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Opinion

Recycled Concrete with Mixed Granulate Material: Still a Future Perspective?

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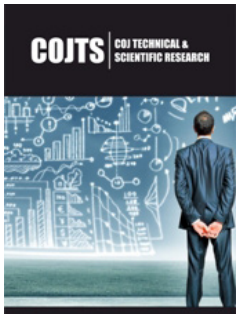

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Introduction

The use of concrete is worldwide largely widespread. A relevant ingredient is cement. The production of cementitious binders is often related to an increase in the CO_2 production. In order to limit the environmental pollution, the presence of CO_2 must be limited. A huge effort is ongoing toward more sustainable cementitious materials [1-6]. This takes place in the production phase with alternative combustion products. In addition, to reduce the Portland cement component of the cementitious binders, several materials are largely added to the mixtures. Wastes alternatives, such as carbon, oil-shale, bio-mass, incinerator and sewage plant ashes and cement kiln dust are added in substitution. Glass, shredded tyres, plastics, textiles and other inorganic components are also used. Furthermore, the applied research is also currently focused on the use of supplementary cementitious materials, i.e., fly ashes, granulated blast furnace slags, nanosilica, silica fume, metakaolin, volcanic ashes and carbonate dusts [7]. Aluminate-calcium sulfoaluminate cements, alkali-activated binders, celite cements, Magnesium containing and calcined clay cements are also investigated.

Recycled Concrete

The concrete recycling process is a complimentary procedure to the above described, that contributes to the circular economy. This limits the landfill disposal and partially solve the lack of space, which was significantly reduced during the last decades [8]. In the last twenty years, the recycling of concrete became an important issue. Today a wide range of knowledge is present concerning the properties of recycled cementitious materials. In spite of the inhomogeneity of the recycled materials, adequate quality controls contribute to attain the required properties. The sieve curves of the granulates may fulfill the limits, while the fine component is largely limited in the content [9]. In fact, this latter fine material causes an increase in the water adsorption of the cementitious mixtures and its use needs to be clarified more in detail. On the other hand, the main characteristics of concrete, namely the compressive strength, may be achieved with recycled concrete [10]. This depends on the percentage of the recycled components added to the blends. However, values below 50 % allow to obtain a concrete with a compressive strength class C 25/30. Consequently, the materials may be used for the main building parts. Nevertheless, a wide skepticisms is still widely present in many construction professionals [11]. In the civil engineering field, the mechanical as well as the durability properties must be reached. Especially the requirements concerning the resistance to freeze / thaw, the chloride diffusion and the carbonation. This is possible by using demolished high-quality concrete or homogeneous crushed aggregates with known properties [12].

Recycled Mixed Granulate Concrete

Mixed inorganic demolition waste, in particular ceramic tiles, bricks, excavation material, stones and demolished concrete are often present simultaneously in the disposals. The use of these materials to prepare recycled concrete is done since decades. Nevertheless, the quality of this type of recycled concrete is questionable [13]. The inhomogeneity of this recycled concrete requires a more detailed and frequent control of the properties of the blends (Figure 1). The wide difference in the component's features, creates even more doubts on the end quality. The compressive strength can reach values up to 20/25Mpa or higher depending on the percentage of the addition of the recycled mixed components. Until now, this type of recycled concrete is used for low quality part of structures, such as basements, small support walls or pipeline embedments. In this concern, the low homogeneity of this cementitious material does not allow further relevant applications in practice. For this reason, it will be necessary to sort part of the demolition debris, especially the ceramic component. This light weight and porous material could be used as a thermal insulating or fire resistance component or as an additional source of Aluminum in the production of cement-based materials. But it can no longer be treated as a concrete aggregate. In addition, the rocky wastes have to be sorted from the cementitious debris in order to get a more clear identification of the material type and expected quality. These three main components need to be accurately separated one another at the disposal stadium or during the demolition process. A future task that needs to be pursued to get a more clear construction and demolition waste management. At an initial phase this process is linked with higher costs, but on a mid-term basis it allows to gain usable high quality materials that can be re-directed to build high performance structures.

Figure 1

Conclusion

The recycling of inert materials is a big challenge and needs to be done with care. The recycled materials already lived a life. Therefore, the contamination and the quality of the debris need to be controlled. It is possible to build infrastructures with recycled concrete, although the use of mixed granulates is no longer reasonable. A more selective demolition process must be implemented in the future and a re-thinking of some of the old composite construction systems are necessary to satisfy the recycling needs of the society and the future recycled concrete.

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