

2011 International Conference on Green Buildings and Sustainable Cities

Sustainable cements for green buildings construction

Maria Chiara Bignozzi^{a*}

^a*Dipartimento di Ingegneria Civile, Ambientale e dei Materiali, Università di Bologna,
Via Terracini 28, Bologna 40131, Italy*

Abstract

The large amount of waste yearly disposed to landfill, the global impoverishing of natural resources and environment, the emergency of carbon dioxide emissions, are some of the motivations driving research institutes and industrial world to move towards sustainable solutions for civil engineering field. Accordingly, the use of sustainable materials for green buildings construction is an important goal that must be reached in short times.

Sustainable cements can be designed by partially replacing clinker content with non hazardous waste. Indeed, recycling process can transform waste in secondary raw materials that work as new cement constituents usually leading to sustainable binders with peculiar environmental resistances. Details of cement manufacturing process and its effect on the environmental pollution as well as the route that can be carried out to tailor sustainable cements are reported and discussed.

© 2011 Published by Elsevier Ltd. Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).

Selection and/or peer-review under responsibility of APAAS

Keywords: sustainable materials; waste management; recycling; cement; building materials;

1. Introduction

Materials are the fundamental elements of buildings construction. Chemical, physical and mechanical properties of materials as well as a proper design are responsible of the building mechanical strength. Moreover, materials have the aim to ensure structures durability. The Italian Ministerial Decree 14/01/2008 “Regulations for constructions” [1] lists materials and products allowed for structural use, their characteristics and the main performances that must be fulfilled. CE (Conformité Européenne or European Conformity) marking is compulsory for the most important building materials, such as cement, aggregates for concrete and mortar, steel, etc., according to the 89/106/EEC “Construction products

* Corresponding author. Tel.: +390512090342 fax: +39 0512090322

E-mail addresses: maria.bignozzi@unibo.it.

directive, CPD” [2]. The directive states “in Europe, construction products on the market must satisfy, for a reasonable working life, the essential requirements with regard to mechanical strength and stability, safety in the event of fire, hygiene, health and the environment, safety in use, protection against noise and energy economy and heat retention” [3]. The use of certified materials, their selection on the basis of environmental exposure during their working life and a proper design should guarantee building durability, including ordinary maintenance, over a period of at least 50 years (100 years for large and/or strategic public works) [1].

The design of green buildings should thus start with the choice and use of sustainable materials with similar or better features than traditional building materials. However, some questions arise: Can a frequently used building material such cement be sustainable and available on the market? Do sustainable cements follow all the requirements fixed for traditional ones? Do they have performances comparable to those of traditional materials?

Sustainable building materials are usually based on recycling of proper waste that, thank to its own characteristics, can partially and/or entirely replace natural materials deriving from no-renewable resources. Quarries exploitation to obtain natural raw materials, treatments such as grinding, washing, selection that are usually carried on natural resources, technological process (e.g. the sintering at high temperature for bricks and tiles, the clinkerization process for cement production, etc.) are all energy consuming procedures. Accordingly, in Europe building industry requires almost the 40% of the total energy consumed and is one of the main producer of CO₂ emissions.

Indeed, moving towards green buildings means modifying the usual building materials introducing between their components what today it is still called waste, but tomorrow it shall be called secondary materials. This strategy will lead to a strong decrease of landfill disposal, to safeguard non-renewable natural resources, to preserve the environment, to save energy and reduce costs. However, to be sure of the effectiveness and success of this change, it is extremely important that all the requirements provided by technical standards for traditional materials are completely fulfilled for the unconventional ones. Therefore, European Directive CPD has introduced a tool, the European technical approval (ETA), that need to be issued when no harmonized standards exist for the product, no mandate for such a standard has been given by the European Commission, no standard is going to be developed (yet) or a product deviates significantly from the relevant harmonized standards [4]. ETA is thus a European certification that can help the introduction of unconventional building materials based on waste, guaranteeing performances and characteristics of new building products and allowing their use even if a CE marking is still not available. When an ETA has been issued, it is valid in all EEA countries, for a period of five years, renewable thereafter.

The aim of this contribute is to highlight how cement, probably the most popular building material in Europe, can become sustainable thank to waste introduction in its productive process. Although reviews about waste recycling for building materials are available [5-7], not all the parameters necessary to validate and allow the use of waste based cement are usually taken into consideration and reported.

2. Cement Production

Italy is one of the main cement manufacturers with 32 Mton in 2009. In the European Union countries and in the world, cement production in 2009 was 191 Mton and 789 Mton, respectively [8]. The European standard EN 197-1 [9] disciplines which are the cements available on the market, their compositions, the chemical-physical-mechanical requirements that they have to fulfill and conformity criteria. Five main cement typologies are recognized, even if each category can have further division. Ordinary Portland cement (OPC) is defined as CEM I, composite Portland cement is CEM II, blast furnace and pozzolan cements are respectively CEM III and CEM IV, and composite cement is defined as CEM V.

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات