CONSTRUCTION AND DEMOLITION WASTE AS A RENEWABLE RESOURCE FOR RECYCLED AGGREGATES: ANALYSIS OF ITALIAN CASE STUDIES

Alessandra, Diotti*, Sabrina, Sorlini*, Luca, Cominoli*, Giovanni, Plizzari*

** University of Brescia, Department of Civil Engineering, Architecture, Land, Environment and Mathematics, Via Branze 43, 25123 Brescia, Italy*

Construction and demolition activities produce large quantities of waste materials, named as Construction and Demolition Wastes (CDW), classified as special waste according to the current Italian legislation [1] and codified by the Chapter 17 of the European List of Waste – EWC code.

In 2016, the total wastes generated by the construction sector in EU accounted for around 36% of the total wastes production, with 924 million tons. Italy, with a production of about 54,5 million tons, is the fourth European country for CDW production after Germany, France and Netherlands [2]. The level of EU recycling varies significantly between the Member States: from 10% (e.g. Greece) to 90% (e.g. Germany, Netherlands) [3]. In Italy conflicting data on recovery rates are reported: from 10% [4] to 76% [5].

The recovery of these materials in the construction sector has important environmental and economic advantages, in terms of minimizing landfill waste disposal, less depletion of natural resources and reuse of recycled aggregates (RA) that can be reintroduced in the production cycle of the construction industry. The interest in the CDW recovery is supported by both European (Directive EU 2018/851) and national legislation (L.D 152/2006), that aim to improve the efficiency of resource reuse to facilitate the transition to more sustainable material management and to a circular economy model. In particular, the Directive EU 2018/851 requires that at least 70% of the CDW must be recycled/recovered by 2020.

Generally, CDW represent a large source of secondary raw materials, consisting roughly out of concrete, wood, masonry, drywall, glass, plastics, metals and more. As can be seen, the composition is extremely variable. This is due to the different demolition techniques adopted, to the lack of adequate treatments for the RA production, as well as to the high variability of the material used, over the years, for building's construction. In fact, waste and debris from construction and demolition of buildings can contain potentially dangerous materials. Although many of these materials are not necessarily dangerous, if improperly disposed of they can impact the environment and water. In addition to CDW from existing buildings that may contain lead, asbestos and other toxic materials, debris generated from new building construction materials can include treated wood, paint and solvent wastes, glues and roofing tars, and other possible toxic materials.

These CDWs are mainly treated in dedicated mobile plants that carry out rough treatments, such as single crushing and simple screening. So, the resulting RA has extremely variable physical and chemical characteristics that often do not comply with the environmental and technical standards required for their use as aggregates in

buildings construction. However, the final quality of the recycled materials is not only related to the adopted treatment techniques, but also to the demolition activities. In fact, a more effective CDW separation into homogeneous fractions already during the demolition phase will give a more efficient and clean recycling process.

Ideally, waste collected from construction and demolition activities should be subjected to pre-sorting of potentially hazardous materials (e.g. by selective demolition), thereby ensuring that the CDW consists of mainly unproblematic materials. However, this may not always be the case, as documented by Butera et al., 2014 [6], who reported large variations in appearance, composition and leaching determined in batch leaching tests. In fact, in terms of environmental and chemical aspects of composition and contaminant release of CDW, chromium and sulphate are the most critical compounds in the RA leachates [6,7]. Specifically, the total chromium is mainly released by ceramic materials and partly carbonated samples, while high sulphate levels are released by the gypsum-based materials and other CDW compounds (such as mortar particles). Therefore, since there is still a great deal of uncertainty about the qualitative characteristics both of CDW and RA, the present research work aims to evaluate and develop new knowledge on the characteristics of these materials related to their strong heterogeneity, that hinders their recovery. In particular, to identify possible correlations between the RA characteristics and the different CDW, building types, materials, years of construction and demolition procedures, data on qualitative and quantitative characteristics of the CDW treated and relative RA produced were collected by 3 CDW treatment plants located in Northern Italy (Brescia).

Certificates already available at the companies (indicatively of the last 5-10 years) relating to chemical characterization, leaching test, EC marking of CDW and RA were acquired. Subsequently, through a statistical approach, the resources data collected from companies have been processed and elaborated with a statistical approach. In light of the information acquired from the database created, strengths and weaknesses of the RA generated by different CDW were identified. In particular, the variability ranges of the chemical, physical and mechanical characteristics of the CDW and RA respectively were identified.

In relation to the applications and future uses of AR (e.g. concrete production or geotechnical applications), the results obtained by the study will be presented, in order to provide useful indication for optimal CDW treatment and recovery paths for the goals to be achieve.

Acknowledgements

Authors gratefully acknowledge technical and financial supports provided by the companies “Gruppo Gatti S.p.A”, “Esse Emme S.r.l” and “Fasanini S.r.l”.

References

[1] Official Gazette, 2006. *Legislative Decree 3 April 2006 n.152. Code on the Environment.*

[2] Eurostat*, 2019. Statistics Database.*

[3] Giorgi S, Lavagna M, Campioli A, 2018. *Guidelines for Effective and Sustainable Recycling of Construction and Demolition Waste.*

[4] Legambiente, 2017. *Rapporto cave*.

[5] Ispra, 2018. *Rapporto Rifiuti Speciali*.

[6] Butera S, Christensen T.H, Astrup T.F, 2014. *Composition and leaching of construction and demolition waste: Inorganic elements and organic compounds.*

[7] Galvín A.P., Ayuso J., García I., Jiménez J.R., Gutiérrez F., 2014. *The effect of compaction on the leaching and pollutant emission time of recycled aggregates from construction and demolition waste.*