# Chapter 5
# New Environmental Requirements


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**Abstract** In the construction sector, overall policies on resource efficiency and the circular economy have as one of their objectives the shift from the use of natural materials to industrial by-products and materials recovered from waste. In this context, the assessment of the presence of hazardous substances in construction products and the corresponding implications for the environment—soil, air and water—as well as for health is an increasingly relevant topic. This chapter presents the environmental regulations related to the presence of hazardous substances in construction materials, the current developments in harmonized test methods for environmental monitoring of these materials as well as the perspectives regarding European environmental limit values for pollutants. Furthermore, environmental criteria for construction materials based on environmental product declarations, ecolabels and other schemes, intended to inform citizens about environmental performance, are also addressed.

**Keywords** Construction materials · Environmental assessment · Hazardous substances · Leaching · Ecotoxicity · Eco-labels

## 5.1 Framework

The built environment is responsible for 50% of all extracted materials and 35% of the European Union (EU)'s total waste generation [1]. Over the last decade, the European policies concerning the construction sector have emphasized the necessity of improving the efficiency of resources by keeping them in the economy for longer periods. Against this background, the recovery of materials, both by-products and waste, had become the focus for the development of a secondary building materials market.

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Currently, the European Green Deal [2], the new policy framework of the EU, comprises a set of initiatives, namely the new Circular Economy Action Plan [3] and the Renovation Wave [4], which accounts for actions to make construction more sustainable. On this subject, it is worth mentioning that it is crucial to reduce and assess the content of contaminants in order to increase the confidence in secondary materials.

In Europe, regardless of whether primary or secondary raw materials were used in construction products, the Construction Products Regulation (CPR) [5] applies, provided the construction products are covered by harmonized European standards (hEN) or European Assessment Documents (EAD).

Since the replacement of the Construction Products Directive (CPD 89/106/EEC) [6] by the Construction Products Regulation (CPR) in 2013, it is mandatory to issue a declaration of performance (DoP) for construction products to bear the CE marking that allows the free circulation within the EU's single market [7].

## 5.2 Assessment of the Release of Dangerous Substances under CPR

The performance of construction products goes far beyond ensuring its mechanical resistance and durability through its working life. In fact, the aspects of the protection of public health and the environment are a global concern and must also be addressed. To this end, the CPR states that "*Construction works as a whole and in their separate parts must be fit for their intended use, taking into account in particular the health and safety of persons involved throughout the life cycle of the works*" [5]. Furthermore, the CPR in its third basic requirement of construction works (BWR3), named "Hygiene, health and the environment", addresses these issues.

The compliance of a construction product with BWR3, calls for information on the content or emission of 'regulated dangerous substances' and its inclusion in the DoP. This input in DoP is essential for the transition to a cleaner and healthier built environment as it enables the stakeholders to make a more informed choice reducing the risks to the ecosystems and protecting the citizens.

The European Commission has issued the Mandate M/366 to the European Committee for Standardization (CEN), under the subject "*Development of horizontal standardized assessment methods for harmonised approaches relating to dangerous substances under the Construction Products Directive (CPD)—Emission to indoor air, soil, surface water and ground water*" which was carried out by the Technical Committee CEN/TC 351 "*Construction products: Assessment of release of dangerous substances*".

Since it was set, CEN/TC 351 [8] has worked out methodologies and horizontal test methods related to the release (and/or content) of regulated dangerous substances taking into account the emission scenarios (emission to indoor air and release to the soil, surface water and groundwater) and the intended conditions of use of the product.

After verifying the existing assessment methods for substances from an indicative list of regulated dangerous substances, possibly associated with construction products, CEN/TC 351 defined the harmonized methods to be developed and created the following five working groups [8]:

- WG1 Release from construction products into soil, ground water and surface water;
- WG 2 Emissions from construction products into indoor air;
- WG 3 Radiation from construction products;
- WG 4 Terminology;
- WG 5 Content and eluate analysis in construction products.

To carry out its mission CEN/TC 351 has also taken into account European legislation on chemical substances and environmental policies that cross with construction products legislation [9], namely Regulation (EC) No 1907/2006 "*concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)*" [10], Regulation (EC) No 850/2004 "*concerning on persistent organic pollutants*" [11] and Directive 2000/60/EC "*establishing a framework for community action in the field of water policy*" [12].

An overview of the most relevant technical specifications (TS), technical reports (TR) or European standards (EN) published is given in Table 5.1.

It should be noted that different TS are now being draft as harmonized standards, keeping the code number of TS. The following are examples of this coexistence: FprCEN/TS 17459, prEN 16637-1 rev, prEN 16637-2, prEN 16637-3 rev, prEN 17195 rev, prEN 17196, prEN 17197, prEN 17200 rev, prEN 17201, prEN 17331 and prEN 17332. Table 5.2 shows other work in progress from CEN/TC 351.

### *5.2.1 Indoor Air*

The construction products can emit dangerous substances into indoor air, contributing significantly to indoor pollution, and therefore affecting the health of the occupants of the buildings [13]. Concerning the release scenario "emission to indoor air", CEN/TC 351 published the horizontal reference method EN 16516 "*Construction products: Assessment of release of dangerous substances—Determination of emissions into indoor air*" [14], that applies to volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), very volatile aldehydes and ammonia. The method is based on the use of a reference test chamber with standardized dimensions, climate and ventilation. The emission of compounds is determined 28 days after the installation of the construction product in the chamber. At this time the vapour-phase compounds present in the chamber air are collected and analysed by an appropriate method (GC–MS and HPLC for volatile organic compounds and spectrophotometric methods or any equivalent analytical methods for ammonia) [14].

There is a quite large amount of gaseous organic substances that can be emitted by building materials (such as floorings, particle boards, walls and ceiling finishes,

**Table 5.1** Published Standards and guidance documents under harmonization work of CEN/TC 351 [8]

| TS/TR/EN | Title |
|---|---|
| CEN/TR 15855:2009 | Construction products—Assessment of release of dangerous substances—Barriers to trade |
| CEN/TR 15858:2009 | Construction products—Assessment of the release of regulated dangerous substances from construction products based on the WT, WFT/FT procedures |
| CEN/TR 16045:2010 | Construction Products—Assessment of release of dangerous substances—Content of regulated dangerous substances—Selection of analytical methods |
| CEN/TR 16098:2010 | Construction products: Assessment of release of dangerous substances—Concept of horizontal testing procedures in support of requirements under the CPD |
| CEN/TR 16220:2011 | Construction products—Assessment of release of dangerous substances—Complement to sampling |
| CEN/TR 16410:2012 | Construction products—Assessment of release of dangerous substances—Barriers to use—Extension to CEN/TR 15855 Barriers to trade |
| CEN/TR 16496:2013 | Construction Products—Assessment of release of dangerous substances—Use of harmonised horizontal assessment methods |
| CEN/TS 16637-2:2014 | Construction products—Assessment of release of dangerous substances—Part 2: Horizontal dynamic surface leaching test |
| EN 16687:2015 | Construction products—Assessment of release of dangerous substances—Terminology |
| CEN/TR 16797-1:2015 | Construction products: Assessment of release of dangerous substances—Guidance on the statistical assessment of declared values—Part 1: Principles and rules of application |
| CEN/TR 16797-2:2015 | Construction products: Assessment of release of dangerous substances—Guidance on the statistical assessment of declared values—Part 2: Technical and statistical background |
| CEN/TS 16637-3:2016 | Construction products—Assessment of release of dangerous substances—Part 3: Horizontal up-flow percolation test |
| CEN/TR 17105:2017 | Construction products—Assessment of release of dangerous substances—Guidance on the use of ecotoxicity tests applied to construction products |
| CEN/TR 17113:2017 | Construction products—Assessment of release of dangerous substances—Radiation from construction products—Dose assessment of emitted gamma radiation |
| CEN/TS 17195:2018 | Construction products: Assessment of release of dangerous substances—Analysis of inorganic substances in eluates |

(continued)

**Table 5.1** (continued)

| TS/TR/EN | Title |
|---|---|
| CEN/TS 17196:2018 | Construction products: Assessment of release of dangerous substances—Digestion by aqua regia for subsequent analysis of inorganic substances |
| CEN/TS 16637-1:2018 | Construction products—Assessment of release of dangerous substances—Part 1: Guidance for the determination of leaching tests and additional testing steps |
| CEN/TS 17216:2018 | Construction products—Assessment of release of dangerous substances—Determination of activity concentrations of radium-226, thorium-232 and potassium-40 in construction products using semiconductor gamma-ray spectrometry |
| CEN/TR 17304:2018 | Construction products—Assessment of release of dangerous substances—Determination of emissions into indoor air of ammonia from cellulose insulation at 90% RH |
| CEN/TS 17197:2018 + AC:2018 | Construction products: Assessment of release of dangerous substances—Analysis of inorganic substances in digests and eluates—Analysis by Inductively Coupled Plasma—Optical Emission Spectrometry (ICP-OES) |
| CEN/TS 17200:2018 + AC:2018 | Construction products: Assessment of release of dangerous substances—Analysis of inorganic substances in digests and eluates—Analysis by Inductively Coupled Plasma—Mass Spectrometry (ICP-MS) |
| CEN/TS 17201:2018 + AC:2018 | Construction products: Assessment of release of dangerous substances—Content of inorganic substances—Methods for analysis of aqua regia digests |
| EN 17087:2019 | Construction products: Assessment of release of dangerous substances—Preparation of test portions from the laboratory sample for testing of release and analysis of content |
| CEN/TS 17331:2019 | Construction products: Assessment of release of dangerous substances—Content of organic substances—Methods for extraction and analysis |
| CEN/TS 17332:2019 | Construction products: Assessment of release of dangerous substances—Analysis of organic substances in eluates |
| EN 16516:2017 + A1:2020 | Construction products: Assessment of release of dangerous substances—Determination of emissions into indoor air |

wooden panels and sealants) [9]. EN 16516 [14] gives a non-exhaustive list of volatile organic compounds, included in the following categories: aromatic hydrocarbons, saturated aliphatic hydrocarbons, terpenes, aliphatic and aromatic alcohols, glycols and glycol ethers, aldehydes, acids and esters [14].

For a harmonised assessment of the building product emissions, a working group, under the coordination of the European Commission's Joint Research Centre (EC-JRC), is setting a harmonised list of compounds and their associated European harmonised 'lowest concentrations of interest (EU-LCI)' values [15]. The "*EU-LCI*

**Table 5.2** Standards under development (working in progress) by CEN/TC 351 [8]

| Draft/Working item | Title |
|---|---|
| prEN (WI = 00351034) | Construction products: Assessment of release of dangerous substances—Determination of the content of polycyclic aromatic hydrocarbons (PAH) and of benzene, toluene, ethylbenzene and xylene (BTEX)—Gas-chromatographic method with mass spectrometric detection |
| prEN (WI = 00351035) | Construction products: Assessment of release of dangerous substances—Determination of biocide residues using LC-MS/MS |
| prEN 17216 | Construction products: Assessment of release of dangerous substances—Determination of radium-226, thorium-232 and potassium-40 activity using gamma-ray spectrometry |
| prEN 17637 | Construction products: Assessment of release of dangerous substances—Dose assessment of emitted gamma radiation |
| (WI = 00351050) | Construction products: Assessment of release of dangerous substances—Sampling and qualitative determination of asbestos in construction products |
| (WI = 00351042) | Construction products: Assessment of release of dangerous substances—Methods for the determination of N-nitrosamines in air samples derived by EN 16516 |

*values are health-based reference concentrations of chemical substances for inhalation exposure used to assess emissions after 28 days from a single construction product during a laboratory test chamber procedure as defined in the EN 16516*" [16]. The definition of these values is based on all relevant published toxicological and risk assessment data and in the REACH principles [15]. The up-to-date EU-LCI values are available on the official website of the European Union [16].

Currently, there are three mandatory systems in different Member States for the assessment of VOC emissions to the indoor environment from construction products [17, 18], each of them with its particular criteria. German AgBB scheme is based on pass-fail criteria for 185 compounds established in the German LCI list (EU-LCI values are usually adopted) [19]. The criteria established in the Belgian Royal Decree are similar to the German system, but in this case it is considered the harmonised EU-LCI list [20]. French VOC regulation focuses on a classification system based on the selection of 10 compounds [21–23]. An overview of the German and Belgian limits is given in Table 5.3 and the French classification system is presented in Table 5.4.

In addition, to these mandatory systems, several voluntary labelling schemes for low-emission building materials, with their specific requirements for product evaluation, are used in other European countries [25, 26]. For example, the M1 for low-emission building materials in Finland considers the following parameters: total volatile organic compounds emission < 0.2 mg/m$^2$h; Emission of a single volatile organic compound (VOC) ≤ EU-LCI; Formaldehyde emission < 0.05 mg/m$^2$h, Ammonium emission < 0.03 mg/m$^2$h; The emission of CMR-compounds belonging to category 1A or 1B in Annex VI to Regulation (EC) No 1272/2008 < 1 μg/m$^3$

**Table 5.3** Overview of mandatory limit values in Germany [19] and Belgium [20]

| After 28 days of testing | German | Belgium |
|---|---|---|
| Total Volatile Organic Compounds (TVOC) | ≤1000 µg/m$^3$ | ≤1000 µg/m$^3$ |
| Total Semi-Volatile Organic Compounds (TSVOC) | ≤100 µg/m$^3$ | ≤100 µg/m$^3$ |
| Volatile carcinogen of categories 1A and 1B (according to Regulation No 1272/2008 [24]) | ≤1 µg/m$^3$ | ≤1 µg/m$^3$ |
| Toluene | ≤ 900 µg/m$^3$ | ≤300 µg/m$^3$ |
| Acetaldehyde | 1200 µg/m$^3$ | ≤200 µg/m$^3$ |
| Formaldehyde | 100 µg/m$^3$ | ≤100 µg/m$^3$ |
| R value (sum of all Ri values to the COV with LCI) | ≤1 | ≤1 |
| TVOC without LCI | ≤100 µg/m$^3$ | – |
| Ri is given by the ratio Ci/LCIi (where Ci is the mass concentration in the air of the reference room and LCIi is the LCI value of compound i) | | |

**Table 5.4** French classification system (limit values of the emissions classes in µg/m$^3$) [23]

| Substance/Emission class | A + | A | B | C |
|---|---|---|---|---|
| Formaldehyde | <10 | <60 | <120 | >120 |
| Acetaldehyde | <200 | <300 | <400 | >400 |
| Toluene | <300 | <450 | <600 | >600 |
| Tetrachloroethylene | <250 | <350 | <500 | > 500 |
| Xylene | <200 | <300 | <400 | >400 |
| 1,2,4—Trimethylbenzene | <1000 | <1500 | <2000 | >2000 |
| 1,4—Dichlorobenzene | <60 | <90 | <120 | > 120 |
| Ethyl benzene | <750 | <1000 | <1500 | >1500 |
| 2-butoxyethanol | <1000 | <1500 | <2000 | >2000 |
| Styrene | <250 | <350 | <500 | >500 |
| TVOC | <1000 | <1500 | <2000 | >2000 |
| According to the French regulation: Trichlorethylene, Benzene, Bis(2-ethylhexyl) phthalate and Dibutyl phtalate ≤ 1 µg/m$^3$ | | | | |

and Odour: not odorous [27]. The Danish indoor climate is similar to the German AgBB scheme and includes the evaluation of the release of particles and the odour assessment [13].

Based on the existing labelling schemes, the European Commission has been working on the development of a harmonised labelling scheme for the assessment of VOC emissions from construction products under the CPR. However, until now, no consensual protocol has already been reached. It is expected that within a few years, the CE marking accompanied by DoP may contain classes or levels for the release of dangerous substances based on a harmonised VOC emission label.

**Table 5.5** Classes for formaldehyde emissions [28]

| Class | Requirements (using test method EN 717-1 [29]) | Requirements (using test method EN 16516 [14]) |
|---|---|---|
| E1 | Equilibrium concentration in the air of the test chamber $\leq 0.12$ mg/m$^3$ | $\leq$0.12 mg/m$^3$ |
| E2 | Equilibrium concentration in the air of the test chamber $> 0.12$ mg/m$^3$ | >0.12 mg/m$^3$ |

After the publication of the harmonised standard EN 16516 [14] in 2017, the product standards in the EU have started to include the assessment of the "*Emission of dangerous substances into indoor air*" using this harmonized test method. The product standard EN 14041 [28] *"Resilient, textile, laminate and modular multilayer floor coverings—Essential characteristics"* is one example of this inclusion.

Regarding the levels/classes of emission into indoor air, currently, only the emission formaldehyde classes have been addressed in the construction product standards and therefore in the CE marking (Table 5.5).

### *5.2.2 Soil and Water*

Under outdoor exposure conditions, construction products can potentially release Regulated Dangerous Substances (RDS) to surface water, groundwater and soil through different physicochemical paths related to the construction product characteristics and scenario of exposure. Several contaminants (e.g, biocides, PAH, heavy metals) found in the stormwater can be linked to the use of construction products (e.g, renders, mortars, paints, roofing materials, bricks) [30]. These pollutants may have toxic effects on the environment and, consequently, on human health [31]. To ensure the environmental compatibility of construction products, it is essential to determine the adequate release test applied to the construction product to understand which substances are released and in what amount.

To assess the release of RDS from different construction products into water and soil, CEN/TC 351 developed two harmonized tests: the CEN/TS 16637-2 [32], a dynamic surface leaching test (DSLT) for determining the release of inorganic and/or non-volatile organic substances from the monolithic, plate or sheet-like construction products or from granular construction products with low hydraulic conductivity whose surface is in contact with a leachant, and CEN/TS 16637-3 [33], an up-flow percolation test (PT) to determine the release of inorganic and/or non-volatile organic substances from common granular construction products [8]. The scheme for choosing the preferred method to assess the release of RDS is presented in Fig. 5.1.

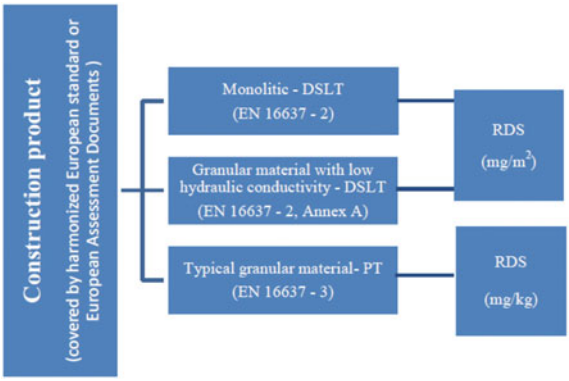


**Fig. 5.1** Test for release of RDS from construction products based on CEN/TS EN 16637-1 [36]

In the DSLT, the sample from the construction product is immersed in a leachant for specified periods of time, keeping a specific liquid to area (L/A) ratio. After each period, the leachant is renewed and the collected liquid fraction is analysed for its content.

For the PT test, the granular material is packed in a column and under hydraulically dynamic conditions, using a continuous vertical up-flow that ensure a specific liquid to solid ratio (L/S), different fractions of eluate are gathered for chemical analysis.

It should be mentioned that none of the referred tests covers metals, metallic coatings and organic coatings, since these materials have a different mechanism of release. However, it is expected that future validation works may extend the scope for the use of the method [7]. For construction products not in permanent contact with water (with dry and wet phases), namely façade coatings such as paints, mortars, mineral renders, renders with organic binders, which are subject to changes of physical and chemical properties during the permanent contact with leachant, the laboratory test EN16105 [34] can be applied instead of part 2 or 3 of CEN/TS 16,637 [35].

The eluates obtained from the above-mentioned tests can subsequently be subjected to chemical and ecotoxicological characterization. Concerning chemical analysis, available test methods to determine the released dangerous substances from the construction products have been compiled in the technical report CEN/TR 16045 [7]. The chemical characterization of the eluate is the desirable option, however analysis of the construction product content can also be undertaken when this is the only feasible solution to assess the release of specific compounds. The selected methods are based on test methods from other fields (for example soil quality, characterization of waste and water quality). Based on these existing methods, CEN/TC 351 has prepared technical reports for the analysis of inorganic and organic substances in eluates (see Table 5.1).

For the analysis of specific organic substances in eluates, the technical report CEN/TS 17332 [37] specified the appropriate methods for the determination of individual or groups of substances in aqueous eluates from leaching of construction products. Biocides, bisphenol A, BTEX, dioxins and furans, Dissolved Organic Carbon

(DOC), epichlorohydrin, mineral oil, nonylphenols, PAH, PBDE, PCB, dioxin-like PCB, PCP, phenols and phthalates are covered in this document [37].

Currently, CEN methods have undergone a process of validation for their robustness and are now in the second stage of validation to estimate the precision. As part of the validation work, the Joint Research Centre (JRC) presented a technical report of an interlaboratory comparison of leachates/eluates and the content of substances like biocides, phthalates, mineral oil, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) from render, sealant, asphalt aggregate and recycled aggregate [38].

The DSLT [32] and PT [33] tests are recent and there is not yet enough data regarding their application in construction products. In Europe, the implementation of these methods will lead to comparable data as opposed to the current situation. A study regarding the use of construction and demolition waste, slags from ferrous metals production, and ashes from coal combustion highlighted the diverse regulations and criteria applied, aiming at protecting the environment when these secondary resources are used as aggregates in construction products.

As the question of whether comparable methods exist at the European level has been overcome, the challenge arises as to which substances are relevant to be tested for a given group of construction products. The target substances should be selected based on the product formulation (chemical constitution and composition of the product). This is not to say that what matters is the content of the substances in the construction product. In reality, this content is a very poor indicator of what can be released and, although, in terms of the production of construction products the control of the content of existent substances is easier to apply, it is not adequate. The information on the chemical composition is useful from a qualitative perspective because it allows checking which substances included in the Indicative List of Regulated Dangerous Substances are present and, therefore, which need to be checked in the eluates [9]. The priority substances are considered based on the European legislation [30, 39, 40], such as water framework directive (2000/60/EC) [12], waste framework directive (2008/98/EC) [41], landfill regulation (Council decision 2003/33/CE) [42], REACH [10], persistent organic pollutants (POP) Regulation No 850/2004 [11] and biocidal products Regulation No 528/2012 [43].

Beyond chemical characterization of the eluates, the ecotoxicological characterization provides additional information because it allows an understanding of the effects that the eluate has on living organisms. The main drivers to conduct these tests are the lack of knowledge of the substances present in the construction products or the fact that the content of some substances is not easy to quantify in the eluate. Usually, the minimum test battery focus on acute ecotoxicity (CEN TR/17105 [44]) and it combines the exposition of organisms from three different trophic levels to the diluted eluate followed by assessment of the observed effects as follows:

- Algae—analysis of growth rate inhibition (EN ISO 8692 [45]);
- Crustacea—evaluation of reduction of mobility after 48 h (EN ISO 6341 [46]);
- Luminescent bacteria: inhibition of light emission (EN ISO 11348-3 [47]).

Special attention must be given to the reported substances labelled as "acute toxicity" category 1, 2 e 3, "carcinogenicity category 1A or 1B, "Germ cell mutagenicity" category 1A or 1B, "Aquatic Acute" category 1 or Aquatic Chronic category 1, 2, 3 or 4 and Reproductive toxicity" category 1A or 1B as per the Regulation EC No 1272/2008 [24, 48]. Since construction products are constituted by complex mixtures of additives (e.g, plasticizers, stabilization agents, pigments, surfactants and solvents), screening methods like gas chromatography coupled with mass-selective detection (GC–MS) or liquid chromatography coupled with mass-selective detection (LC–MS) can be used to identify other relevant organic substances [30].

The technical specifications above mentioned are the basis to implement environmental protection requirements of the Construction Products Regulation, and to ensure soil and water protection. The application of these methods will be recommended not only in a legal context under CPR (CE marking of construction products) but also in voluntary labelling and environmental product declarations.

The harmonized methods permit us to compare the obtained leaching results with national or case-specific limit values [39]. However, and because the leaching behaviour is influenced by several factors (e.g, the geometry of the component and the weather), these results are not directly comparable to the environmental concentrations on the real service conditions. To define reasonable release limit values it is necessary further research to develop suitable models to predict the environmental concentration from the leaching test results [49].

Limit values for leaching from construction products have been introduced in some countries (e.g, Netherlands, Belgium, Denmark, German and Finland) [31, 39]. Nevertheless, the limit values are not comparable, because the selected materials and the release scenarios are different between them. It is expected that the harmonisation work of CEN/TC 351 leads to an uniformization of the criteria on EU level to the assessment of the leaching behaviour of construction products.

## 5.3 Environmental Labels

The construction sector plays a significant role in the consumption of resources and energy. As already mentioned, environmental awareness of the effects of this sector on pollution and resources depletion has led to the increasing demand for environmentally friendly building materials [39, 50].

To provide relevant information on the environmental performance of materials to all the stakeholders of the construction sector, various environmental labels and declarations have emerged with the objective to promote the choice of products with low environmental impact when compared to others intended for the same use and having similar performance.

The recognition of the commercial benefits of this type of labels/declarations/claims has led to the appearance of a large number of labelling initiatives, each one with its specific criteria. To establish harmonized criteria, definitions and guidelines for the different labels on the market [51], the International

Standardization Organization (ISO) developed standards concerning different types of labels and declarations:

- ISO 14024 [52]—Environmental labels and declarations—Type I environmental labelling—Principles and procedures.
- ISO 14021 [53]—Environmental labels and declarations—Self-declared environmental claims (Type II environmental labelling). It is a declaration of the company and it is not third-party certified.
- ISO 14025 [54]—Environmental labels and declarations—Type III environmental declarations—Principles and procedures.

The type I labels, commonly known as 'Eco-labels', form part of an independent (third-party certified) and multi-criteria labelling scheme, which certifies a product that meets a set of criteria based on life cycle considerations [55]. Some of these, applied to several product groups including building materials, are, for instance, *European Ecolabel* (e.g, product group: *Indoor and outdoor Paints and Varnishes*) [56], German *Blue Angel* (e.g, product groups: *Floor Coverings, Internal Plasters, Thermal insulation* and *Wall paints*) [57], *Natureplus* (e.g, product groups: *insulation materials, wall paints, adhesives*) [58] and *Nordic Swan* (e.g, product groups: *chemical building products, construction and facade panels* and *floor coverings*) [59].

Besides the type I labels, there is a "Type I-like" label, which focuses only on a single aspect, for example, air quality. Some of these are, for example, the *Eurofins Indoor Air Comfort* [60], *eco-INSTITUT* [61] and *GreenGuard* [62].

Concerning the Environmental Product Declarations—EPDs (Type III environmental declarations), they provide quantitative indicators for the environmental performance based on a life-cycle approach, and they were created for comparing the environmental impact of similar products [55]. To enable this comparison, the Life Cycle Assessment (LCA) should be based on common rules for each group of products, known as Product Category Rules (PCR). Therefore, ISO and European Committee for standardisation (CEN) developed standards with specific requirements for construction products [50]:

- ISO 21930 [63]—Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services;
- EN 15804 [64]—Sustainability of construction works—Environmental product declarations—core rules for the product category of construction products.

These standards have been used as a reference for the development of several EPD programmes for construction products, which includes *IBU*, by the *Institut Bauen and Umwelt e.V.* (Germany), the *Global EPD* by *AENOR* (Spain), the *Alliance HQE-GBC/Programme FDES INIES* (France) and *DAP Habitat System* by the *Habitat Cluster* (Portugal) among others [50].

Environmental information related to the construction products is needed to assess the sustainability of construction works. The life-cycle approach is considered in the Construction Product Regulation, namely in the Basic requirements for construction works BRW3 (hygiene, health and the environment) and BRW7 (sustainable use of natural resources). Although it is not referred in the CPR how to demonstrate the conformity with these basic requirements, it states that: "*For the assessment of the sustainable use of resources and of the impact of construction works on the environment the Environmental Product Declarations should be used when available*" [5].

## 5.4 Future Perspectives

As part of the 2030 Agenda for Sustainable Development Goal of the United Nations, the SDG 12—Ensure sustainable consumption and production patterns, comprised a target related to the protection of natural habitat and human health: "*an environmental sound management of chemicals and all wastes throughout their life cycle would be implemented in order to significantly reduce their release to air, water and soil, protecting human health and the environment from their adverse impacts*" [65]. This objective has not been achieved although several initiatives intended to reach the goal have been developed.

Contrary to expectations, the monitoring indicators at European level that measure the progress towards SDG 12 objectives [66] (see Fig. 5.2) give cause for concern regarding the consumption of toxic chemicals in recent years.

Assuming that this raise of toxic chemicals could affect the construction products, increased demand for faster evaluation procedures regarding the release of hazardous substances could be expected.

It should be pointed out that the new Circular Economy Action Plan [3] foresees the development of methodologies, from 2021 onwards, to track and reduce the presence of substances of concern in recycled materials. It will therefore be important to be aware of these actions in the near future.

| Indicator | Long-term trend (past 15 years) | Short-term trend (past 5 years) |
|---|---|---|
| **Decoupling environmental impacts from economic growth** | | |
| Consumption of toxic chemicals | ↗ (1) | ↘ |
| Resource productivity and domestic material consumption (DMC) | ↑ | ↗ |
| Average $CO_2$ emissions from new passenger cars (**) | ↗ (2) | ↘ |
| Energy productivity (*) | ↑ | ↑ |
| **Green economy** | | |
| Gross value added in the environmental goods and services sector | ↑ | ↑ |
| **Waste generation and management** | | |
| Circular material use rate | ↑ (3) | ↗ |
| Generation of waste excluding major mineral wastes | ↗ (4) | ↘ (5) |

(*) Multi-purpose indicator. (**) Trends for EU target.
(1) Past 14-year period (2) Past 11-year period (3) Past 13-year period (4) Past 12-year period. (5) Past 4-year period

Legend:

↑ Significant progress towards SD objectives

↗ Moderate progress towards SD objectives

↓ Significant movement away from SD objectives

↘ Moderate movement away from SD objectives

**Fig. 5.2** European indicators monitoring of SDG 12 (adapted from [66])

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