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The Brazilian legislation for the reuse of civil construction waste

Abstract

Background: Civil construction is an important sector of the country's economic, technological and social development, generating employment, producing research and innovation and housing. However, it also has significant representation in the consumption of natural resources and generation of waste. The use of recycled construction material for the composition of mortars and concrete is a growing practice in the World and in Brazil, which in a scenario where sustainable development is gaining space is an important social, economic and technological environmental agent. The reuse and recycling provides a market for the generation of jobs, for the containment of raw material waste, for the reduction in the generation of waste and with this, economic gains and incentives to the technological development in relation to the verification of the requirements and properties techniques to ensure that the recycled material has the same quality as the original. Also, the legislation determined by CONAMA (Brazilian National Council for the Environment) for the management of civil construction waste, contributes to the expansion of this practice in the country. Through the literature review, the article presents the Brazilian legislation for the recycling of waste, the evolution of recycling plants, the characteristics of waste and the main aspects of recycling in the country, showing that the recycled waste, not only presents the same characteristics of common inputs, but can even, to offer gains in technical properties. As a conclusion, it is clear that the preservation of the environment resulting from the management of the construction site is extremely relevant to the maintenance of urban quality of life.

Keywords: construction and demolition waste; recycling of construction waste; Brazil, Resolution n°307/2002, Brazilian National Council for the Environment (CONAMA).

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Introduction

The volume of waste generated by construction and demolition in Brazil is twice as large as the volume of urban solid waste. It is estimated that 60% of the total waste produced in the country comes from construction. In the State of São Paulo (the one with the highest number of buildings under construction in the country), it is estimated the waste generation around 17,000 tons / day, being that 30% of this volume comes from the formal construction and the rest from the informal construction. According to the Brazilian Association for the Recycling of Construction and Demolition Waste, Brazil produces approximately 84 million m^3 of construction and demolition waste per year. This recycled volume could build around "7,000 ten-story buildings, 168,000 kilometers of roads, or 3.7 million popular homes.[1]

The use of construction and demolition waste is useful in several aspects:[2]

i. Decreases the incorrect disposal of urban "garbage".

ii. Reduces the need for landfills (even if correct for that purpose).

iii. Reduces the consumption of natural resources for the aggregates production and for all the agents necessary for their production (energy, water, etc.).

iv. Generating income in social programs.

v. Enables the technological development through the study of recycled material, its composition and new possibilities of use.

vi. When in scale, can reduce the cost of the work resulting from the acquisition of aggregates.

Kibert[3] defines the six basic principles of construction waste recycling:

i. Minimize the consumption of resources.

ii. Maximize resource reuse.

iii. Use renewable and recyclable resources.

iv. Protect the natural environment.

v. Foster quality by creating the built environment.

Based on the importance of the subject, the National Environment Council (CONAMA), a department associated to the Brazilian Ministry of Environment, established in 2002, the resolution n° 307, which establishes guidelines, criteria and procedures for the management of construction waste.[4] From then on, recycling plants were distributed throughout the country, allowing the reuse of the waste for the purpose of paving, execution of concrete, mortars and blocks.[5]

Figure 1 shows the implantation evolution of the recycling plants in the country, considering mobile plants (truck type) and fixed plants (private and government) and their accumulated totals.

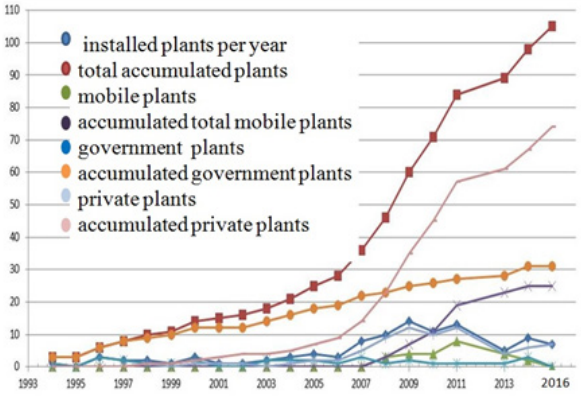

Figure 1: Recycling plants of construction waste in the country between 1993-2016.

Source: Miranda et al.[5]

CONAMA's resolution and recycling in Brazil

Resolution n° 307 of July 5, 2002 of the National Environment Council was an important instrument for the recycling diffusion of construction waste in the country, by requiring that all waste of construction must be correctly disposed of. This resolution "establishes guidelines, criteria and procedures for the management of construction waste". According to its text are considered as construction waste: [...] construction, renovation, repair and demolition of construction works, and those resulting from the preparation and excavation of land, such as bricks, ceramic blocks, concrete in general, soils, rocks, metals, resins, glues, paints, wood and plywood, linings, mortar, plaster, tiles, asphalt pavement, glass, plastics, pipes, electrical wiring etc.[4]

In Article 3 of that resolution, construction waste is classified as:[4]

i. Class A: the waste is reusable or recyclable as aggregates, such as:

ii. Construction, demolition, alteration and repairs of paving and other infrastructure works, including soils from topographical services.

iii. construction, demolition, renovation and repair of buildings: ceramic components (bricks, blocks, tiles, flooring boards etc.), mortar and concrete;

iv. Process of manufacture and / or demolition of precast concrete parts (blocks, tubes, bundles, etc.) produced at construction sites.

Class A waste can be recycled in the form of aggregates, allowing their use or future recycling.

i. Class B: Is recyclable waste for other destinations, such as: plastics, paper / cardboard, metals, glass, wood and others. Class B waste should be reused, recycled or transported to temporary storage areas.

ii. Class C: those residues have no economic viability technologies to enable their recycling / recovery, such as gypsum products. This waste must be stored, transported and disposed of in accordance with the specific technical standards. The same procedure shall apply to Class D waste.

iii. Class D: are hazardous wastes arising from the construction process, such as: paints, solvents, oils and others, or those contaminated from demolitions, repairs and repairs to radiological clinics, industrial installations and others.

According to the IPEA report,[6] the process of recycling construction waste begins at the work site, and some measures are needed to treat the waste until it is sent to the mills:

i. physical arrangement of the construction site and in particular, the planning for waste flow and its storage until the destination; analysis of the prevailing waste profile, analysis of companies that can transport the waste removal, and analysis of possible waste disposal sites;

ii. preliminary analysis of the waste that may be generated during construction and preparation of a proposal for the perfect sorting and storage of waste;

iii. definition of the responsible team for waste collection and all relevant functions: initial packaging and transfer to final storage;

iv. the choice and qualification of the collectors who will remove and transport the waste and routine elaboration for the destination of the waste;

v. Analysis of the possibilities of the waste recycling and recovery (especially masonry, concrete and ceramics).

A characterization of the waste generated in Brazil is given by Miranda et al.[5] Figure 2 shows this and profile

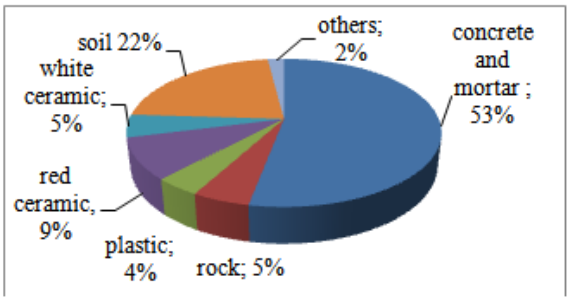

Figure 2: Composition of construction waste in Brazil.

Source: adapted from Miranda et al.[5]

Results

Although resolution n°. 307 order the reuse of waste, the physical-mechanical characteristics must be verified. Often the recycled composition can present better resistance than the traditional one and also sometimes, the use of recycled material results in savings in construction. Table 1 summarizes the uses indicated for each type of waste in Brazil[7].

Table 1 Recommended uses for the Brazilian construction waste

Product	Characteristics	Recommended uses
recycled sand	Material with a maximum characteristic size of less than 4.8 mm, free from impurities, resulting from the recycling of concrete and concrete blocks.	Masonry mortars for sealing, underlayment, soil-cement, blocks and bricks.
recycled small stones	Material with a maximum characteristic size of 6.3 mm, free from impurities, resulting from the recycling of concrete and concrete blocks.	Manufacture of concrete artifacts such as sealing blocks, interlocking floors, sewage shackles, among others.

Table Continued..

Product	Characteristics	Recommended uses
recycled gravel	Material with a maximum characteristic size of less than 39 mm, free of impurities, from the recycling of concrete and concrete blocks.	Manufacture of non-structural concrete and drainage works.
recycled medium stones	Material from the recycling of construction waste, free of impurities, with a maximum characteristic size of 63 mm (or at the discretion of the customer).	Base and sub-base works of pavements, reinforcement and subgrade of pavements, besides regularization of unpaved roads and landfills.
recycled big stones	Material with a maximum characteristic size of less than 150 mm, free of impurities, from the recycling of concrete and concrete blocks.	Paving works, drainage and leveling of ground.

Source: ABRECON[8].

Discussion

It is recommended that the decision for recycle or not the construction waste should consider:[8]

i. estimated generation volume and flow;

ii. Investment and costs for recycling (equipment, labor, energy consumption, etc.).

iii. types of equipment available on the market and technological specifications for recycling;

iv. Spaces allocation for the recycling and formation of an aggregates stock.

v. Possible applications for the recycled aggregates on the own construction.

vi. Technological control over the aggregates produced.

vii. Cost of natural aggregates compared to traditional material.

viii. Cost of waste removal and transport to the recycling plants or to the correct landfills.

It should be emphasized once again that, if recycling is the choice, the materials produced by the waste must meet the physical, mechanical, chemical and environmental requirements of the Brazilian standards and must be resistant, durable and workable with superior or similar quality when compared to traditional ones (this article doesn't intended to address this aspect).

Conclusion

Civil construction among all productive sectors is the one that consumes the most natural resources and one of the most generators of waste and environment impacts. Thus, a legislation that controls the generation of construction waste is of great importance to the sustainable development. This is precisely the role of the CONAMA resolution that creates standard instruments for the management of civil construction waste for public administrators (state and municipal governments) as well as construction companies. As it was seen in this work, the generic composition of construction waste in Brazil favors its reuse, but some care is needed in the sorting, packaging, storage and transportation of this material. It is concluded that in the medium term this practice will be spread throughout the country.

Acknowledgements

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Conflict of interests

Authors declare that there is no conflict of interest.

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