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ENVIRONMENTAL ASPECTS OF THE DISPOSAL OF SOLID REINFORCED CONCRETE WASTE FROM CIVIL CONSTRUCTION

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Abstract: The objective of this work is to understand the diversity of Solid Waste of Reinforced Concrete from Civil Construction - RSCACC in the environmental context, with regard to the management and classification addressed, in addition to carrying out the physical and mineral characterization of samples of this waste. In large urban centers, Civil Construction - CC emerges as one of the main economic activities, but on the other hand, the considerable consequences of this activity are perceived, above all, in relation to Environmental Impacts - AI, since, the CC, for nature, generates notable amounts and varieties of waste, with solids being the main one, and which present considerable volumes on construction sites. Faced with this reality, measures referring to good environmental and management practices, become preponderant, in order to minimize the environmental damage caused by Solid Waste - RS, allowing, therefore, that there are new alternatives.

Keywords: Waste, Construction and Environment.

INTRODUCTION

Inadequate waste disposal is one of the main reasons for harming the environment, with the potential to affect people's quality of life, the balance of ecosystems and the availability of natural resources. Waste from civil construction activities is no exception, and is part of this problem if not properly managed. Furthermore, their inadequate management represents a great economic waste, since these not only constitute the largest mass fraction of waste generated in cities, but in many cases are largely composed of material that can be recycled or reused (CARDOSO, 2019).

With the intense industrialization of metropolises, the advent of new technologies, population growth in urban centers and diversification of consumption of goods

and services, waste has become serious urban problems, with costly and complex management considering the accumulated volume and mass, mainly after the 1980s, 1990s and 2000s. The problems were characterized by a shortage of waste disposal areas caused by the occupation and valorization of urban areas, high social costs in waste management, public sanitation problems and environmental contamination (JOHN, 1999 ; JOHN, 2000; BRITO, 1999; GÜNTHER, 2000; PINTO, 1999).

Waste from civil construction is very common in Brazil, due to the considerable number of existing works, mainly in the large urban centers of the country, where CC stands out in the economic scenario and also for the generation of waste, being solids, the main ones.

Faced with this reality, there is a need to adopt better treatments for the SR generated by the CC, to minimize the problems of Environmental Impacts - AI caused by this activity. Thus, there is no doubt that the creation of alternatives for the use of this type of material is essential to mitigate the impacts generated.

Today, there is a set of norms that govern waste management in general, allowing the public authorities at the Federal, State and Municipal levels, anchored in the law, to actually act together with CC works, on the various scales, ranging from from the exploitation of raw materials, the works and the waste generated in them. Due to the fact that Solid Waste Management - GRS has an environmental character, this practice, at construction sites, is undoubtedly also the responsibility of each citizen, that is, the community must contribute so that the Management of Solid Waste from Reinforced Concrete of the Civil Construction - GRSCACC is successful, however, enabling better results regarding these materials

Santos et al., (2015), states that:

Nowadays, it must be argued that civil construction can be causing a great environmental impact due to the violent extraction of natural resources and the misuse of waste produced by civil construction. It is notorious for the entire population the amount of these materials dumped on construction sites or on sidewalks, streets, etc., which encourages a degraded environment.

Faced with the challenges encountered at the CC construction sites, resulting from the amount of debris, especially RS, the need to disseminate the knowledge produced becomes preponderant. Thus, the dissemination of information through didactic presentations for students of the Civil Engineering and Building Technician courses, in relation to the RSCACC, has considerable relevance.

METHODOLOGY

Next, we have the synopsis on the descriptive design of the different stages of the research.

- Bibliographical research: conducting a survey and readings on the research topic;
- Reading review: organization based on the selection of the most relevant readings for carrying out the research;
- Organization of the readings carried out: elaboration of synopsis of articles, books, etc., registering the bibliographical references;
- Treatment of data obtained by characterization and discussion of results;

HISTORICAL CONTEXT

In the 21st century, the environmental impacts in rural and urban areas have been causing many concerns for humanity. Even with technological advances, it is clear that the environmental issue is placed in the

background, and with that, the quality of human life also suffers the consequences.

In a highly consumerist society, the demand for raw materials is growing, however, due to technological advances, it is possible that adequate and environmentally correct measures are adopted so that less impact on nature occurs.

Today, in Brazil, CC uses a huge range of industrialized products, such as iron, cement, paint, varnish, wood, glass, plastic, etc. In urban areas, civil constructions are numerous, including the construction of houses, buildings, bridges, viaducts, tunnels, among others. It appears that in all these works, we have extensive use of cement and iron.

It happens that over time, even with the reforms for the maintenance of these works, there is a need for demolition, either for safety reasons or to make way for a more modern work to replace the one that existed before, or even to build a totally different one.

In large cities, old buildings and mansions when demolished generate a considerable amount of solid waste, whose destination must comply with established safety standards. In this context, the management of these wastes is a relevant and necessary measure that supports the minimization of environmental problems.

Iron and cement, widely used in the various CC works, with the demolition process, recycling taking place, in addition to enabling the generation of employment and income for many workers, allows them to be reused in various productions.

Therefore, from an environmental perspective, the investigation carried out is of great relevance in itself, as it is perfectly adequate and necessary, above all, because it is outlined in objectives that together allow understanding the importance of the GRS of the CC, in order to provide improvements in environmental quality.

CLASSIFICATION OF SOLID WASTE

According to article 225 of the Federal Constitution of 1988, the so-called Citizen Constitution, in its caput, we have that: "Everyone has the right to an ecologically balanced environment, an asset for common use by the people and essential to a healthy quality of life, imposing itself on the Public Power and the community the duty to defend and preserve it for present and future generations."

Therefore, environmental concerns are the responsibility of public authorities and the community. Thus, it becomes essential that civil society, organized in a conscious manner, has citizen participation with public authorities, directly or indirectly, in order to contribute to public authorities and, this way, contribute to a collective environmental awareness.

However, for this to happen, it is essential that the various entities of the Brazilian federation, namely, the Union, the States and Municipalities, have a policy that includes efforts and initiatives capable of minimizing the serious environmental problems in rural and urban areas of the country.

The CC is, without a doubt, a great generator of RS, and in this sense, there is a need for the public power and the community to strive for improvements for this sector, which with the process of Brazilian industrialization has been showing significant growth, due to the rural exodus and as a consequence the growth of cities, generating an increasing demand for new constructions, as well as demolitions.

In this context, the demolition process of CC works is a field that lacks theoretical foundations that lead to contributions to minimize the environmental problems arising from this reality, very common in the country's urban centers, especially in

large cities. In accordance with CONAMA Resolution 307, Civil Construction Waste - Federal Law, in relation to the GRSCACC, in its article 1, the characteristics of the main elements that make up the production process are defined, namely, "Generators, Conveyors, Management of Waste, Waste Disposal Areas, Civil Construction Waste Landfill, Recycled Aggregate, Reuse, Recycling and Improvement."

Civil construction waste – RCC represent 50% of the mass of urban solid waste – MSW. An estimate points to an amount of 68.5 million tons per year, given that 137 million people live in urban areas. Most countries in the world invest in a formal management system to reduce illegal and systematic dumping, which cause silting up of rivers, clogging of sewers, degradation of areas and depletion of landfill areas, in addition to high socioeconomic costs, especially in cities of medium and large size (ANGULO, 2005).

According to studies by Amorim et al., (1999), mortars with RCC have satisfactory mechanical performance, making waste recycling very promising, capable of producing low-cost constructive elements.

The RCC'S, when going through the comminution and grinding process, can present pozzolanic activity and be used with lime or as partial substitutes for Portland cement in the production of grout, mortar and concrete (FARIAS FILHO et al; 2006).

According to research carried out by Leite (2001), he points out that the absorption rates of recycled aggregates are quite high and, therefore, there is a need to compensate them during the production of concrete so that there is no excessive decrease in water. free of concrete mixtures produced with recycled aggregates, a fact that would compromise workability. Another relevant factor is that the tensile strength of concrete with recycled aggregates is inversely proportional to the

size of the recycled aggregate used, due to the inherent fragility of the material.

In the works of Levy (2001), it is confirmed that the insertion of concrete and masonry residues up to a content of 20% does not affect the behavior of the concrete in relation to the reference (without residue), demonstrating that they can be used without any restrictions on strength and durability.

SOLID WASTE MANAGEMENT

The management of the RSCACC is relevant, mainly in large urban centers, due to the need to minimize the environmental problems that are of great importance, therefore, there is a need for adequate management, in order to curb these problems, which undoubtedly are enormously harmful to man, and finally, to MA as a whole.

Environmental damage from the RSCACC is a reality throughout the national territory, therefore lacking adequate measures to minimize such problems, and management plays an important role in this context.

Thus, the use of recycled materials from CC is important from an environmental point of view, since there are many materials related to iron and cement that, in general, can and must be reused, being, therefore, an environmentally correct measure.

Therefore, in order to enable adequate sustainability in relation to the SR arising from CC, a relevant aspect is the management of these wastes, as a way to provide better results, and thus contribute more significantly in the environmental context.

SR are considered the most visible and concrete expression of environmental degradation, playing an important role in the sanitation structure of an urban community and also in aspects related to public health. In addition to the consequences for community health, one must also consider the impact that the inadequate disposal of this waste causes

on the soil, atmosphere, vegetation and water resources (SANTOS, T. R., MARINHO, J.P. and SOUZA, H.A., 2015).

It is clearly perceived that the RS are the cause of environmental problems, including also causing economic damage, as it affects the environment in the man in his relationship with the MA, due to the degradations caused by the exposure of these residues, being able to even provoke illnesses for the people and also soil contamination, which can pollute rivers and their sources, also affecting aquatic life and flora.

Faced with this reality of an environmental nature, the collectivity and the public power have responsibility and need to fight for the MA not to be radically attacked by man in his relations with nature.

It is clear that man throughout historical time has been related to nature, whether in the search for food for his survival or for the construction of shelters. However, since the Industrial Revolution in the 18th century, it has been verified that, as a result of the growing production of the most diverse types of goods, it has generated an intense exploitation of raw materials, and also, the growth of urban agglomerations with the emergence of large cities, which has substantially aggravated man's aggression towards nature.

However, it is necessary to reflect on this reality, and using available technologies, try to minimize the environmental problems arising from the exploitation of raw materials, and on the other hand, adopt environmentally correct practices in the various areas of production, and also, not adhere to consumerism, that is, unbridled consumption, driven by impulse and fashion, and which does not represent the real human needs.

The Brazilian Magna Carta, in its article 225, caput, makes clear the responsibility of the public power and the community in relation to the MA. This way, each human being must

do their part in order to avoid and minimize environmental problems, so common in local, national and global environments.

ABNT NBR 15112/2004	Civil construction waste and bulky waste – transshipment and sorting area, guidelines for design, implementation and operation.
ABNT NBR 15113/2004	Solid waste from civil construction and inert waste – landfills – guidelines for design, implementation and operation.
ABNT NBR 15114/2004	Solid waste from civil construction – recycling area – guidelines for design, implementation and operation.
ABNT NBR 15115/2004	Recycled aggregates of civil construction solid waste – Execution of paving layers – procedures.
ABNT NBR 15116/2004	Recycled aggregates of civil construction solid waste – use in paving and preparation of concrete without structural function – requirements.

Table 2 ABNT norms referring to civil construction waste.

Source: Prepared by the author, based on ABNT.

There are numerous ABNT norms referring to the SR of the CC, which must be faithfully complied with by the CC, providing greater assurance, and allowing respect for the MA, as the works built respecting the current norms, avoid negative consequences for the workers and the MA.

There is, therefore, emphasis on the SR produced at construction sites, and because they are complex, management has a preponderant role, in order to minimize the AI caused by these wastes. It is undoubtedly a huge challenge, but facing it is a necessity that requires commitment from the public authorities and the community.

It is noted that in Brazil there is legislation relevant to the management of RS, and that, when put into practice, the environmental damage caused by these residues will be minimized.

Therefore, the GRSCACC is a necessity with great demand in Brazil today, considering that each year this waste grows in the CC construction sites. However, in face of this reality, with support in the pertinent legislation, the possibilities of advances are already perceptible, but it is necessary to continue walking the path of environmental responsibility.

GENERAL CLASSIFICATION OF SOLID REINFORCED CONCRETE WASTE FROM CIVIL CONSTRUCTION

There is a huge variety of RS related to CC reinforced concrete, such as iron, concrete, etc. All, in general, are part of CC works, and therefore need special care, since, released into nature, they can cause great environmental damage, thus corroborating the negative affectation of environmental quality.

Faced with this reality, it becomes necessary to know these residues, and to contribute towards minimizing the environmental damage caused by them. Always remembering that this practice must belong to the public authorities and the community, since every citizen has the responsibility to contribute to environmental improvements.

Due to the fact that it is not mandatory, but of high importance, its practice based on actions from the public authorities depends on collective actions, where each citizen, in the exercise of his citizenship, can and must in a peaceful and organized manner, demand that the public authorities take the appropriate measures in relation to SR.

Nowadays, due to technological advances, it is perfectly possible to minimize the emblematic problems in the CC area, with the adoption of measures that respect the MA, and above all people. Finally, CC's entire production chain, using available technologies, undoubtedly guarantees better environmental quality.

It is noticed that the SR have an enormous variety and complexity, as we can identify from their classifications, which requires a treatment compatible with this reality, focusing on the principles of efficiency and organization, as basic elements of the GRSCACC.

There is, therefore, a great diversity of SR, including those that are dangerous, with enormous potential for damage to AM and human health, therefore requiring special care by the public authorities and the community.

It is necessary that the SR have an adequate destination and treatment, in accordance with the current legislation, at the Federal, State and Municipal levels, and that the public power and the community are active, contributing so that in the production chain these residues can again start the process. its production cycle, with reuse.

THE PROPER DESTINATION OF SOLID REINFORCED CONCRETE WASTE FROM CIVIL CONSTRUCTION

The management of RSCC being practiced satisfactorily, in line with the concept of sustainable development is a necessity, and currently it has been a much discussed and debated topic, in the sense of building a society that respects the MA, preventing the productive sector and it occurs irrationally, going against the limits of nature itself, and thereby compromising the very lives of future generations.

The theme of sustainable development is much discussed nowadays, mainly due to the serious environmental damage that has been occurring all over the world due to the growing demand for goods, and consequently, the accentuated demand for the exploitation of raw materials.

These residues, popularly called debris, characterization given by the National

Council for the Environment - CONAMA, present a wide variety of residues, and in the process of demolition of CC works, the volumetric dimension of these elements is clearly observed.

In this context, the reuse of these residues has an enormous advantage for MA, since, this way, the exploitation of raw materials for the production of countless products useful to man is minimized. In the particular case of our research, the use of concrete in general, for the production of fence posts, is undoubtedly already a significant contribution to environmental improvement, considering that, among the various residues, concrete has a prominent volume.

It is clear that the reuse of CC waste is an appropriate and necessary way to ensure that these wastes do not cause environmental impacts, above all, in the big cities, demanding, therefore, higher demand for raw materials.

IMPORTANCE OF RSCACC REUSE

Nowadays, in Brazil, there is a large amount of RS, which are released into nature without the necessary care, as determined by current legislation, at the Federal, State and Municipal levels. This reality needs to be modified, and for this to happen, the participation of each citizen is important.

One of the ways to minimize AI caused by this waste is its reuse, also contributing to the generation of jobs and income for many people, and thus giving them citizenship and more dignity.

In the process of demolition of CC works, it is important to reuse the waste generated, because, with this practice of an environmental nature, there will be less AI, considering that fewer raw materials will be exploited.

According to Tam, Soomro and Evangelista (2018), we have that:

Construction waste occurs due to construction and renovation of buildings and results from surplus material (oversupply), damaged or broken material (therefore unusable), cut parts, processing waste (saw dust, metal waste), dismantled formwork, used tools and accessories, packaging and garbage generated by people on construction sites.

It is noted that there is a huge variety of SR at CC construction sites, and its reuse is a viable alternative, as it has the real possibility of contributing to improvements in environmental quality and also providing more labor for people, from the generation of employment and income.

Still, according to Tam, Soomro and Evangelista (2018), the demolition waste of:

demolition of built structures, bridges, roads, etc., their removal or complete renovation. It also includes demolition debris caused by natural disasters (earthquakes, hurricanes and tsunamis), civil unrest, vandalism, explosions, fires, collapse of weak structures, etc.

In the context of the reuse of SR, there is also the aspect related to the opportunity to generate job opportunities for many people, contributing, therefore, to earn more human dignity for these workers, whether working in companies that reuse these materials or through cooperatives, working in the cooperative system, being therefore the owner of his own business, since in a cooperative the bonuses and the onus belong to everyone.

According to Sá et al., (2019), understand that:

The solid waste that the work generates can be recycled and used at the construction site itself. With the implementation of recycling equipment, not only does it reduce costs, but it helps to preserve natural resources and minimize the environmental impacts caused by the civil construction sector. Emphasizing that natural aggregates are

finite and exhaustible resources, therefore visualizing a future in which replacement by recycling will no longer be something optional and will become mandatory.

RS are exhaustible, and in this sense, recycling is a necessity and also a way of generating jobs and income for people, and thus contributing in practice to minimizing the exploitation of raw materials. With this understanding, the GRSCACC plays an important role, and it is certainly a contribution towards making it possible for SW at construction sites to be treated effectively.

GENERAL APPROACHES ON THE ENVIRONMENTAL ISSUE ARISING FROM SOLID WASTE OF REINFORCED CONCRETE FROM CIVIL CONSTRUCTION

In Brazil, environmental problems are the subject of many questions, especially in higher education institutions and research centers. However, it is clear that environmental awareness, when it comes to the community, still needs greater action, from a real point of view, in order to minimize these problems in practice.

Facing the environmental problems generated by SR is a necessity, since the neglect of this reality is undoubtedly the passivity of society, and which is itself the main harm, when living with an environment conducive to the proliferation of diseases, and therefore, compromising the quality of life for people.

Bessa, et al., (2019) claim that:

The irregular disposal of waste can bring a series of problems to the environment, such as contamination of the soil and surface and groundwater, offering shelter and favorable conditions for the development of pathogenic agents and synanthropic animals, in addition to the unpleasant visual aspect it provides, directly influencing negatively on the quality of life of the population.

It is undeniable that the SR being irregular in nature, the environmental problems are of enormous gravity, requiring, therefore, attention, both from the public power, as well as from the community, as each citizen can and must participate in the search for alternatives, in order to minimize this problem that directly affects the quality of life of the population, especially in large urban centers.

It is undeniable that consumerism is part of today's societies, but questioning and confronting this reality go hand in hand, because environmental awareness, even incipient, shows that a portion of society discredits the practice of consumerism.

Undoubtedly, consumerism is harmful to people, as many products are put back on the market, with some innovations, which, in general, instills in people an excessive desire to acquire these products, as a way of satisfying their personal desires, even that do not need to use technological additions. The cell phone is a good example of this vision that we present, within the concept of consumerism, as we often acquire a new device, but do not use most of the resources it offers.

Consumerism, undoubtedly, is responsible for the high amount of waste, especially in large urban centers, and in this current context in Brazil, the SR generated by CC, increase in construction sites, because it is precisely from the years of It was 1950 that Brazilian industrialization began to show greater growth, giving rise to an intense migratory process of rural exodus, and, in turn, the growth of urban centers.

Therefore, the environmental damage that RS can cause to MA is enormous, especially in large urban centers, and thus, it is clear that human beings are the most affected, especially the population residing in the urban outskirts of the country, where

infrastructure, especially basic sanitation, is quite deficient.

CONCLUSIONS

In addition to the AI caused by the irregular disposal of RSCC, where the damage will often be difficult to repair or irreparable, one has to consider the economic potential that reuse can provide. For making stakes, stakes and roofing, in addition to being environmentally appropriate, as most of the input will be the result of reprocessed concrete or mortar, iron is another extremely important input, thus avoiding even contamination of streams.

The aforementioned research, carried out based on a qualitative approach, had an environmental focus in its course, approaching the GRSCACC, as it is a necessity, in view of the need to adopt improvements in construction sites, using technologies, disseminating information and valuing people, as this research, at different times, demonstrated the need to reuse the SR generated by CC, whether from demolitions or not.

Thus, it is expected that this research will have a positive impact on the scientific community in general, and on educational institutions, above all, on the Technical courses in Buildings and Civil Engineering, in order to awaken in these students, more information and knowledge, the regarding the topic researched, and for those who already work or will work in the CC, to reflect and act on the construction sites, striving for improvements in the treatment of SR.

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