCl, SO2 and NOx) was conducted by Monfort et al., (2011), who collected actual emission data in mg/m3, compared it to current BREF recommended limits and then transformed it into specific emissions in mg/m2 and mg/kg to permit a comparison of the same emissions with the EU Ecolabel limits.

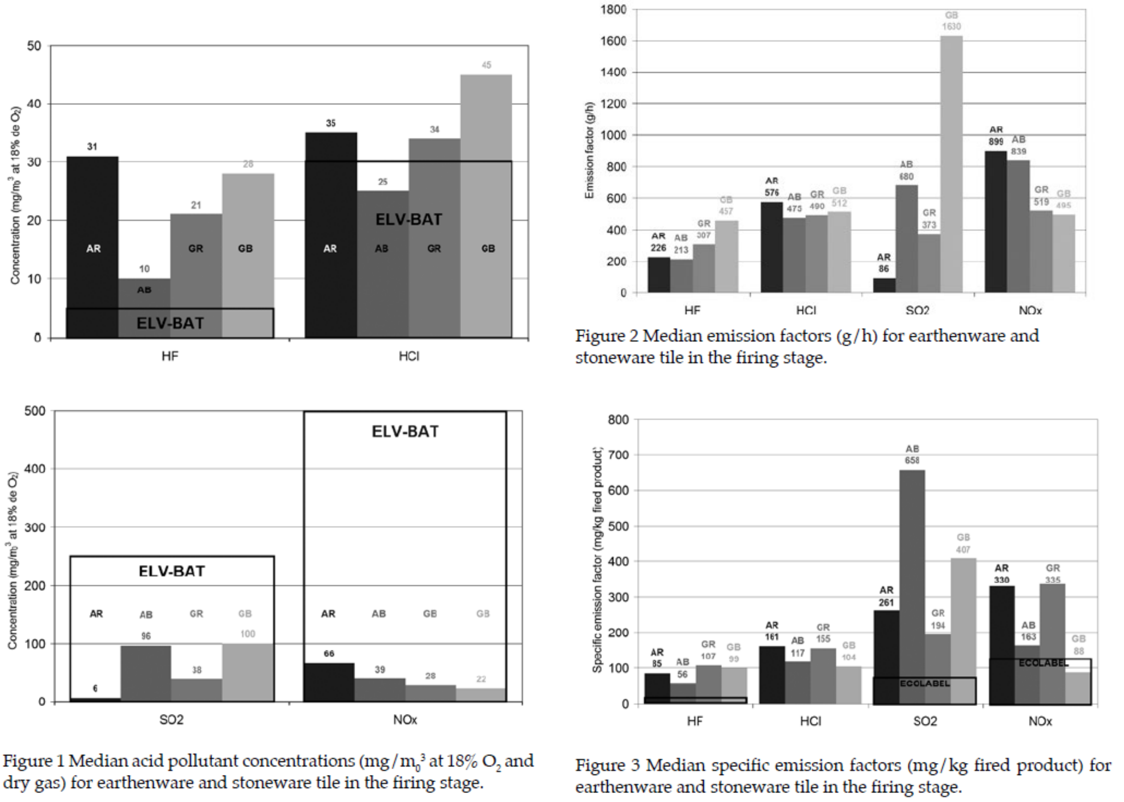


Figure 13. Comparison of acidic gas emissions from 4 ceramic tile products with BREF and EU Ecolabel thresholds (Source: Monfort et al., 2011).

A quick glance at the data on the left hand side of Figure 13 shows that kiln emissions are well within the recommended BREF limits for SO2 and NOx but that abatement is needed due to the HF and HCl concentrations. In the bottom right hand graph of Figure 13 it is clear that abatement is needed for all gaseous emissions in order to comply with the EU Ecolabel limits, especially for SO2 and NOx (no limit was set for HCl). Consequently, it can be concluded that compared to BREF, the EU Ecolabel limits are much more challenging for SO2 and NOx emissions and of a similar level for HF emissions.

Points for discussion about the other acidic gas emission
Do you think that a limit for HCl should be introduced?

4.4 – Wastewater management

Existing criterion: 4.4. Emissions to water

After waste water treatment, whether onsite or off-site, the following parameters shall not exceed the following limits:

Parameter	Limit	Test methods
Suspended solid emission to water	40 mg/l	ISO 5667-17

Cd emission to water	0,015 mg/l	ISO 8288
Cr(VI) emission to water	0,15 mg/l	ISO 11083
Fe emission to water(1)	1,5 mg/l	ISO 6332
Pb emission to water	0,15 mg/l	ISO 8288
(1) The 'Fe' parameter is applicable to all the processed products 'with the exclusion of ceramic tiles'.		

Assessment and verification: the applicant shall provide appropriate documentation and test reports showing compliance with this criterion.

Proposal for criterion 4.4: Waste water management

Mandatory requirement

Wastewater shall be treated onsite via sedimentation to recover sludge for potential reuse and shall not be mixed with wastewater from toilets, canteens and any other non-process related inputs of wastewater.

In cases where process wastewater is discharged to local watercourses, the applicant must demonstrate compliance with the following limits:

Parameter	Limit	Test methods
Suspended solid emission to water	40 mg/l	ISO 5667-17
Cd emission to water	0,015 mg/l	ISO 8288
Cr(VI) emission to water	0,15 mg/l	ISO 11083
Pb emission to water	0,15 mg/l	ISO 8288

If the settled wastewater is discharged to a municipal sewage works or other third party operated treatment plant, the applicant shall be exempted from demonstrating compliance with the emission limits defined above.

EU Ecolabel points

5 points shall be awarded if the applicant does not use glazes at all or, in cases where glazes are used, the applicant can demonstrate that wastewater from the glazing process is collected and treated separately to facilitate glaze recovery.

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, clearly state if process wastewater is discharged to local watercourses or to the sewerage network and provide details about any glazing process wastewater handling.

In cases where treated process wastewater is discharged to local watercourses and it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant and provide test reports based on weekly analysis of the discharged wastewater according to the standard test methods defined above or equivalent in-house laboratory methods.

Less frequent testing may be permitted in cases where the operating permit sets less frequent testing.

Rationale and discussion:

Why provide a potential way out of testing of pollutants in wastewater?

It is expected that all ceramic production plants will have some type of onsite wastewater treatment in order to remove the suspended inorganic particles carried in process wastewater. Even after the solids have been settled and recovered as a dewatered sludge, it is likely that the process water will be recycled to a significant degree. There are three main problems with the existing criterion.

First of all, as water recycling increases, any remaining wastewater could potentially become more concentrated in contaminants in terms of mg/l even if the actual discharge in terms of mg/kg tile product does not increase.

Secondly, if the process wastewater is not discharged directly to a local watercourse but is instead sent to a third party wastewater treatment plant, the applicant has no control on removal performance or means to obtain final effluent data.

Thirdly, if only part of the production of the ceramic production plant is to be EU Ecolabelled, it is possible that emissions caused by glazing of other non-EU ecolabelled products could complicate the demonstration of compliance with this criterion when all wastewater is processed through a single onsite treatment system.

It should also be added that while the test for suspended solids is relatively simple and can be regularly conducted onsite by personnel, the testing of heavy metals requires specialised laboratory analysis and the method for Cr(VI) determination is even more complex.

Why reward separate treatment of glaze wastewater (or not glazing at all)?

Glazes are relatively expensive raw materials based on frits and colorants that will tend to have a significantly different elemental composition to the raw material for the main body of the ceramic tile.

The separate treatment of glaze wastewater facilitates the recovery and reuse of high value glaze materials and avoids one potential source of variation to the normal elemental composition of sludge recovered from the main sedimentation plant – which may be important if the sludge is directly reincorporated into the production process.

The potential recovery (or non-use) of glaze is important from an environmental perspective since it reduces the demand for frits and glazes, which are produced in fritting kilns at temperatures of 1350 to 1550°C.

Points for discussion about wastewater management
What was the basis for these original test requirements and limits? Is it based on an Italian Regulation? **Is Cr(VI) a relevant pollutant to the ceramic industry?** **Opinions about the general approach in the proposal?**

4.5 – Process waste reuse

Existing criterion 5.2. Recovery of waste (*for processed products only*)
The applicant shall provide an appropriate documentation on the procedures adopted for the recycle of the by-products originated from the process. The applicant shall provide a report including the following information: *— kind and quantity of waste recovered,* *— kind of disposal,*

— information about the reuse (internally or externally to the production process) of waste and secondary materials in the production of new products.

At least 85 % (by weight) of the total waste generated by the process or the processes (2) shall be recovered according to the general terms and definitions established by Council Directive 75/442/EEC (3).

Assessment and verification: the applicant shall provide appropriate documentation based on, for example, mass balance sheets and/or environmental reporting systems showing the rates of recovery achieved whether externally or internally, for example, by means of recycling, reuse or reclamation/regeneration.

(2) Process wastes do not include maintenance wastes, organic wastes and urban wastes produced by auxiliary and office activities.

(3) OJ L 194, 25.7.1975, p. 39.

(4) OJ L 40, 11.2.1989, p. 12.

Proposal for criterion 4.5. Process waste reuse

Mandatory requirement

At least 85% by mass of the process waste* generated in ceramic tile production shall be reincorporated into the ceramic production process onsite, be reincorporated into ceramic production processes by third parties offsite or be reused in other production processes.

*i.e. sludge from grinding, body preparation and glaze preparation, reject/broken material from shaping, drying, firing, rectification and surface finishing operations and residues from exhaust gas abatement systems such as separated dust/ashes, gas scrubbing residues and peelings from cascade adsorber bed materials.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate higher reuse rates of process waste up a maximum of 95% reuse (up to 10 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a calculation of total production process waste (in kg or t), split between sludge, reject/broken material and gas treatment residues for the most recent calendar year or 12 month period. Details about the destination of these process wastes shall also be provided with clarifications about whether it is internal reuse in ceramic production, external reuse in ceramic production, external reuse in another process or sent to landfill. For any external reuse or landfill disposal, shipment notes shall be presented.

In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. process waste reuse rate of 85% = 0 points and 95% = 10 points).

Rationale and discussion:

Process waste from ceramic production has a high potential to be reused within the same process. In particular, sludge and dust from "cold processes" can be directly returned to wet grinding processes of new raw materials or dried first before being incorporated into dry grinding processes.

Allowance has to be made for the external reuse of these materials since some ceramic tile producers simply buy spray dried material and so do not have a significant material grinding capacity onsite.

In terms of onsite reuse, sludge production has been estimated to be in the range of 0.09 to 0.15 kg/m2 which, if completely reincorporated to the production of ceramic tiles of 20kg/m2 density, would amount to approximately 0.4 to 1.0% of the total produced ceramic tile mass (BREF, 2007). Such small additions are not expected to have any adverse effect on the predictability of raw body physical properties.

Unfired reject material can easily be reincorporated into the ceramic tile production process as well as small amounts of fired materials. Due to the toughness of fired material, it may be considered as a very useful secondary aggregate in road base or non-structural concrete.

Wastes from flue gas treatment will be more difficult to find reuse applications for. However, in cases where SO2 emissions are a concern and hydrated lime is used in gas scrubbed, the generated flue gas desulphurisation residue can potentially be used in other industries such as plasterboard and cement production.

Points for discussion about material efficiency in the production process
Opinions about the approach proposed? **Any recent data from industry about this aspect to share?**

4.6 – Glazes

Existing criteria:

2.2. Limitation of the presence of some substances in the additives

6.1. Release of dangerous substances (glazed tiles only)

2.2. Limitation of the presence of some substances in the additives

Where lead, cadmium and antimony (or any of their compounds) are used in the glazes, their content shall not exceed the following specific limits:

(% in weight of the glazes ([1]))

Parameter	Limit
Lead	0,5
Cadmium	0,1
Antimony	0,25

([1]) Glazes are all the substances applied on the tiles surface between the tile shaping and the firing stage

Assessment and verification: in terms of chemical and mineralogical analysis, the material formulation shall be provided by the applicant together with a declaration of compliance with the abovementioned limits.

6.1. Release of dangerous substances (glazed tiles only)

In order to control the potential release of dangerous substances in the use phase and at the end of the glazed tile's life, the products shall be verified according to the EN ISO 10545-15 test. The following limits shall not be exceeded:

Parameter	Limit (mg/m^2)	Testing method
Pb	80	EN ISO 10545-15
Cd	7	EN ISO 10545-15

Assessment and verification: the applicant shall provide an analysis and test reports with regard to the emission parameters mentioned above. This shall include a declaration of conformity of the product with the requirements of Council Directive 89/106/EEC (4) and with relevant harmonised standards created by CEN once published in the *Official Journal of the European Union*.

Proposed criterion 4.6. Glaze (for glazed tiles only)

Mandatory requirement

The migration of Pb and Cd from glazed ceramic tiles or kitchen counter-tops shall not exceed 8 mg/m2 or 0.7 mg/m2 respectively when tested according to EN ISO 10545-15.

EU Ecolabel points

In cases where ceramic tiles are unglazed or where the glaze formulation contains less than 0.1% Pb and less than 0.1% Cd, 10 points shall be awarded.

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion. Where tiles are glazed, the declaration shall be supported by test results according to EN ISO 10545-15.

Rationale and discussion:

Legal background to requirements on Pb and Cd migration

Article 2(4) of Council Directive 84/500/EEC set requirements for the leaching limits of Pb (0,8 mg/dm2 or 80 mg/m2) and Cd (0,07 mg/dm2 or 7 mg/m2) for different ceramic articles intended to come into contact with foodstuff. More specifically, Article 2(4) refers to migration limits of 0,8 mg/dm2 (i.e. 80 mg/m2) for Pb and 0,07 mg/dm2 (i.e. 7 mg/m2) for Cd for "*Articles which cannot be filled…*". These limits can be considered to relate to ceramic countertops in kitchens and a wide variety of different types of ceramic tableware. Details of the migration test were set out in Annex I to Council Directive 84/500/EEC which, in the case of a flat ceramic tile, entails the immersion of the specimen in a solution of 4% (v/v) acetic acid at 22°C for a period of 24 hours (in total darkness when Cd migration is to be measured). After the test period, the acid is tested for Pb or Cd by atomic absorption spectrophotometry.

The same procedure and limits have been incorporated into EN ISO 10545-15: Ceramic tiles – Part 15: Determination of lead and cadmium given off by glazed tiles.

As permitted under Article 5 of Regulation 1935/2004, the Commission is currently considering the downward revision of allowable Pb migration limits and to check if migration limits for other metals may be relevant to consider, based on potential adverse exposure to users of ceramics intended to come into contact with foodstuffs.

The JRC have conducted research about the adequacy of the original leaching method and found that it was in general suitable as an estimate of potential migration of Pb and Cd to food but that the migration test should be conducted three times in succession (3 x 24 hours) and the results of the third test used (JRC, 2017).

There is no lower safe exposure limit for Pb and so a conservative approach has been proposed (not yet finalised) where food DSVs (Discussion Starting Values) would be matched with the Drinking Water Directive (98/83/EC) limits for Pb and Cd. Such a proposal would lower the food DSV value from 4mg Pb/kg food to 10µg Pb/kg food (a factor of 400 reduction for Pb) and from 0.3mg Cd/kg food to 5µg Cd/kg food (a factor of 60 reduction for Cd).

Use of lead in ceramic glazes

The use of lead oxide in silicate glaze compositions imparts a number of desirable physical properties to the glaze such as: lower fusion point and reduced surface tension which in turn permits the formulation of a broad range of compositions that are capable of delivering chemically durable and smooth surfaces with high brilliance which are highly resistant to devitrification and with the ability to heal defects in the clay surface (Lehman, 2002).

According to the Glass Manufacturing BREF (BREF, 2013) a typical low melting point frit could consist of 50% by weight red lead (PB3O4), with the remainder being due to quartz (ca. 20%), zinc oxide (ca. 15% and boric acid (ca. 15%).

Adverse health effects of lead

Even if lead in the final ceramic product is well immobilised and not likely to migrate into foodstuffs during the use phase, the very creation of demand for lead glazes drives a production process, from mining through smelting and frit production to glaze formation and firing where larger or smaller amounts of lead are emitted to the environment. At the End of Life of the glazed ceramic tile, it is also possible that emissions of lead may be possible via leaching or inhalation of crushed tile dust or via emission to exhaust gases should old tiles end up in municipal solid waste incinerators.

Some of the health impacts associated with exposure to lead stated by the World Health Organisation are staggering, for example in 2016, it was estimated that lead exposure was responsible for 540000 deaths and 13.9 million years of healthy life lost. The effect of lead exposure is especially pronounced on children, due to their increased specific uptake of lead (x4-5) compared to adults under the same exposure conditions.

Development of lead-free ceramic glazes

Research into low-lead or lead-free glazes were prompted by lead shortages during World War II and later due to health and environmental concerns about lead exposure. Two possible alternatives are (Lehman, 2002):

- Zinc/Strontium-based glazes: although these glazes can fire well, they do not deliver great colour development.
- Alkali borosilicate (ABS) based glazes: the use of approximately 10% B2O3 and 10% (Li,Na,K)2O by weight is required although higher firing temperatures are required and defect rates are higher.

It must be highlighted that these alternative glazes have been presented for use in the production of ceramic tableware and it is not sure how they would carry over to the process for floor and wall tile manufacture.

Points for discussion
Are lead frits and glazes essential for the ceramic floor and tile sector? **Can we consider exclude the use of lead frits and glazes altogether?**

Concrete criteria

Clarifications needed about existing concrete pavers and terrazzo tiles

In the criteria established in Decision 2009/607/EC, the only concrete products included were concrete paving units (including tiles and flags) and terrazzo tiles. Any cement used had to come from kilns that operate better than a defined process energy efficiency (3800 MJ/t, not defined whether it was 1t of cement or 1t of clinker) and with emissions of dust, NOx and SO2 (presumably from the kiln gas only) within certain limits. At the concrete factory, terrazzo tile and paving unit producers must comply with certain emission limits for dust, NOx and SO2. In addition, and only for terrazzo tile producers, the process energy requirement cannot exceed 1.3 MJ/kg.

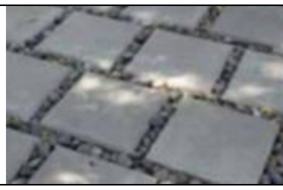
Following a review of the production technologies it is clear that there are many clarifications and adjustments necessary. For example, it is necessary to distinguish between cement-based terrazzo tiles and epoxy-based terrazzo tiles. The former can be considered as a type of dry-cast concrete while the latter is not and, due to the choice of binder, is much more similar to agglomerated stone production methods. It is also clear that emissions of NOx and SO2 and concrete production plants are negligible because the process uses equipment that is predominantly operated by electricity. There is no justification for production process emissions of pre-cast or dry-cast concrete to be comparable to those of ceramic tiles, where natural gas is combusted in high temperature kilns (ca. 1000-1300°C).

LCA hotspots of dry-cast and pre-cast products

According to evidence in LCA literature, the dominant source of environmental impacts of dry-cast and pre-cast concrete products covered in the hard covering scope is cement. Although the precise content of cement in relevant concrete products can vary significantly depending on the strength performance class in question (e.g. from 150 to 450 kg/m^3), even at the lower cement contents, raw material manufacture (i.e. cement) remains the dominant source of impacts. For example, an EPD published by one American company includes the following 4 relevant concrete products with the mix recipes as follows:

Table 7. Examples of different mix recipes for concrete products within the proposed scope (Source: HBF, 2018).

Mix recipe	Image
1m^3 of 200mm Hollow Concrete Masonry Unit: 146kg water; 250kg Portland cement; 1000kg crushed coarse aggregate; 1150kg crushed fine aggregate; 250kg natural fine aggregate	
1m^3 of 200mm Solid Concrete Masonry Unit: 120kg water; 140kg Portland cement; 850kg crushed coarse aggregate; 1410kg crushed fine aggregate; 250kg natural fine aggregate	
1m^3 of 80mm grey rectangular concrete paver: 136kg water; 422kg Portland cement; 782kg crushed coarse aggregate; 843kg crushed fine aggregate; 0kg natural fine aggregate	

1m^3 of 50mm Grey roof tiles: 108kg water; 424kg Portland cement; 790kg crushed coarse aggregate; 841kg crushed fine aggregate; 0kg natural fine aggregate	

Despite the significant variations in cement content and aggregate types used, the impacts due to raw material extraction (A1) are consistently more important than impacts during concrete processing (A3).

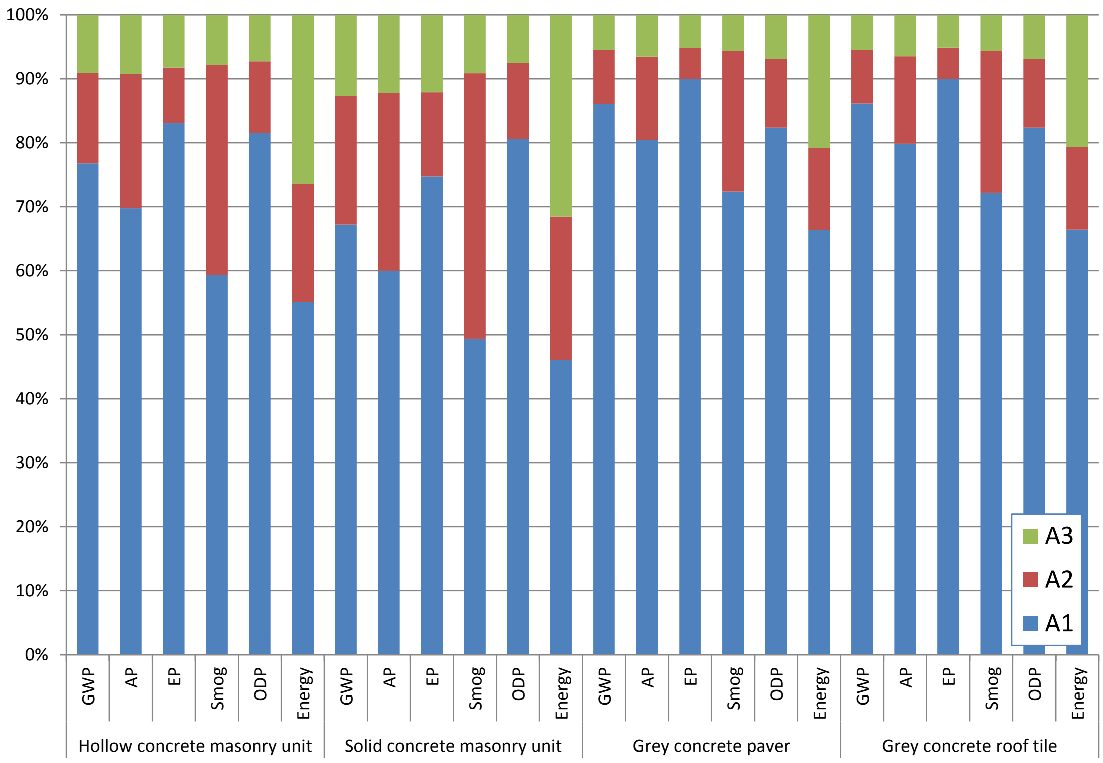


Figure 14. A1, A2 and A3 impacts for manufacture of 5 different concrete products.

Due to the dominance of A1 stages, it is justifiable that EU Ecolabel criteria should pay particular attention to the raw materials used. The relative influences of aggregates and cement on the overall impacts of concrete have been examined by many authors in the LCA literature. There is a broad consensus that impacts due to cement are far higher, despite the fact that aggregates are present in levels up to 10 times higher in the concrete mix recipe.

Marceau et al., (2007) showed that for concrete masonry units, the average total embodied energy was 1.32GJ and the 69% of this energy was due to the cement, even though cement accounted for only 8.7% of the concrete mass. Conversely, in the same production process, aggregates accounted for just 3.8% of the energy footprint despite accounting for 75.3% of the concrete mass. In a similar manner, Flowers and Sanjayan (2007) reported that cement accounted for 74 to 81% of CO2 emissions and aggregates for 13 to 20% of emissions. The same authors also showed that the emissions associated with cement could be reduced by 13-15%

when replacing 25% of the cement with coal fly ash, or be reduced by 40% when replacing 40% of the cement by blast furnace slag.

Higher performance concrete, for example higher strength or frost-resistant concrete will tend to have a higher cement content and a lower water content. Across all of the main types of concrete relevant to the hard coverings scope, the cement content may vary from 150 to 450 kg/m^3 concrete.

In summary, the main environmental impacts for concrete are dominated by the cement used. This argument must be countered against the fact that concrete producers only have a relatively limited choice of economically competitive cement suppliers. Consequently, less than half of the points available (50 of 130) are linked to the cement while the remainder are linked to aspects fully under the control of the concrete producer. The proposed EU Ecolabel criteria for concrete products therefore focus on the two aspects considered to be most relevant: the clinker factor and the CO2 emissions from the cement kiln.

However, if the intention is to EU Ecolabel cement, a closer look at additional criteria could be relevant (i.e. not only clinker factor and CO2, but also thermal efficiency of kilns, kiln gas abatement and the use of alternative fuels). Due to the fact that there is no "*one-size fits all*" solution for all cement kilns, it is proposed that the criteria be structured in such a way that the EU Ecolabel criteria can recognise and reward environmentally beneficial strategies taken up by the cement industry while ensuring some minimum ambition level across most aspects covered by the criteria.

Data available from "Getting the Numbers Right" (GNR) database

The GNR database is a voluntary project managed by the Cement Sustainability Initiative (CSI), which in turn operates under the World Business Council for Sustainable Development (WBCSD). Interested stakeholders submit data via standard web-based reports which are verified and logged in a global database. In 2016, a total of 849 individual cement facilities submitted data covering 807 million tonnes of cement production, approximately 19% of global production. The degree of industry coverage varies depending on the geographical region.

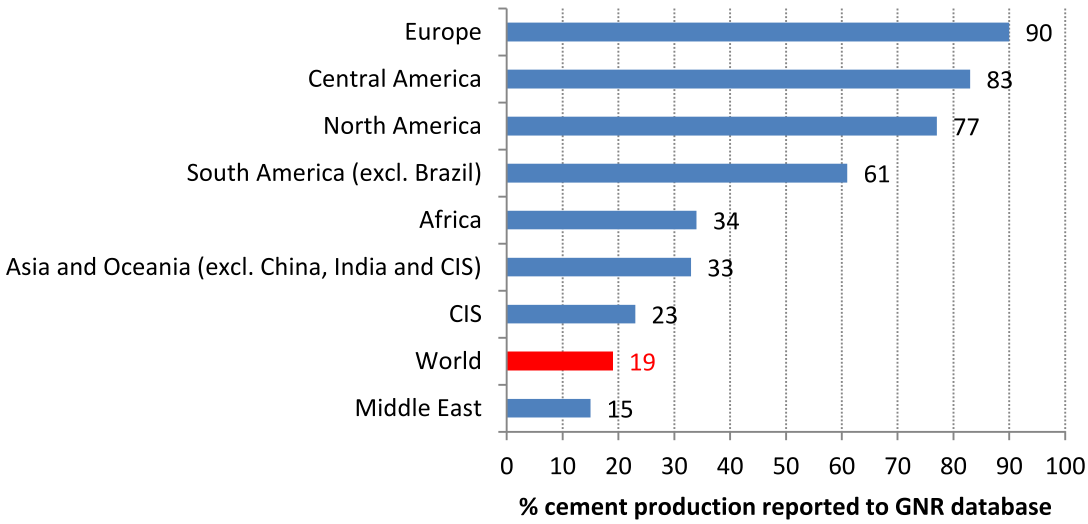


Figure 15. Variation in GNR data reported by geographical region.

The low global average of 19% cement production must be due to low levels of reporting in China and maybe India, which are the two dominant global producers of Portland cement (China with approximately 70% and India with around 8% of total global production) (CEMBUREAU, 2017).

Despite the low global average, it is clear that data from Europe can be considered as highly relevant for the European cement sector due to the fact that 90% of cement production capacity is reporting to the database. This high extent of coverage also acts as a justification for any EU Ecolabel criteria on CO2 or energy consumption to align with the same calculation and reporting format as is already required for the GNR database.

Comparison of existing and proposed criteria

The criteria specifically for cement and concrete set out in Decision 2009/607/EC and the current proposals are compared below. A combination of mandatory criteria and opportunities to gain EU Ecolabel points are detailed in this section for cement and for concrete products (which includes cement-based terrazzo tiles).

Table 8. Cement- and concrete-specific criteria structure and scoring system

Proposed criteria	Decision 2009/607/EC	Proposed criteria details	
		Mandatory?	Points?
1.1. Environmental Management System	No	Yes	5
1.5. VOC emissions	No	Yes	5
Cement production plant			
5.1. Clinker factor of cement	No	Yes	25
5.2. Non-CO2 emissions to air from cement production	Yes	Yes*	-
5.3. CO2 emissions from clinker/white cement production	No	Yes	25
5.4. Cement kiln thermal efficiency	Yes	Yes*	-
Concrete production plant			
5.5. Recycled and secondary materials at the concrete plant	No	Yes	25
5.6. Concrete plant process energy consumption	Yes? (for terrazzo)	Yes	25
5.7. Photocatalytic surfaces	No	No	10
5.8. Permeable paving	No	No	10
TOTAL points available in proposed criteria			**100 + 30**
MINIMUM points needed in proposed criteria			**60**

** JRC consider that it could be justifiable to remove requirement in proposals, either due to doubts about availability of information from suppliers or if impacts are indirectly covered by other criteria already.*

Points for discussion
Opinions about the choice of criteria? Any should be deleted? Any new ones to be considered? **Opinions about the points allocation and thresholds required?** **Would it be interesting to have the opportunity for cement to be EU Ecolabelled?**

5.1 – Clinker factor of cement

Existing criterion
No existing criterion
Proposed criterion 5.1. Clinker factor of cement

<u>Mandatory requirement</u>

A clinker factor for the cement or cements used shall be provided by the cement supplier.

In cases where more than one cement is used in the concrete product(s) that are to be EU Ecolabelled (e.g. in dual layered products) a weighted average clinker factor shall be calculated based on the average masses of each cement used in the concrete.

<u>EU Ecolabel points</u>

Up to 25 points can be awarded in proportion to how low the clinker factor is between a reference point of 1.00 for no points and 0.50 for maximum points.

<u>Assessment and verification:</u>

The applicant shall provide a declaration of compliance which states the relevant clinker factor. The cement supplier shall provide a declaration of the clinker factor in writing to the applicant and/or Competent Body. The clinker factor shall be calculated by estimating the kg of Portland cement clinker present in 1t of the cement product and dividing the kg of clinker by 1000kg.

In cases where packaged cement is delivered and no specific declaration is provided by the cement supplier, the following assumptions can be made for the cement clinker factor:

EN 197-1 Code	Factor assumed	EN 197-1 Code	Factor assumed
CEM I	0.97	CEM II/A-L	0.87
CEM II/A-S	0.87	CEM II/B-L	0.72
CEM II/B-S	0.72	CEM II/A-LL	0.87
CEM II/A-D	0.92	CEM II/B-LL	0.72
CEM II/A-P	0.87	CEM II/A-M	0.84
CEM II/B-P	0.72	CEM II/B-M	0.72
CEM II/A-Q	0.87	CEM III/A	0.50
CEM II/B-Q	0.72	CEM III/B	0.28
CEM II/A-V	0.87	CEM III/C	0.12
CEM II/B-V	0.72	CEM IV/A	0.77
CEM II/A-W	0.87	CEM IV/B	0.55
CEM II/B-W	0.72	CEM V/A	0.76
CEM II/A-T	0.87	CEM V/B	0.60
CEM II/B-T	0.72		

Rationale and discussion:

<u>The importance of the clinker factor</u>

The clinker factor is basically a measure of how much Portland cement clinker is there in the Portland cement. The vast majority of the environmental impacts associated with Portland cement production are due to clinker production (i.e. raw meal grinding, preheating, precalcining and calcination at around 1450°C in the kiln). In a "pure" Portland cement, the only material that is ground together with clinker is calcium sulfate in the form of gypsum or anhydrite in order to control the setting and hydration reactions of the clinker phases once they come into contact with water. A typical content of gypsum of hemihydrate is from 3-5%, which would result in a cement with a "clinker factor" of 0.97-0.95.

Decades of research have shown that a number of other materials, herein referred to as supplementary cementitious materials (SCMs) can be blended with clinker to produce blended cements that have equivalent or sometimes superior properties to those of a pure, CEM I type cement. The main SCMs are defined by EN 197-1 and represent a mixture of industrial by-products and natural materials that may or may not need to be processed prior to blending with clinker.

- Industrial by-products: blast furnace slag (from iron production); silica fume (from silicon metal production); coal fly ash (from coal combustion).
- Natural materials: pozzolana (e.g. volcanic ashes or kaolin calcined at 500-700°C), burnt shale, limestone (can be sourced from the same quarry as the raw meal).

From a practical and market-based perspective, all of these materials have considerable environmental (especially those which are industrial by-products) and economic benefits (especially limestone obtained from the same quarry operated by the cement producer).

Data from EPDs published by CEMBUREAU for "average" CEM I, CEM II and CEM III produced in several European countries illustrates very clearly the influence of clinker factor on the life cycle environmental impacts when looking at the cradle-to-gate life cycle. The average clinker factors were 0.925, 0.76 and 0.44 for CEM I, CEM II and CEM III EPDs respectively.

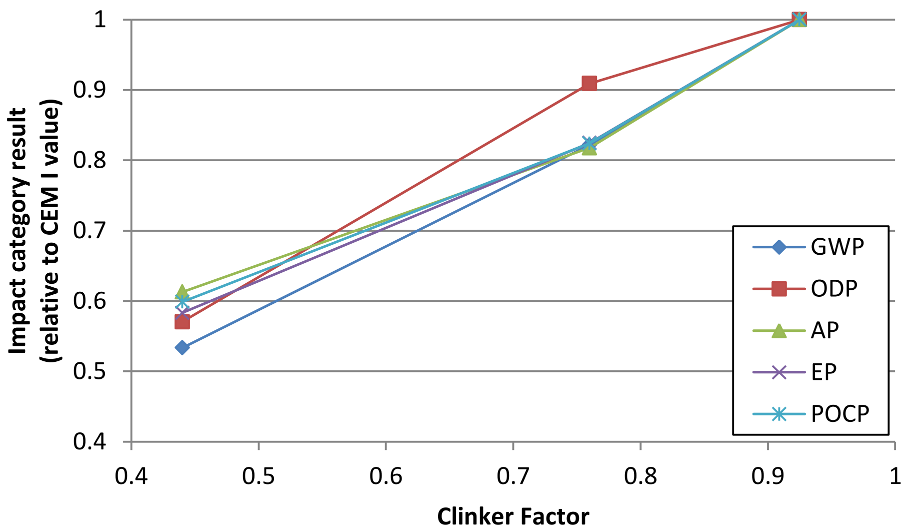


Figure 16. Influence of clinker factor on EPD impact category results (Sources: CEMBUREAU 2015a, b and c).

For the sake of comparing numbers that vary widely in scale between different impact categories, all results for CEM I have been normalized to 1.00 and the CEM II and CEM III data expressed as a decimal of the CEM I data. A clear proportional relationship between the clinker factor and the environmental impacts can be seen, although there are only 3 points on the line, the R^2 values for best fit linear trendlines were all 0.97 or higher. With the notable exception of limestone, the choice of SCM will be influenced by and may depend on regional availability, material quality and market fluctuations in SCM prices. Consequently, the EU Ecolabel criteria seek to reward any blended cements in a manner that is proportional to how well they manage to reduce their clinker factor, without specifying which any particular SCM.

Data available from "Getting the Numbers Right" (GNR) database

Although the GNR database reports on clinker factors, it counts own produced and bought clinker separately, which is more appropriate for defining a clinker factor for an entire facility or sector. The formula used for calculating the clinker factor (CF) in the GNR reporting format is as follows:

$$CF = \frac{Total\ clinker\ consumed}{Own\ clinker\ consumed + (gypsum, limestone, CKD\&SCMs\ in\ blending) + bought\ clinker\ consumed}$$

**where CKD stands for Cement Kiln Dust and SCM stands for Supplementary Cementitious Material (e.g. coal fly ash etc.).*

Table 9. Clinker factors reported in the GNR database* (GNR, 2018)

Region	2012	2013	2014	2015	2016
Africa	78%	77%	76%	77%	77%
Asia (n.e.c.) + Oceania	81%	80%	80%	80%	80%
Brazil	68%	69%	69%	69%	71%
Central America	73%	74%	74%	74%	73%
China + Korea + Japan	77%	77%	77%	77%	77%
CIS	79%	80%	80%	82%	82%
Europe	75%	76%	76%	76%	76%
India	71%	71%	70%	69%	70%
Middle East	83%	84%	84%	84%	85%
North America	91%	91%	90%	90%	89%
South America ex. Brazil	70%	70%	68%	69%	66%

**Data from indicator "92AGWce – Clinker to cement equivalent ratio – Weighted average – Grey and White clinker in Portland and blended cements (%).*

The weighted average clinker factors vary from as low as 0.66 (i.e. 66%) in South America (excl. Brazil) to 0.89 in North America. Europe is somewhere towards the middle of this range with a 0.76 clinker factor. Lower clinker factors are not only good for the environment but also good for economics whenever SCMs are available of a suitable quality.

Future trends in the clinker factor in Europe

In terms of future prospects, CEMBUREAU estimate that the European cement sector could achieve a sector average clinker factor of 0.70 by 2050 (CEMBUREAU, 2013) (i.e. only minor and incremental progress from today). Two particularly important SCMs are blast furnace slag (from steel production) and coal fly ash (from coal combustion). Any decreases in European steel production will make it more costly for European cement producers to obtain blast furnace slag. Coal combustion is likely to decrease in Europe due to efforts to decarbonize the energy sector, resulting in less fly ash being available for EU cement production. Furthermore, NOx emission abatement from coal combustion plants by treatment via selective reduction with ammonia dosing may pose a threat to the consistency of fly ash quality when ammonia slip occurs.

Ambition level in proposed approach

This criterion proposal is new to the EU Ecolabel and so stakeholder feedback is particularly important. The minimum requirement for simply reporting the clinker factor may seem unambitious considering that in Europe the weighted average factor is already 0.76. However, it must be borne in mind that there may be cases when a high clinker factor is required (e.g. in white cements or in concretes that use a low dose of high quality cement per unit of concrete).

In the latter case, the low dose of cement may be because the concrete producer has their own supply of SCMs and wishes to blend them onsite prior to concrete production. The criteria have been set up so that even if a concrete producer loses points by using cement with a high clinker factor, he can obtain extra points by demonstrating a higher use of secondary or recycled materials in his concrete mix.

For these reasons, it is considered most suitable to allow for higher clinker factor cements but to reward those cements which achieve lower clinker factors in proportion to the actual clinker factor towards an arbitrary best practice benchmark of 0.50.

Dosing and blending systems in cement production

For EU Ecolabel, a similar formula that used in the GNR database described above can be used, although it is unimportant whether any distinction is made between own produced and bought clinker.

It must be appreciated that a single cement factory may produce multiple different cement products even if it would only produce one clinker - the distinction in products comes from blending of the clinker with other materials in different combinations after the clinker has cooled. Consequently, the clinker factor must be based at the level of individual cement products rather than the entire facility.

The cement blending process may be simple or relatively complex depending on how many materials are to be blended and at what point. In any case, it is always possible to make a reasonable estimate of the clinker factor by monitoring the mass flows of clinker in and cement out. Monitoring the mass flows of other key materials, such as gypsum, will be necessary in order to ensure predictable performance of each cement batch.

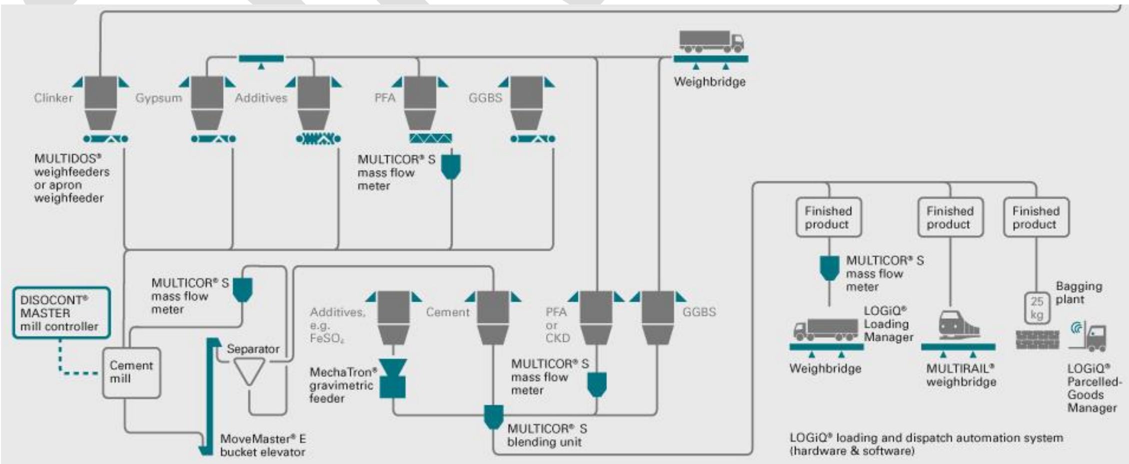


Figure 17. Cement blending process diagram (Source: SchenkProcess).

The process diagram in Figure 17 shows that the combination of cement clinker with other materials may be carried out prior to milling with gypsum, which results in a homogenous material, or that it may be blended with SCMs of sufficient fineness in a simple blending unit. The return of fines from the milling operation to the system may complicate the mass balance process if these returns are not metered.

Alternative verification via cement code on packaging

There may be cases where a concrete manufacturer is unable obtain information about the clinker factor of the cement they use. The exact number may be considered as commercially sensitive information by some producers. In such cases, an alternative means of estimating the clinker factor is provided via the code that should be displayed on packaging of any CE marked Portland cement.

The codes listed in the criterion indicate which type or types of SCM have been used and the range of SCM content that is present in accordance with table 1 of EN 197-1. The estimated clinker factor is simply based on the medium range of the added SCM. For example, if code CEM II/A-S corresponds to clinker blended with 6-20% of blast furnace slag. If the middle percentage is taken (i.e. 13%) this would correspond to an estimated clinker factor of 0.87.

Table 10. Different classes of Portland cement according to EN 197-1

Type	Code	From kiln	From other sources (supplementary cementitious materials (SCMs))									Other minor constituents
		Clinker	Blast furnace slag	Silica fume	Pozzolana natural	Pozzolana natural calcined	Fly ash siliceous	Fly ash calcareous	Burnt shale	Limestone		
		K	S	D	P	Q	V	W	T	L	LL	
CEM I	CEMI I	95-100	-	-	-	-	-	-	-	-	-	0-5
CEM II	CEM II/A-S	80-94	6-20	-	-	-	-	-	-	-	-	0-5
	CEM II/B-S	65-79	21-35	-	-	-	-	-	-	-	-	0-5
	CEM II/A-D	90-94	-	6-10	-	-	-	-	-	-	-	0-5
	CEM II/A-P	80-94	-	-	6-20	-	-	-	-	-	-	0-5
	CEM II/B-P	65-79	-	-	21-35	-	-	-	-	-	-	0-5
	CEM II/A-Q	80-94	-	-	-	6-20	-	-	-	-	-	0-5
	CEM II/B-Q	65-79	-	-	-	21-35	-	-	-	-	-	0-5
	CEM II/A-V	80-94	-	-	-	-	6-20	-	-	-	-	0-5
	CEM II/B-V	65-79	-	-	-	-	21-35	-	-	-	-	0-5
	CEM II/A-W	80-94	-	-	-	-	-	6-20	-	-	-	0-5
	CEM II/B-W	65-79	-	-	-	-	-	21-35	-	-	-	0-5
	CEM II/A-T	80-94	-	-	-	-	-	-	6-20	-	-	0-5
	CEM II/B-T	65-79	-	-	-	-	-	-	21-35	-	-	0-5
	CEM II/A-L	80-94	-	-	-	-	-	-	-	6-20	-	0-5
	CEM II/B-L	65-79	-	-	-	-	-	-	-	21-35	-	0-5
	CEM II/A-LL	80-94	-	-	-	-	-	-	-	-	6-20	0-5
	CEM II/B-LL	65-79	-	-	-	-	-	-	-	-	21-35	0-5

	CEM II/A-M	80-88	<--------12-20-------->									0-5
	CEM II/B-M	65-79	<--------21-35-------->									0-5
CEM III	CEM III/A	35-64	36-65	-	-	-	-	-	-	-	-	0-5
	CEM III/B	20-34	66-80	-	-	-	-	-	-	-	-	0-5
	CEM III/C	5-19	81-95	-	-	-	-	-	-	-	-	0-5
CEM IV	CEM IV/A	65-89	-	<--------11-35-------->					-	-	-	0-5
	CEM IV/B	45-64	-	<--------36-55-------->					-	-	-	0-5
CEM V	CEM V/A	40-64	18-30	-	<--------18-30-------->			-	-	-	-	0-5
	CEM V/B	20-38	31-49	-	<--------31-49-------->			-	-	-	-	0-5

Verification of clinker factor via testing of the cement product?

Standard procedures (EN 196-4) have been developed for quantifying the content of certain SCMs in blended cement via a selective dissolution procedure or, in cases where blended cements consist only of clinker + one SCM + gypsum/anhydrite, other specific procedures are defined for blast furnace slag, for siliceous fly ash and for natural pozzolana.

However, due to problems with the determination of calcareous fly ash and burnt shale in blended cements, and due to the additional testing burden that this would entail, it is preferred that the evidence by based simply on the declaration of the cement supplier or the packaging information.

Points for discussion
Opinions about the proposed criterion and approach? **Is the clinker factor commercially sensitive information or is it general enough so long as the precise SCM types and contents do not need to be communicated?**

5.2 – Non-CO2 emissions to air from the cement kiln

Existing criteria:

4.3 (d) Terrazzo tiles and concrete paving units

4.5 Cement (part relevant)

4.3 (d) Terrazzo tiles and concrete paving units

The emissions to air for the following parameters for the whole manufacturing process shall not exceed the following values:

Parameters	Limit (mg/m2)	Test method
Particulate matter (dust)	300	EN 13284-1
Nitrogen oxides (as NO_x)	2000	EN 14792
Sulphur dioxide (SO2)	1500	EN 14791

Assessment and verification: the applicant shall provide appropriate documentation and test reports for each emission parameter mentioned above, following the indications of the Technical appendix — A6.

A6 Emissions to air (for processed products only)
The air pollutant emission factors shall be calculated as follows:
— the concentration in the exhaust gas emitted to the environment of each parameter considered in the tables shall be calculated,
— the measurements used for the calculation must be made following the testing methods indicated in the tables,
— the samplings shall be representative of the considered production.

4.5 Cement

The use of raw materials for cement production shall be consistent with extraction management for processed products requirements (criterion 1.2).

Those producers who use cement in the production process shall comply with the following requirements:

~~— cement included in any product shall be produced using not more than 3 800 MJ/t of process energy requirement (PER), calculated as explained in the Technical appendix — A4,~~

— the cement included in any product shall be produced respecting the following air emission limits:

Parameter	Current limit (g/t)	Test methods
Dust	65	EN 13284-1
SO2	350	EN 14791
NO_x	900	EN 14792

Assessment and verification: the applicant shall provide the relevant test reports and documentation related to the PER and the air emissions deriving from the cement production.

Proposal for criterion 5.2

Mandatory requirement

The following non-CO_2 emissions to air from the cement kiln shall be continuously monitored and comply with relevant limits for the parameters defined below:

Parameter	Specific emission (g/t clinker*)
Dust	≤ 37
NO_x	≤ 943 or 1656**
SO_x (as SO_2)	≤ 736

** g/t clinker limits were translated from mg/Nm3 data by multiplying by a factor of 2.3 Nm3/t clinker*
*** higher limit applies to Lepol kilns, long rotary kilns or white cement production*

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by site data in mg/Nm^3 and expressed as an annual average value calculated from daily average values. The data shall have been generated via continuous monitoring according to EN 13284-1 for dust, EN 14792 for NOx and EN 14791 for SO_2.

To convert exhaust gas monitoring results from mg/Nm^3 into g/t of clinker, it is necessary to multiply by the specific gas flow volume (Nm^3/t clinker). One Nm^3 refers to one m^3 of dry gas under standard conditions of 273K, 101.3 kPa and 10% O_2 content.

For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than

30 days.

Rationale and discussion:

Existing criterion in Decision 2009/607/EC

Requirements for non-CO2 emissions to air (dust, SO2 and NOx) from cement production were set in the existing Decision for Hard Coverings. The requirements cover the same three parameters and refer to the same three standards for the measurement technique.

Due to the fact that there are no existing hard covering licenses for cement-based products, it is not possible to know if any one of the existing criteria for cement were problematic in terms of setting unrealistic ambition levels.

Feedback from cement experts identified that criterion 4.3(d) in Decision 2009/607/EC must be a mistake and should not be included. This was because there is no significant thermal process involved in dry-cast or pre-cast concrete plants. So there is no justification for the emission limits to be set at a similar level to those for ceramic tile production, where a kiln must be fired at temperatures up to 1300°C. To support this conclusion, the choice of unit is highly questionable (mg/m2) since the thickness of concrete products will vary significantly between pavers, flags and tiles.

The requirements in existing criterion 4.5 make much more sense. This is because by far the most important source of dust, NOx and SO2 emissions is the cement kiln and not the concrete plant and the choice of unit (g/t) makes sense since the cement producer has no idea how many m2 of concrete will be generated per kg of cement they sell.

Since 2009, the BAT Reference Document (BREF, 2013b) and BAT Conclusions (Decision 2013/163/EU) have been published for Portland cement production. More recently, emission data has been published by CEMBUREAU in their 2017 activity report, covering more than 250 kilns. Now it is possible to put the existing numbers stated in the Decision 2009/607/EC in the context of a much broader data gathering exercise and decide whether or not the EU Ecolabel thresholds are of a suitable ambition level or not.

Requirements of the BAT Conclusions

Cement kilns operating in compliance with the BAT Conclusions (EC, 2013) are required to continuously monitor emissions of dust, NOx and SOx (as SO2) from the kilns (specifically in BAT 5 part d). Other gases may be combined with kiln exhaust gas, particularly for dust control. Upper emission limits that must be complied with are defined in units of mg/Nm^3.

CEMBUREAU data for dust emissions in 2015

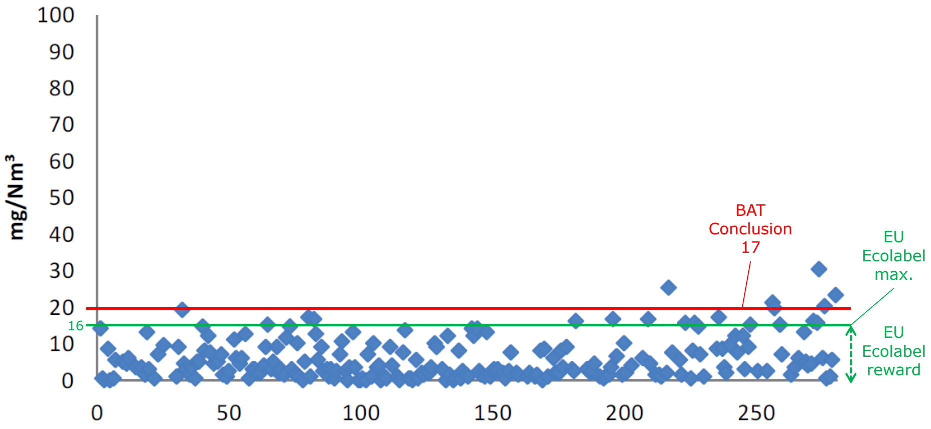


Figure 18. Comparison of EU Ecolabel and BAT ambition levels with 2015 industry data for dust emissions.

The data in Figure 18 show that all but 5 of the 250+ kilns covered (ca. 2%) exceeded the upper AEL for BAT Conclusion 17 in 2015 (20 mg/Nm^3). With the more stringent upper limit (16 mg/Nm^3) proposed for EU Ecolabel cement criteria, an additional 15 mills (ca. 6%) would have problems meeting the limit, at least based on this data presented from 2015.

CEMBUREAU data for NOx emissions in 2015

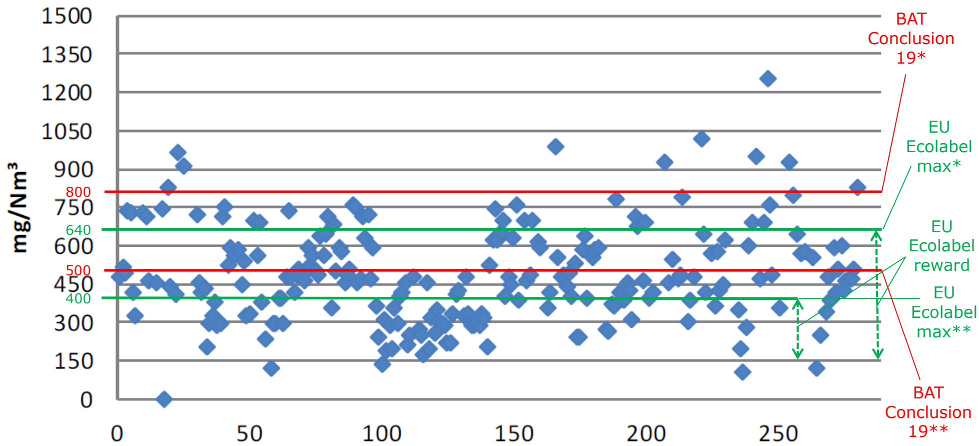


Figure 19. Comparison of EU Ecolabel and BAT ambition levels with 2015 industry data for NOx emissions (*denotes limits for Lepol kilns, long kilns and white cements, **denotes limits for all other kilns and normal cements).

The data for the NOx emissions is more complicated because the BAT Conclusions set two upper AELs, with a higher limit allowed for Lepol kilns and long rotary kilns (800 mg/Nm^3) and another limit for all other kilns (450 mg/Nm^3). Furthermore, a number of situations are described where it may be unrealistic to meet the 450 mg/Nm^3 limit even when using selective reduction (catalytic or non-catalytic) of NOx.

It is therefore proposed to mirror this distinction when considering EU Ecolabel criteria proposals. One example of a complicated situation for NOx <450 mg/Nm^3 is the production of white cement. Due to the potential importance of white cement to this EU Ecolabel product group, any EU Ecolabel criteria for white cement are proposed to be aligned with the less stringent level.

Clear conclusions cannot be drawn from the data in Figure 19 because it is unknown which points refer to Lepol kilns, long rotary kilns or white cement production and which do not. However, looking at the data as a whole, it is apparent that the initial proposal for an upper limit for EU Ecolabel NOx emissions is much more stringent than that for dust, despite the fact that both follow the same initial logic of applying to 80% of the BREF upper AEL. Approximately 41 of the kilns (ca. 16%) do not meet the higher limit proposed for EU Ecolabel. An additional 112 kilns or thereabouts (ca. 44%) do not meet the lower limit proposed for EU Ecolabel.

In total, according to the 2015 data, around 60% of the cement kilns operating in Europe would not be able to meet this singular proposed criterion for NOx. And of the 40% that would comply, it is unsure if they would meet the other requirements for dust and SO2, without considering the other criteria to come. Further discussion on the best approach to take with NOx ambition level will be necessary.

CEMBUREAU data for SO2 emissions in 2015

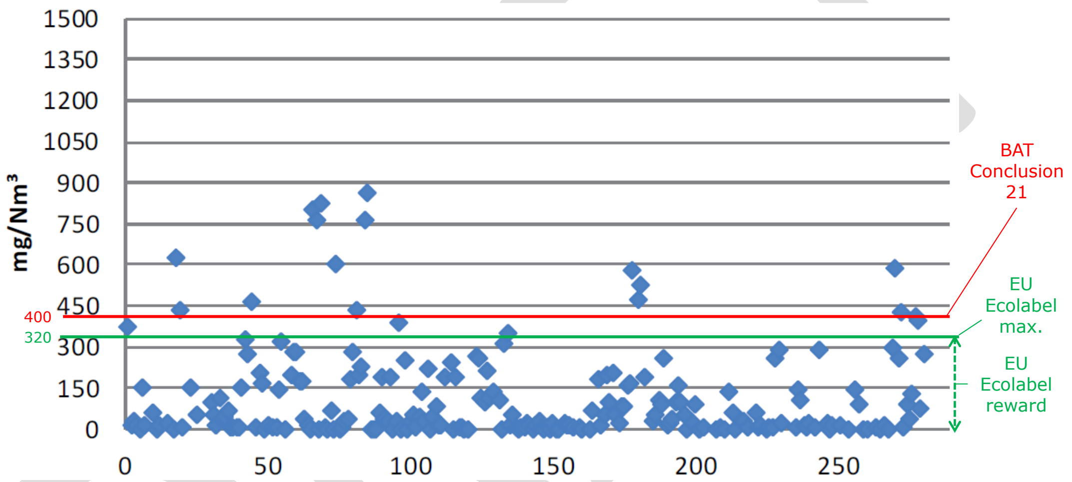


Figure 20. Comparison of EU Ecolabel and BAT ambition levels with 2015 industry data for SO2 emissions.

The data in Figure 20 show that all but 15 of the 250+ kilns covered (ca. 6%) exceeded the upper AEL for BAT Conclusion 17 in 2015 (400 mg/Nm^3). With the more stringent upper limit (320 mg/Nm^3) proposed for EU Ecolabel cement criteria, an additional 5 mills (ca. 2%) would have problems meeting the limit, at least based on this data presented from 2015.

Looking at the data, it is clear that there are many mills able to achieve very low SO2 emissions, which will most likely be due to the use of very low sulphur content fuels. While these kilns should be rewarded, it is worth mentioning that kilns with notable sulphur emissions may also have some merit of their own. In cases where sulphur emissions are due to burning of certain alternative fuels, sulphur emissions are simply transferred from either the landfill (where they would arise as sulphides) or waste incinerators (where an inorganic ash would be produced that requires disposal). Incinerating such waste in a cement kiln effectively prevents ash generation because any mineral content is incorporated into the clinker in one way or another.

The rise in use of alternative fuels will be discussed in more detail later in section 5.5.

Converting from mg/Nm³ into g/t clinker

In section 1.3.4 of the BAT Reference Document it is stated that typical kiln exhaust gas volume flow rates are in the range of 1700 to 2500 Nm^3/t clinker. Consequently, it is possible to approximately convert the values stated in the BAT Conclusions in mg/Nm^3 to g/t clinker as follows:

$$Measured\ emission\ (mg.Nm^{-3})\ x\ \frac{1700\ to\ 2500\ Nm^3}{1\ tonne\ clinker}\ x\ \frac{1g}{1000mg} = Specific\ emission\ (g.t^{-1}\ clinker)$$

Or, to simplify:

$$Measured\ emission\ (mg.Nm^{-3})x\ 1.7\ to\ 2.5 = Specific\ emission\ (g.t^{-1}\ clinker)$$

Although it is understood that each kiln will have its own specific air flow rate (typically ranging from 1.7 to 2.5), a single conversion factor of 2.3 has been used when converting the ambition levels derived from the BAT Conclusions into EU Ecolabel criteria. Now the proposed limits can be compared to the limits established in Decision 2009/607/EC.

Table 11. Comparison of existing limits and proposals for dust, NOx and SO2 emissions.

Parameter	Decision 2009/607/EC	Current proposal	% Difference
Dust	65 g/t	36.8 g/t clinker (i.e. 16 mg/Nm^3 x2.3)	-43.4%
NOx	900 g/t	920 or 1472 g/t clinker (i.e. 400 or 640 mg/Nm^3 x2.3)	+2.2% or +63.5%
SO2	350 g/t	736 g/t clinker (i.e. 320 mg/Nm^3 x2.3)	+110%

Before making any comparison, it must be pointed out the Decision 2009/607/EC is not clear about whether or not the emissions were intended to relate to one tonne of cement or one tonne of clinker.

This may be an important difference because one tonne of cement will always contain less than one tonne of clinker, sometimes this difference will only be a few percent and other times it may be more than 50% (see the discussion for "5.1 clinker factor" for more information on this topic).

Presuming that the limit values in Decision 2009/607/EC relate to per tonne of clinker, the comparison above shows that the new proposal is now considerably more ambitious for dust, similar for NOx but nuanced with a less ambitious level for certain situations, and much less ambitious for SO2.

Points for discussion about non-CO2 emissions to air from the cement kiln
Should this criterion be maintained at all? These emissions are controlled by the cement supplier, not the concrete producer who, in the end, will be the EU Ecolabel applicant. **Is information on dust, NOx and SO2 emissions readily communicated by cement companies to their customers?** **Opinions about the general approach (i.e. no points and units changed from mg/m2 concrete to kg/t cement clinker)?** **Opinions about ambition level for dust, for NOx and for SO2? (especially for NOx where biggest variation exists).**

5.3 – CO2 emissions from grey clinker/white cement production

Existing criterion:
No existing criterion on CO2 emissions.
Proposed criterion 5.3. Gross CO2 emissions from grey clinker/white cement production
Mandatory requirement In accordance with the methodology defined by the Getting the Numbers Right (GNR) initiative, the gross CO_2 emissions shall comply with the relevant limits defined below: • Grey cement: 900 kg CO2/t grey cement clinker. • White cement: 1100 kg CO2/t white cement. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate the following aspects: • Reduction of CO2 emissions from a grey cement kiln towards a best practice limit of 600 kg CO2/t grey cement clinker. • Reduction of CO2 emissions from a white cement kiln towards a best practice limit of 600 kg CO2/t white cement. ***Assessment and verification:*** *The applicant shall provide a declaration of compliance from their cement supplier(s) with the mandatory requirement of this criterion supported by a statement of the calculated gross CO2 emission in accordance with the latest GNR reporting methodology.*

Rationale:

The need to align with an existing calculation method

Emissions of CO2 are at the very top of the scientific and political agenda for climate change. The cement industry is commonly cited as being responsible for some 5-8% of global anthropogenic CO2 emissions. This has resulted in a variety of difference mandatory and voluntary policies being applied to the cement sector (and other energy intensive sectors) to manage CO2 emissions.

At one end of the spectrum is the mandatory reporting of CO2 emissions under the Emissions Trading Scheme (ETS), where only emissions from the site are included (i.e. not those from grid electricity). At the other end of the spectrum are the Product Category Rules that are defined for EPDs, where all sorts of variables that influence the final CO2 "footprint" of the product can be considered (e.g. assumptions about grid factors, assumptions about transport of raw materials etc.).

In terms of market coverage, the ETS calculations will cover essentially 100% of the EU cement market, while the coverage of EPD style calculations is less clear, although sectoral average EPDs have been published by CEMBUREAU for a representative CEM I, CEM II and CEM III type Portland cement.

With the EU Ecolabel, it is important not to invent yet another way to calculate CO2 emissions if possible. The approach to calculating gross CO2 emissions for the GNR database was considered to be suitable since around 90% of EU cement production capacity is already reporting to this database. One major advantage of the GNR database is that it does not include grid electricity, which would lead to further stakeholder debate about any assumptions about grid factors.

Whether or not CO2 emissions from onsite power generation should be included or not is a point that could potentially be debated when considering EU Ecolabel criteria. The GNR database has scope for reporting with or without onsite power generation included, but the publically available data is with onsite power generation excluded. In cases where CO2 emissions from grid electricity are not included, it would be difficult to justify any proposal to include CO2 emissions from onsite power generation since all that would be achieved is the penalization of any cement producer who produces part or all of their own electricity demand onsite.

Methodology of calculating gross CO2 emissions according to GNR reporting

Gross CO2 emissions consider CO2 from raw materials, from combustion of conventional fossil fuels, combustion of alternative fossil fuels and combustion of any fossil fraction of mixed alternative fuels.

It is presumed that emission factors for fuels shall be used in accordance with Annex VI to Commission Regulation (EC) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions.

However, the GNR calculation of gross CO2 emissions does not include the combustion of biomass or biogenic fractions of mixed fuels, the combustion of fuels for onsite power generation or the CO2 emissions associated with the production of any grid electricity that is consumed.

Data published from the GNR database

Data is publically available for gross CO2 emissions expressed as:

- kgCO_2/t grey clinker,
- kgCO_2/t white cement,
- kgCO_2/t grey and white cement equivalent, and
- kgCO_2/t cementitious.

Clinker refers to the product material exiting the kiln and is specified for grey clinker. The data for white cement presumably refers to the combination of white cement clinker with any additives and SCMs, although this still needs to be consulted further. The "cement equivalent" and the "cementitious" take into account the clinker factor of the site and, in the latter case, the production of any SCMs is included as well.

In order to focus on the actual clinker production process, and due to the fact that the influence of the clinker factor is already considered in criterion 5.1, it was decided that the best units would be per t cement clinker. Data specific for white cement was also compared to see if there is a significant difference that may require the setting of separate ambition levels.

The WBCSD publish a summary of key data and trends of CO2 emission data reported in a variety of different ways (e.g. by country, by geographical region, by kiln type, by cement type). The data available for gross CO2 emissions in the EU28 is provided below.

Table 12. Gross CO2 emissions in EU 28 reported in the public GNR database

YEAR	kgCO2/t grey cement clinker*	kgCO2/t white cement**
1990	**911**	**997**
2000	**881**	**993**
2005	**865**	**997**
2006	**863**	**947**
2007	**868**	**992**
2008	**863**	**938**
2009	**854**	**967**
2010	**856**	**1,001**
2011	**847**	**1,031**
2012	**841**	**1,103**
2013	**829**	**1,042**
2014	**829**	**1,061**
2015	**825**	**1,075**
2016	**821**	**1,071**

**Data from indicator "59cAG – Gross CO2 emission – Weighted average – excluding CO2 from on-site power generation - Grey clinker (kgCO2/t clinker)". **Data from indicator "59cAWcm – Gross CO2 emission – Weighted average – excluding CO2 from on-site power generation – White cement (kgCO2/t white cement)".*

The data in Table 12 show that weighted average gross CO2 emissions associated with grey cement clinker have gradually reduced during the last 30 years and appear to be relatively stable now around to 820-830kgCO2/t grey cement clinker.

<u>White cement specificities</u>

The data for white cement is significantly different, and actually shows a general increase in weighted average gross CO2 emissions since 2008. Compared to grey cement, white cement is a relatively niche market, with some 3 Mt of production (Saunders, 2014) in EU28 countries compared to 121 Mt of grey cement clinker (GNR, 2018). In fact, significant white cement production is only noted in Spain, Denmark, Portugal and Germany.

White cement can be considered as a value added product that is used when concrete with a high surface reflectivity is required. Although the production process for white cement is generally the same as that for grey cement, there are strict requirements on the iron content of raw materials (each 0.1% increase in iron oxide can reduce cement reflectivity by 2.5%). In order to minimize any potential oxidation of iron impurities, higher kiln temperatures and more rapid clinker cooling techniques tend to be used, which decrease the energy efficiency of the process and lead to higher specific CO2 emissions.

White cement is important for aesthetic purposes, especially in terrazzo tile facing layers, and also important due to potential indirect environmental benefits from higher albedo (more reflective) surfaces. Examples of these indirect environmental benefits could be due to lower interior or exterior lighting requirements for a fixed luminance level or a reduction in the urban heat island effect in warm climates.

For the aforementioned reasons, it is considered acceptable to set a separate ambition level for white cement in the EU Ecolabel criteria.

<u>Ambition level principles</u>

The mandatory minimum requirement has been arbitrarily set for a value that is slightly higher than the EU28 weighted average. It is strongly recommended to consult the individual data behind the weighted average before making any conclusive recommendation.

If the individual plant data were to be available, the basic logic would be to set a maximum limit for CO2 emissions that 75% of grey cement and 75% of white cement production can meet in the EU28 and then offer points for how much an individual plant may be below the maximum level, towards a best practice that 25% of grey cement and 25% of white cement production can meet in the EU28.

Currently we are working with weighted average data, which will be somewhere in between the top and bottom quartile. Consequently, the numbers proposed in the criterion should be considered as a starting point for discussion rather than concrete recommended values.

Points for discussion about gross CO2 emissions from cement production
Opinions about aligning with the GNR approach for "Gross emissions" which excludes onsite power generation? **Opinions about the distinction between grey cement clinker and white cement?** **Opinions about numbers proposed and/or general approach towards ambition level setting (for both grey clinker and white cement)?** **Why now GNR data for "white clinker"?** **Additional information about white cement production in the EU (e.g. number of plants, production volumes etc.).**

Alternative approach to CO2

During preliminary discussions with some representatives of the concrete industry, an alternative approach was proposed which would focus on the CO2 footprint of the concrete product rather than the cement used. There are advantages and disadvantages to this approach, which are briefly mentioned here.

The main advantage is that it is a more holistic approach and allows for situations where smaller quantities of a higher quality (but higher CO2 cement) could be used to make a concrete of acceptable performance.

The main disadvantage is that trying to fix any limit on embodied CO2 would need to be nuanced to the difference performance classes of concrete products that are included in the scope. For example, paving that is designed to withstand a higher load will have a higher cement content. Other issues that need to be considered with this approach would be the need to define how embodied CO2 emissions from the aggregates and cement are handled (would they all need EPDs?) and how issues such as electricity consumption at the concrete plant are addressed (i.e. what is the carbon intensity of the electricity supplied?).

So in general, the trade-off seems to be having a more relevant and holistic approach but at the expense of requiring greater data collection and setting of more rules in the EU Ecolabel criteria.

Points for discussion about alternative approach to CO2 emissions
Opinions about an approach to CO2 emissions of the final product instead of just the cement (which is the dominant source of CO2 emissions in concrete)?

5.4 – Cement kiln thermal efficiency

Existing criterion: 4.5 Cement

~~The use of raw materials for cement production shall be consistent with extraction management for processed products requirements (criterion 1.2).~~

~~Those producers who use cement in the production process shall comply with the following requirements:~~

— cement included in any product shall be produced using not more than 3 800 MJ/t of process energy requirement (PER), calculated as explained in the Technical appendix — A4,

~~— the cement included in any product shall be produced respecting the following air emission limits:~~

~~Parameter~~	~~Current limit (g/t)~~	~~Test methods~~
~~Dust~~	~~65~~	~~EN 13284-1~~
~~SO2~~	~~350~~	~~EN 14791~~
~~NO_x~~	~~900~~	~~EN 14792~~

Assessment and verification: the applicant shall provide the relevant test reports and documentation related to the PER and the air emissions deriving from the cement production.

A4 Energy consumption calculation (PER, ERF)

When providing a calculation of process energy requirement (PER) or energy requirement for firing (ERF), the correct energy carriers shall be taken into account for the entire plant or for the firing stage only. Gross calorific values (high heat value) of fuels shall be used to convert energy units to MJ (Table A1). In case of use of other fuels, the calorific value used for the calculation shall be mentioned. Electricity means net imported electricity coming from the grid and internal generation of electricity measured as electric power.

~~*Evaluation of PER for agglomerated stone production shall consider all energy flows entering the production plant both as fuels and electricity.*~~

~~*Evaluation of PER for terrazzo tiles production must consider all energy flows entering the production plant both as fuels and electricity.*~~

~~*Evaluation of ERF for ceramic tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of ERF for clay tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

Evaluation of PER for cement production shall consider all energy flows entering the production system both as fuels and electricity.

Table A1

Table for calculation of PER or ERF (see text for explanations)

Production period	Days	From	To	
Production (kg)				
Fuel	Quantity	Units	Conversion factor	Energy (MJ)
Natural gas		kg	54,1	
Natural gas		Nm^3	38,8	
Butane		kg	49,3	
Kerosene		kg	46,5	
Gasoline		kg	52,7	
Diesel		kg	44,6	
Gas oil		kg	45,2	
Heavy fuel oil		kg	42,7	
Dry steam coal		kg	30,6	
Anthracite		kg	29,7	
Charcoal		kg	33,7	
Industrial coke		kg	27,9	
Electricity (from net)		kg	3,6	
			Total energy	
Specific energy consumption (MJ/kg of product)				

Proposal for criterion 5.4
Mandatory requirement Specific thermal energy consumption of the cement kiln (excluding fuel drying) shall be: • ≤ 3800 MJ/t grey cement clinker or • ≤ 6000 MJ/t white cement ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the mandatory requirement for specific kiln thermal efficiency and shall calculate all inputs of fuel to the kiln system (including the main kiln burner and any auxiliary burners, for example in the precalciner). The total thermal energy of the fuel input (in MJ) shall be calculated by multiplying the mass of fuel consumed in a defined production period (in kg, t, L or Nm3) by a specific or generic calorific value for the same fuel (in MJ/kg, t, L or Nm3).* *The specific thermal energy consumption (MJ/t) shall be determined by dividing the total fuel input (MJ) by the total clinker output (in kg or t) during the same production period.* *For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.*

Points for discussion
Opinions about correcting the approach to kiln thermal efficiency per clinker output? **How relevant is this criterion to the cement producer? Are the main impacts already addressed by CO2 emissions and the clinker factor?** **Opinions on ambition level and justification, based on GNR data about a separate approach for white cement?** **Is the accounting method for estimating specific thermal energy consumption appropriate?** **Is non-continuous clinker production a common occurrence in Europe today?**

Rationale and discussion:

Existing criterion in Decision 2009/607/EC

A single pass or fail requirement for 3800 MJ/t is stated in Decision 2009/607/EC. It is presumed that this value refers to per tonne of cement production. According to technical annex A4 of the existing criteria, the limit value should consider both fuel and electricity consumption. This means that it would be necessary to convert any consumed electricity from kWh into MJ although no standard conversion factor is mentioned.

It appears that the value stated has been chosen based on "cement kiln thermal efficiency" but that the scope includes other factors apart from kiln energy consumption (e.g. electricity for raw meal milling and final grinding to blend clinker with gypsum and other supplementary cementitious materials).

Consequently it is proposed that the criterion is adjusted to be more specific to the thermal efficiency of the kiln, which is well understood and specifically reported in the public GNR database as a function of kiln technology.

Why focus on thermal energy consumption in the proposal and not electricity?

When considering general energy consumption indicators for Portland cement production, a general comparison from the following two sources serves to highlight the relative importance of thermal and electrical energy consumption:

- GNR database, 2016: Thermal energy = 3677 MJ/t grey clinker (reported under code 25aAG); Electrical power = 117 kWh/t cement (reported under code 33AGW).
- IEA, 2018: Thermal energy = 3500 MJ/t clinker; Electrical power consumption = 91 kWh/t cement.

If the kWh are converted into MJ (1 kWh = 3.6 MJ) then it shows that the total energy consumption for cement production is split into 8-10% electricity and 90-92% thermal energy. Consequently, thermal energy consumption is the dominant area to focus on.

Data available from "Getting the Numbers Right" (GNR) database

As mentioned previously, the GNR database can be considered as highly relevant for the European cement sector due to the fact that 90% of cement production capacity is reporting to the database.

To give a broader context, data for weighted average specific thermal energy consumption is included for different geographical regions and the EU28 data highlighted in red. For comparison, data for white cement production (data only available from Europe) is also included.

Table 13. Specific thermal energy consumption of grey clinker/white cement production.

Region	Specific thermal energy consumption excl. fuel drying (MJ/t grey clinker, GNR code 25aAG)				
	1990	2000	2010	2015	2016
Africa	4,612	4,056	3,740	3,776	3,743
Asia (n.e.c.) + Oceania	3,811	3,415	3,349	3,380	3,395
Brazil	4,214	3,413	3,675	3,553	3,560
Central America	3,933	3,700	3,588	3,646	3,627
China + Korea + Japan	3,476	3,444	3,397	3,310	3,206
CIS	6,470	6,223	5,799	4,362	4,079
Europe	4,056	3,726	3,700	3,678	3,677
India	3,907	3,145	3,130	3,058	3,086
Middle East	3,973	3,453	3,366	3,384	3,382
North America	4,944	4,591	3,888	3,817	3,894
South America ex. Brazil	4,308	3,933	3,893	3,701	3,599
Region	**Specific thermal energy consumption excl. fuel drying (MJ/t white cement, GNR code 25AaWK)**				
	1990	**2000**	**2010**	**2015**	**2016**
Europe	6,163	6,160	6,084	6,326	6,352

With regards to grey clinker production, weighted average values range from around 3100 to 4000 in different regions, a range of almost 30%. The lower values as associated with data reported from India, Asia and the Middle East, where only a small fraction of the industry is reporting and where most production plants are newer and larger due to the recent and rapid economic developments in the construction sector in those regions. North America and the CIS report have the lowest weighted average thermal efficiencies, which will no doubt be due to many of the kilns being much older.

With rotary kiln technology in general, there is a maximum thermal efficiency that can be achieved. This could equate to around 2900 MJ/t clinker in ideal scenarios which are not very practical in real day to day operation.

Older kilns can be upgraded or retrofitted but the improvements possible depend on the process set-up, which in turn depends on the nature of the raw materials used (especially their moisture contents). As a general rule, the wetter the feed material becomes, the higher the specific thermal energy consumption in the kiln.

Table 14. Specific thermal energy consumption of grey clinker production in EU 28 by kiln technology.

PI_KILN	MJ / t grey clinker (GNR code 25aAGK)					
	1990	2000	2005	2010	2015	2016
DRY WITH PREHEATER AND PRECALCINER	3,705	3,516	3,500	3,576	3,541	3,528
DRY WITH PREHEATER WITHOUT PRECALCINER	3,837	3,591	3,619	3,709	3,664	3,754
DRY WITHOUT PREHEATER (LONG DRY KILN)	3,871	3,936	3,770	3,641	3,831	3,389
SEMI-WET/SEMI DRY	3,999	3,745	3,782	3,829	4,176	3,954
WET / SHAFT KILN	5,810	5,330	5,267	5,044	5,505	5,589

In 2016, the kilns reporting the GNR database provide a good estimate of the distribution of kiln technologies in Europe due to the fact that 90% of production capacity is covered. The split of kiln technologies for grey cement production is: 47% dry with preheater and precalciner; 35% dry with preheater but no precalciner; 4% dry without preheater; 4% mixed kiln type; 8% semi-dry/semi-wet kiln type and 2% wet type kilns. It is not clear what the kiln technology split is for white cement production but it is probably linked to semi-wet or wet type processes due to the very high specific thermal energy values reported in Table 13.

The data in Table 14 implies that, both in 2010 and in 2016, a figure of 3800 MJ/t grey cement clinker would have been a useful reference figure to distinguish between wet-type kilns and dry-type kilns. It is for this reason that the criterion established in Decision 2009/607/EC was most likely based on this approach. However, it must be remembered that when comparing the proposal to keep the same number for kiln thermal efficiency, the proposal refers to clinker production and thermal energy consumption, while the existing limit in Decision 2009/607/EC refers to cement production and thermal energy + electricity consumption.

The thermal efficiency of grey cement clinker production of 3800 MJ/t clinker still seems like a reasonable value to employ as a minimum mandatory requirement, but the GNR data make it clear that a separate ambition level is necessary if the intention is to permit concrete products with white cement to be EU Ecolabelled.

5.5 – Recycled and secondary materials at the concrete plant

Existing criterion:

No existing criterion

Proposal for criterion 5.5

Mandatory requirements

The applicant shall assess and document the regional availability of recycled or secondary aggregates, including fillers.

The applicant shall have procedures in place for the recovery of aggregates from batches of returned or rejected concrete batches.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the incorporation of recycled/secondary materials into the concrete product up to 50% w/w content (Up to 25 points).

The incorporation of returned or rejected concrete into new concrete shall not be considered as recycled content if it is going back into the same process that generated it.

Assessment and verification:
The applicant shall provide a declaration of compliance with the mandatory requirements of the criteria, supported by a copy of their company policy for the identification of potential sources of secondary or recycled materials for use as aggregates, fillers or supplementary cementitious materials.
An inventory of all sold or stored concrete production, existing raw materials in stock and raw material deliveries to the concrete plant shall be provided, supported by production reports and delivery invoices for a defined production period.
In cases of concrete plants that only produce one type of concrete product and to only one specification, the results should be averaged across the entire production. Where the EU Ecolabel concrete products are produced in specific batches, any secondary or recycled materials should be allocated according to batch mix compositions used.
Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. recycled/secondary material content of 0% = 0 points and 50% = 25 points).

Points for discussion about recycled and secondary materials in the concrete plant
Opinions about this approach?   **In cases were recycled/secondary materials are not locally available, the criteria could also promote "responsibly sourced" virgin materials. Opinions on that? How best to define?**

Rationale and discussion:

The mandatory requirements are largely inspired by criterion E7 Secondary Materials that is defined in version 1.0 of the Concrete Sustainability Council's (CSCs) technical manual.

What is meant exactly by "recycled material"?

The ISO 14021 definition of the term "recycled content" and related terms are as follows:

- ***Recycled content***: *Proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content, consistent with the following usage of terms.*
- ***Pre-consumer material***: *Material diverted from the waste stream during a manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.*
- ***Post-consumer material***: *Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.*
- ***Recycled material***: *Material that has been reprocessed from recovered [reclaimed] material by means of a manufacturing process and made into a final product or into a component for incorporation into a product.*
- ***Recovered [reclaimed] material***: *Material that would have otherwise been disposed of as waste or used for energy recovery, but has instead been collected and recovered [reclaimed] as a material input, in lieu of new primary material, for a recycling or a manufacturing process.*

So unless the concrete has previously been transferred to other actors in the distribution chain, it cannot be considered as recycled content when it comes back to the concrete factory. Especially in the case of fresh concrete returns or reject batches, this would normally be considered as being a waste of the production process.

What is meant by "secondary material"?

The ISO 14021 definition for recycled content and recycled material does seem to cover materials such as blast furnace slag, silica fume and coal fly ash. However, it is possible that they may be considered as industrial by-products rather than waste, which would complicate their recognition as recycled materials.

Consequently, the term "*secondary material*" has also been used in order to avoid any confusion about whether these commonly used materials should be counted as contributing to points in the EU Ecolabel criteria. Potential confusion may stem from Article 5 of the Waste Framework Directive (2008/98/EC) when a "*waste*" is no longer considered as a waste but instead as a "*by-product*" when:

- *Further use of the substance or object is certain;*
- *The substance or object can be used directly without any further processing other than normal industrial practice;*
- *The substance or object is produced as an integral part of a production process; and*
- *Further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.*

Considering recycled and secondary aggregates from an LCA and LCC perspective

When assessing the environmental impacts of concrete production from an LCA perspective, aggregates are a relatively minor contribution to most impacts. It has also been argued that the normal abiotic depletion LCA impact category is not suitable for considering the impacts of aggregate use because, when global resources are considered, the impact is negligible because sand and gravel reserves are vast.

Furthermore, due to the high bulk mass and low value, transport costs for aggregates are highly significant (truck haul for 30 miles can double to cost of the aggregate to the end user, Robinson and Brown, (2002)) and aggregates do not tend to travel far unless rail or barge transport links are convenient. Consequently, it would be much more relevant to consider abiotic depletion potential at the regional level (Habert et al., 2010), where the impacts would undoubtedly be far more significant.

The benefits of using recycled aggregates is greatly increased if consequential impacts of reduced land use impact (via avoided landfill and reduced quarrying) (Blengini and Garbarino, 2010) and reduced transport emissions (via the preservation of natural aggregate resources at the regional level). Another important aspect is that, especially in developed areas, recycled aggregates tend to be available in the local environments where construction activities are taking place and may even be reincorporated into the same project where demolition activity precedes new construction on the same site.

In cases where recycled aggregates are available, but require longer transport distances than natural aggregates, there is a trade-off in environmental impacts. Blengini and Garbarino (2010) estimated that the use of recycled aggregates (when compared to natural aggregates) can remain environmentally beneficial up until the point when the transport distance for recycled aggregates becomes 2-3 times longer than for natural aggregates.

EU policy promoting recycled content and secondary aggregates and fillers

Two of the main types of recycled aggregate that is relevant to concrete production is recycled concrete aggregate (RCA) and crushed brick waste, which is produced by processing waste concrete from construction and demolition waste (CDW). As one of the most voluminous waste streams in the EU, accounting for some 25-30% of all EU waste, the Waste Framework Directive (WFD) has identified the recycling of CDW as a priority area. Specifically under Article 11(2) of the WFD, Member States are required to achieve a minimum of 70% of non-hazardous CDW recycling by 2020.

Although backfilling is permitted to count towards the 70% target, higher value recycling applications possible, such as use in non-structural or structural concrete. Data reported back in 2011 revealed that there was considerable scope to improve the handling of CDW by moving away from backfilling and towards recycling.

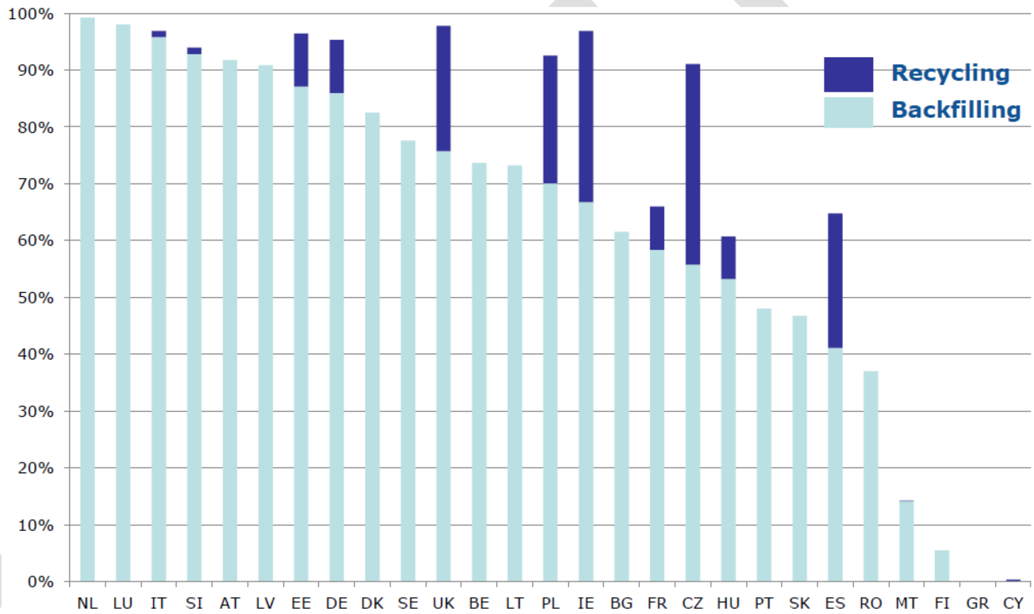


Figure 21. CDW backfilling and recycling in 2011 (Source: DG ENV).

Based on the data above, it is clear that only a handful of Member States were implementing CDW recycling in 2011. The leading Member States in CDW were clearly Ireland, the UK, Spain and Poland. The Commission has since published an EU CDW protocol (EC, 2016) and guidelines (EC, 2018) to encourage better uptake of CDW recycling and increase awareness of higher value reuse and recycling opportunities compared to simple backfilling.

There is a lack of harmonised approach to the regulation of CDW in Member States, which in turn leads to a wide range in performance. It is generally understood that CDW does not travel far, since it the materials are generally bulky and of low value. Selective demolition of gypsum plasterboard is one sensible approach due to the higher added value of gypsum and the fact that the sulphate present in gypsum is undesirable in any waste that would be sent to landfill (possible anaerobic biodegradation to sulphide gases) or in recycled aggregates used in concrete (as it could adversely affect the Portland cement hydration chemistry).

A large volume of research has been published regarding the use of recycled aggregates in concrete products. Structural engineers are reluctant to use recycled aggregates in structural concrete due to concerns about consistency of properties, especially the fact that recycled aggregates tend to be weaker than natural ones and that they will show a higher, and variable water absorption. As Poon et al., (2002) explain, the concerns about recycled aggregate in structural concrete do not extend to mechanically moulded concrete bricks and blocks. The authors demonstrated that up to 100% of the natural aggregate could be replaced by recycled aggregate of a suitable size distribution with only a minor decrease in compressive strength, a minor reduction in density, a minor increase in drying shrinkage and a notable increase in skid resistance. With both masonry unit bricks and paving blocks, a 50% replacement of natural aggregates by recycled aggregates improved all physical properties.

5.6 – Concrete plant process energy consumption

Existing criterion: 4.1 (a) Process energy requirement (PER) limit

The process energy requirement (PER) for agglomerated stones and terrazzo tiles manufacturing processes shall not exceed the following levels:

	Requirement (MJ/kg)	Test method
~~Agglomerated stones~~	~~1,6~~	~~Appendix A4~~
Terrazzo tiles	1,3	Appendix A14

Note: all the requirements are expressed in MJ per kg of final product ready to be sold. This criterion does not apply to concrete paving units.

Assessment and verification: the applicant shall calculate the PER according to the Technical appendix — A4 instructions and provide the related results and supporting documentation.

A4 Energy consumption calculation (PER, ERF)

When providing a calculation of process energy requirement (PER) or energy requirement for firing (ERF), the correct energy carriers shall be taken into account for the entire plant or for the firing stage only. Gross calorific values (high heat value) of fuels shall be used to convert energy units to MJ (Table A1). In case of use of other fuels, the calorific value used for the calculation shall be mentioned. Electricity means net imported electricity coming from the grid and internal generation of electricity measured as electric power.

~~*Evaluation of PER for agglomerated stone production shall consider all energy flows entering the production plant both as fuels and electricity.*~~

Evaluation of PER for terrazzo tiles production must consider all energy flows entering the production plant both as fuels and electricity.

~~*Evaluation of ERF for ceramic tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of ERF for clay tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of PER for cement production shall consider all energy flows entering the production system both as fuels and electricity.*~~

Table A1

Table for calculation of PER or ERF (see text for explanations)

Production period	Days	From	To	
Production (kg)				
Fuel	Quantity	Units	Conversion factor	Energy (MJ)
Natural gas		kg	54,1	
Natural gas		Nm^3	38,8	
Butane		kg	49,3	
Kerosene		kg	46,5	
Gasoline		kg	52,7	

Diesel		*kg*	*44,6*	
Gas oil		*kg*	*45,2*	
Heavy fuel oil		*kg*	*42,7*	
Dry steam coal		*kg*	*30,6*	
Anthracite		*kg*	*29,7*	
Charcoal		*kg*	*33,7*	
Industrial coke		*kg*	*27,9*	
Electricity (from net)		*kg*	*3,6*	
			Total energy	
Specific energy consumption (MJ/kg of product)				

Proposal for criterion 5.6: Concrete plant energy management

Mandatory requirements

The applicant shall assess and document the electricity consumption (kWh) and fuel consumption (L diesel, m3 natural gas etc.) of the concrete process plant equipment (including forklifts and trucks used for onsite transport) for the full calendar year or rolling 12 period.

The total concrete production during the same 12 month period shall be expressed in terms of m^3.

Both the specific electricity consumption (MJ/m^3 concrete) and specific fuel consumption (MJ/m^3 concrete) shall be reported. Conversion of kWh to MJ shall be carried out by multiplying the kWh value by 3.6 MJ/kWh.

EU Ecolabel points

Points shall be awarded to applicants that have installed onsite CHP units that can meet up to a maximum of 50% of the process electricity (up to 10 points).

Points shall be awarded to applicants that can demonstrate that the electricity used in the concrete plant is from renewable sources up to a maximum of 90% (up to 15 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of the criterion, supported by calculations of electricity and fuel consumption, as well as production capacity during the same 12 month period.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. CHP electricity 0% of process electricity = 0 points; CHP electricity 50% of process electricity = 10 points; renewable energy share of 0% = 0 points; renewable energy share of 90% = 15 points).

Points for discussion
Opinions about this approach?

Rationale and discussion:

Why focus on energy consumption at the concrete plant?

Although the energy footprint of concrete is dominated by cement manufacture, it is necessary that the EU Ecolabel criteria focus on some aspects that can be directly controlled by the potential EU Ecolabel applicant, i.e. the pre-case or dry-cast concrete producer.

The type of information that is requested as part of the mandatory requirements fits well with what would be expected of an energy management system or the energy part of a broader environmental management system.

Why promote onsite CHP?

The installation of onsite CHP brings clear environmental benefits for any industry where the waste heat from the CHP unit can be beneficially reused. As a general rule of thumb, grid electricity can be considered to represent no more than a 40% efficient conversion of primary energy into useful energy (i.e. electricity) due to losses of heat and transmission losses across the grid. However, CHP can generally be considered as an 80% efficient conversion of primary energy into useful energy (i.e. electricity plus heat) because the demand for the heat is located next to the CHP unit.

The potential for CHP is maximised when heat demand exceeds electricity demand onsite by at least a factor of 2. Some typical process operating data for concrete production plants by Marceau et al., (2007) is presented below.

Table 15. Example of specific energy inputs in pre-cast concrete production (Marceau et al., 2007)

Concrete Masonry Unit production		
Energy carrier	**Used for**	**Quantity (KJ/100 units)**
No 1, 2 and 4 diesel	Light trucks e.g. fork lift, loaders etc.	79,310 (24.4%)
Natural gas	Kiln and industrial boiler: for steam and vapour	201,890 (62.2%)
Electricity	Throughout plant	43,270 (13.3%)
Precast concrete		
Energy carrier	**Used for**	**Quantity (kJ/m3)**
Gasoline	Light trucks e.g. fork lift, loaders etc.	32,470 (4.0%)
No 1, 2 and 4 diesel	Light trucks e.g. fork lift, loaders etc.	92,550 (11.3%)
No 1, 2 and 4 fuel oil	Light trucks e.g. fork lift, loaders etc. Industrial boiler for steam curing.	139,790 (17.1%) 8,920 (1.1%)
Kerosene	Portable building heater.	750 (0.09%)
Natural gas	Industrial boiler for steam curing. Building heating.	297,340 (36.3%) 52,470 (6.4%)
LPG	Industrial boiler for steam curing. Various manufacturing equipment.	52,100 (6.4%) 5,790 (0.7%)
Electricity	Throughout plant	137,110 (16.7%)

The data in Table 15 confirms that onsite CHP units would be beneficial for both concrete masonry unit production and pre-cast concrete product where the heat to electricity ratios are around 4.7 and 3.0 respectively. For onsite CHP to be useful, the heat to electricity ratio should be higher than 2 but not excessively high.

Why promote higher renewable energy?

The Renewable Energy Directive has recently been recast and sets a target of an average renewable energy share of 27% by 2030. A criterion on renewable energy fits well with onsite CHP in the sense that the applicant has a much better control over the fuel choice they use and can led to win-win situations in terms of EU Ecolabel points.

5.7 – Photocatalytic surfaces

Existing criterion:

No existing criterion

Proposal for criterion 5.7: Photocatalytic surfaces

EU Ecolabel

Points shall be awarded for concrete tiles and flags, including terrazzo tiles, with a NOx reduction of up to 40% during active periods (up to 10 points).

Assessment and verification:

The applicant shall provide a declaration stating whether or not this criterion is relevant to their product(s) that will apply for the EU Ecolabel.

In cases where this criterion is relevant, the applicant shall provide test reports according to ISO 22197-1 or equivalent methods.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (i.e. NOx reduction of 0% = 0 points and NOx reduction of 40% = 10 points).

Points for discussion about photocatalytic concrete tiles, flags and paving units.

Opinions about this approach?

How significant are the costs of TiO2 or other photocatalytic additives to the total concrete production cost?

Previous experience with photocatalytic paving?

Rationale and discussion:

Why promote photocatalytic paving blocks?

Emissions of air pollutants is considered as arguably the most significant cause of premature death in the EU and contributes to major healthcare costs and lost productivity associated with respiratory diseases (EC, 2013). Air pollution is a major issue in many European cities due to emissions from vehicles that are powered by internal combustion engines. Apart from CO_2, the emissions of concern are mainly nitrogen oxides (NOx), hydrocarbons (VOCs) and carbon monoxide. The potential of NOx to interact with other air pollutants to form particulate matter, ozone and other oxidants led the WHO to set guideline values for NO_2 of 200µg/m^3 for 1 hour exposure and 40µg/m^3 for annual average exposure (WHO, 2003). The EU Ambient Air Quality Directive (2008/50/EC) adopted the same limits as recommended by WHO with the additional detail that the one hour limit should not be exceeded for more than 18 hours in any one year. and that special measures must be taken if an alert limit is triggered (3 consecutive hours of NO2 concentrations exceeding 400µg/m^3).

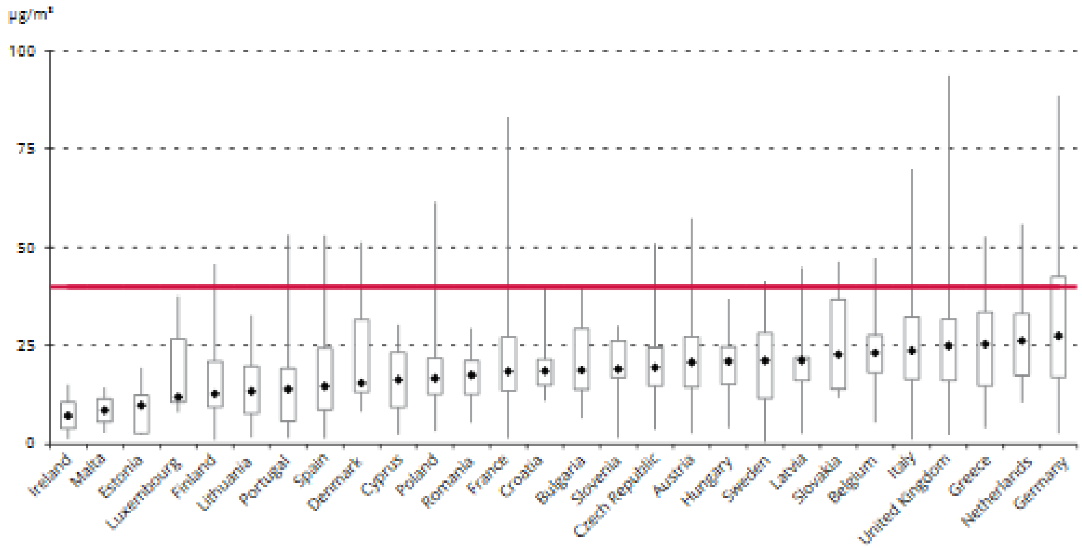


Figure 22. Annual average NO2 values at Member State level: lowest value = bottom of line; highest value = top of line; 25th and 75th percentiles = bottom and top of rectangles: overall mean = black point and red line is WHO guideline for annual average (EEA, 2016).

The EEA reported that 12% of all stations in the EU28 reported values that exceeded the 40µg/m3 annual average limit. Of those stations exceeding the limit, 94% were classified as "traffic stations", highlighting the fact vehicular emissions are a major source of NO2 pollution in Europe.

The EEA also compiled data at the national level as shown above in Figure 22, which show that Germany has the most severe problem with NO2 levels in ambient air but that around half of all Member States had some stations that were above the WHO recommended annual average limits for human health.

Policy efforts to reduce NO2 levels have correctly focussed on the source of the problem, i.e. vehicular emissions. However, even with improvements in emissions of individual vehicles, NO2 levels can increase due to increasing volumes of traffic and increasing traffic congestion in urban areas resulting in engines running longer for a journey of a fixed distance.

One interesting possibility to tackle NO2 pollution is the incorporation of photocatalytic surfaces onto road paving. Such surfaces contain TiO2 particles which, in combination with UV radiation from the sun and the presence of moisture, can generate free radicals that will breakdown common air pollutants such as NOx and VOCs.

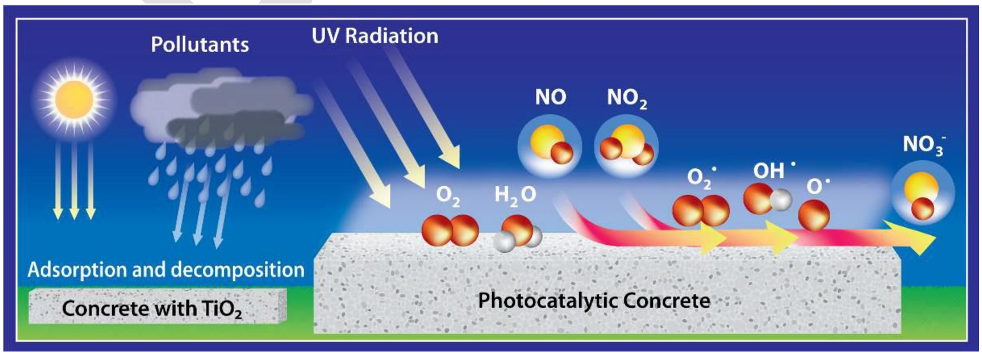


Figure 23. Schematic representation of the photocatalytic breakdown of NO and NO_2 to water soluble NO_3^- (Boonen and Beelders, 2014).

The photocatalytic activity of treated surface can be tested under standard conditions according to ISO 22197-1:2016 where gas of a controlled NOx concentration is passed over a defined surface area subject to a controlled level of UV radiation at a controlled velocity and the NOx concentration of the outlet air measured.

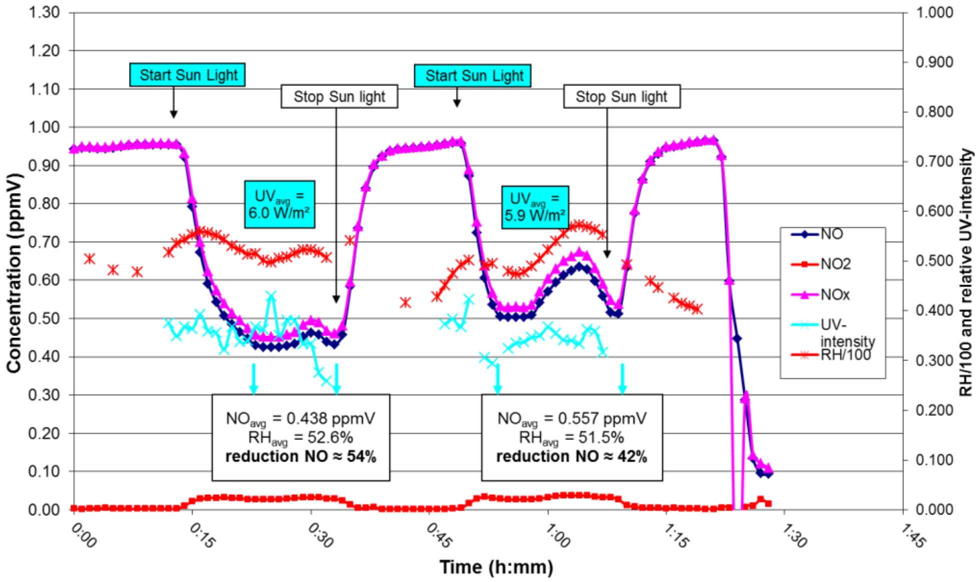


Figure 24. Real measured data of tested photocatalytic concrete pavers (Boonen and Beeldens, 2014).

In the example laboratory data provided above, average NOx reductions of 42% and 54% are achieved. Whether or not these results are translated into real life situations is much more difficult to predict because of the many complex variables that can influence performance (e.g. relative humidity, dust build-up, UV intensity, air velocity, traffic volume and active surface area to airflow ratios). Initial experience suggests that dual-layered concrete, with a 50mm active top layer is much more durable in its photocatalytic function than any surfaces that are simply coated.

5.8 – Permeable pavements

Existing criterion:
No existing criterion
Proposal for criterion 5.8
<u>EU Ecolabel points</u> Points shall be awarded for concrete tiles and flags which are designed to have: • a void area of more than 5%, or • where installation guides are provided using different types of joint filling aggregates, at least one of which demonstrate standard infiltration rates of at ≥ 400 mm/hour. ***<u>Assessment and verification:</u>*** *The applicant shall provide a declaration stating whether or not this criterion is relevant to their product(s) that will apply for the EU Ecolabel.* *In cases where this criterion is relevant, the applicant shall provide test reports according to BS 7533-*

13, BS DD 229:1996 or similar standards. *A maximum (single or combined) total of 10 points shall be awarded in proportion to how closely the data reaches the maximum benchmarks set:* • *i.e. void area 0% = 0 points and a void area of 5% = 10 points or,* • *i..e 400 mm/hr = 0 points and 2000 mm/h =10 points.*

Points for discussion
Opinions about this approach? **Any appropriate standard methods for assessing infiltration rates in the laboratory?** **Any industry experience to share on this subject?**

Rationale and discussion:

Permeable paving blocks

Paved surfaces are beneficial in the sense that they provide flat and solid surfaces that are designed to drain well and which facilitate the continued optimum movement of pedestrians and vehicles. The classical design of paving systems is to be impermeable to water and to be sloped in order to quickly divert rainwater to drainage systems. As urbanisation has increased so too has the extent of impermeable paving. During a storm event in any particular river catchment, water that hits an impermeable area is rapidly conveyed via the drainage system to the river whereas storm water hitting a greenfield site infiltrates into the ground and only once the ground is saturated, it would flow across the vegetated surface towards the river or be trapped in natural depressions in the surface topography. The result is that, for a given storm event, there is a higher and more concentrated peak flow in watercourses fed by impermeable areas compared to those fed by greenfield areas.

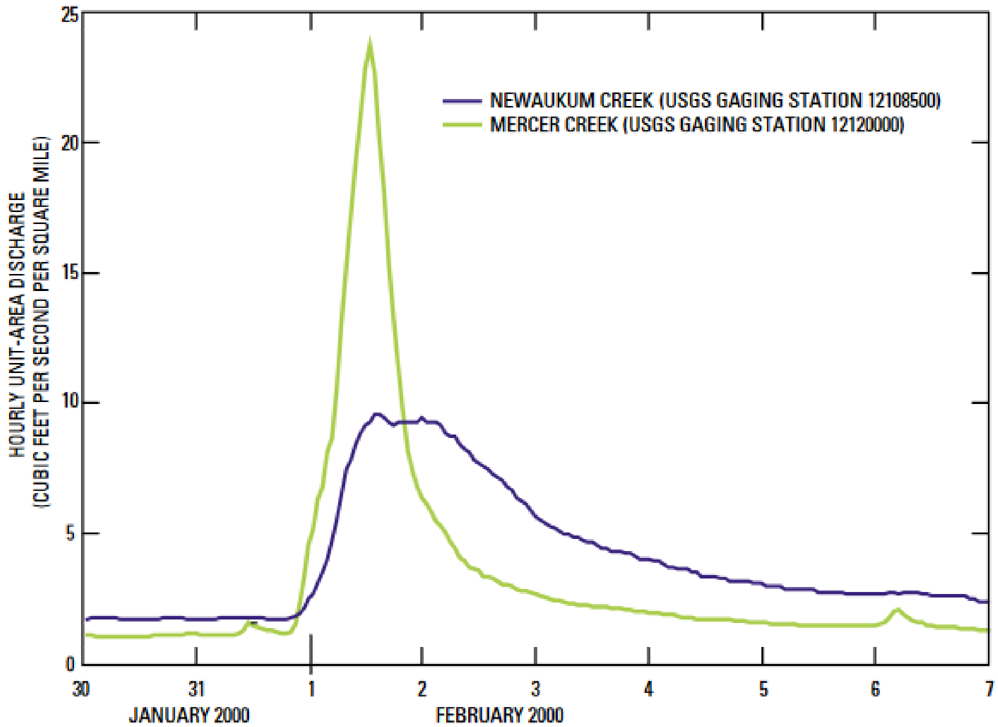


Figure 25. Specific runoff rates in an urban stream (green) and a rural stream (purple) that are located in the same area (Konrad, 2003).

Even though the rainfall event on the 1st February was essentially the same for both stream catchments, the urban stream shows a much higher (x2.5) peak runoff rate. Furthermore, almost all of the storm runoff has passed to the stream within one day whereas this process takes more than 5 days in the rural stream. The two runoff behaviours indicate that watercourses in urban areas are much more susceptible to the phenomenon of flash flooding simply due to the increase in speed with which stormwater reaches the watercourse.

Impermeable pavements play an important role in the rapid conveyance of stormwater to watercourses. To design and construct paved areas that deliver more gradual runoff in a similar (or better) manner when compared to a greenfield site, permeable paving is one of a number of options possible, all of which fall under the concept of sustainable (urban) drainage systems (SUDS for short).

Apart from elevated risks of flash flooding, impermeable paving reduces the possibility of recharging of groundwater aquifers. Permeable pavements can be designed for full, partial or zero infiltration, depending on what is most appropriate for the local area, by adjusting the broader paving system design and underlying base layers that are installed. Focusing purely on the top paving layer, there are two broad types of permeable paving:

i. impermeable blocks with larger joints that are to be filled with high void content aggregate, and

ii. concrete blocks that are permeable on the surface of the block itself (i.e. pervious concrete).

With the first option, in order to ensure the permeability of the filled joints, it is necessary to fill joints with aggregates with a very low fines content, to ensure that voids between coarse aggregates are not filled by small aggregates.

With the second option, for pervious concrete, it is also important to restrict the fines content in aggregates as well as the cement content. Ranges of mix compositions (aggregate, cement and water) that have been used in academic research have been summarised by Chandrappa and Biligiri, (2016). With correct compositional control, pervious concrete with an interconnected void content of 15-35% can be produced (Kia et al., 2017).

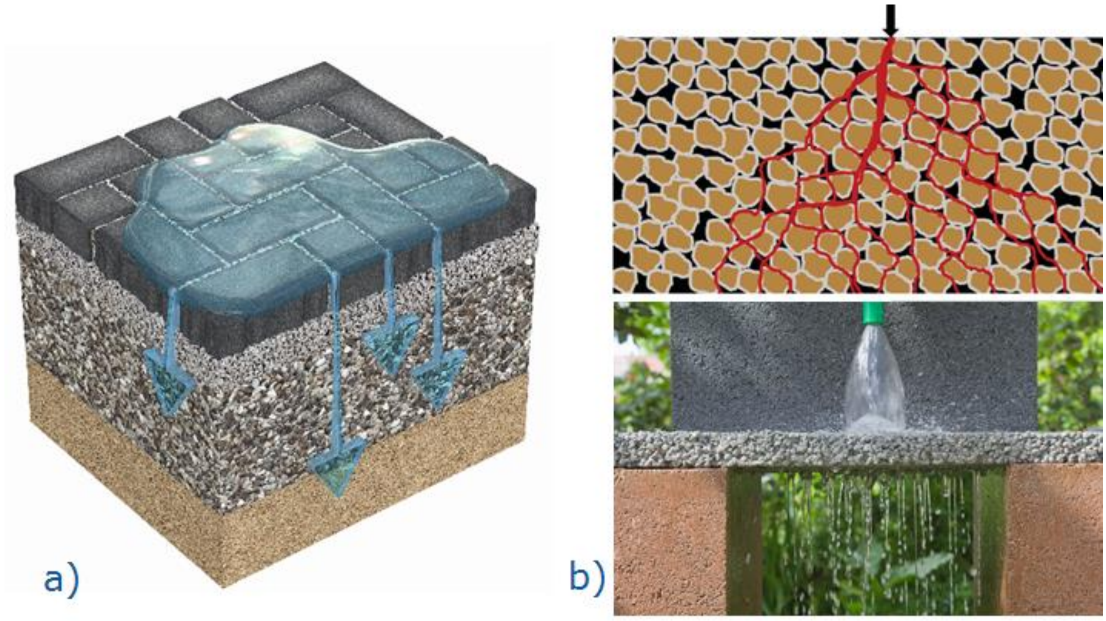


Figure 26. Drainage mechanisms in a) paving with permeable joints and b) pervious concrete blocks (Source of image a) Marshalls, image b) Kia et al., 2017).

It is worth noting that permeable paving is recognised by a number of green building assessment schemes. Points can be awarded under credit 6 (Stormwater Management) of LEED for reducing the runoff rate by at least 25% (credit 6.1) and removing at least 80% of total suspended solids and 40% of total phosphorus (credit 6.2). The BREEAM scheme has a requirement related to surface runoff rates (Pol. 03), HQE rewards building plot designs with fewer impermeable areas (criterion 5.2.1) and that limit rainwater discharge into combined sewers (criterion 5.3.3).

If claims for permeable paving are to be recognised, it is important to consider exactly how the claims should be assessed and verified. Although results will also depend on the correct specification of joint filler and underlying base materials, one simple and reproducible test is to measure the infiltration rate of water (in mm/h) under standard conditions. It is unclear if there is a harmonised European standard for this type of test but one example used in the UK is BS DD 229:1996 (Method for determination of the relative hydraulic conductivity of permeable surfacings). With impermeable pavers that are interlocked with permeable joints and spacings, a simple specification would be to specify the permeable area as a fraction of the total area.

8 Concluding remarks

The first draft proposals for the revision of the EU Ecolabel criteria for hard coverings, as set out in Decision 2009/607/EC, has been presented.

Following a review of the production technologies involved, a number of the existing criterion have been found to be irrelevant (e.g. NOx and SO2 emissions from the concrete plant and suspended solids emissions from quarries), unreasonable (e.g. weighting factors beyond applicants control for quarry scoring matrix and styrene emissions to air from natural stone product processors) or impractical (e.g. emissions of dust to air from quarries).

For cement and ceramic criteria, the authors have attempted to focus on parameters that are already widely used and reported by industry and which do not require the definition of, or reference to, any LCA rules. There are number of potential criteria that could be applied to cement and concrete and the aim at this stage of the project is to put them on the table for discussion with a view to settling on what are considered as the most appropriate ones (and their ambition levels)

For natural stone, a novel approach has been taken to try and define how a quarry can be assessed for its impact on the landscape in such a way that underground quarry activity and material efficiency is rewarded. The wording attempts to respect the same terminology agreed in the soon to be published BAT Reference Document for the management of waste from the extractive industries.

With agglomerated stone products, more information is needed about how the actual production process works exactly. Nevertheless, there are some obvious criteria that are worth promoting, such as the reduction of binder content and the increase of recycled/secondary material content.

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