ANÁLISE DA CADEIA DE RESÍDUOS DA CONSTRUÇÃO CIVIL DE FORTALEZA

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RESUMO

Esse estudo buscou mapear o fluxo de processos do RCC desde a geração até a reinserção no mercado ou disposição final. A metodologia da pesquisa se pautou na realização de entrevistas semiestruturadas com representantes do setor público e privado do processo de gerenciamento de RCC. A pesquisa contribuiu para a caracterização das atividades individuais e coletivas de empresas locais envolvidas na logística reversa do RCC e dos intervenientes do processo, além da listagem dos seus principais entraves. Conclui-se que existe a necessidade de maior conscientização dos *stakeholders* (principalmente as construtoras), desburocratização para implantação de usinas de reciclagem, desenvolvimento de técnicas para tratamento de outros materiais como o gesso e a madeira, incentivos para os produtores e compradores de produtos reciclados, maior fiscalização da triagem, transporte e destinação final do RCC. O estudo da logística reversa do RCC se faz necessário para a criação de novos planos de ação, políticas de incentivos, leis e aplicação de sanções que permitam o avanço da atuação sustentável.

Palavras-chave: Gerenciamento do RCC. Logística Reversa. Sustentabilidade.

CIVIL CONSTRUCTION WASTE CHAIN ANALYSIS IN FORTALEZA

ABSTRACT

This study sought to map the flow of CDW processes from generation to reinsertion in the market or final disposal. The research methodology was based on semi-structured interviews with public and private sector representatives of the CDW management process. The research contributed to the characterization of the individual and collective activities of local companies involved in the reverse logistics of the CDW and of the stakeholders of the process, in addition to listing its main obstacles. It is concluded that there is a need for greater awareness of stakeholders (mainly construction companies), reduction of bureaucracy for the implementation of recycling plants, development of techniques to treat other materials such as gypsum and wood, incentives for producers and purchasers of recycled products, greater supervision of the sorting, transportation and final destination of the CDW. The study of CDW reverse logistics is necessary for the creation of new action plans, incentive policies, laws and application of sanctions that allow the advance of sustainable performance.

Key-words: Management. Reverse logistic. Sustainability.

1. INTRODUCTION

Currently, the Construction Industry is among the main causes of environmental impacts, not only due to the consumption of natural resources in its production chain, but also due to the indiscriminate disposal of construction and demolition wastes (CDW)[1]. The CDW not only represents the largest share of solid waste existing in urban áreas[2] but also makes construction industry the largest contributor to landfill growth[3].

Increasing pressure to improve quality, productivity, efficiency, effectiveness and sustainable development has guided the new behavior of construction companies[4]. Therefore, it is crucial the study of the reverse distribution channels, also known as reverse logistics, which deal with actions ranging from the reduction of raw materials used to the correct destination of products, materials and packaging[5].

This research aims to propose improvements to the CDW reverse logistics process through the analysis of the waste generation chain in Fortaleza, Ceará. It is important to emphasize that this study does not focus on the chemical analysis of materials, their reactions or technological innovations. Nor is it intended to investigate the details of the material life cycle. Its approach is focused on aspects of reverse logistics, through the study of several stakeholders in the Metropolitan Region of Fortaleza.

2. SUSTAINABILITY IN CONSTRUCTION INDUSTRY

Over the last decades, it has been noted that economic and production systems cannot be separated from environmental aspects. Increased awareness about sustainability has become a priority in the design and operation of supply chains[6]. Green supply chain management practices, such as reverse logistics, ensure that environmental and ecological objectives are aligned with the chain's operational objectives[7].

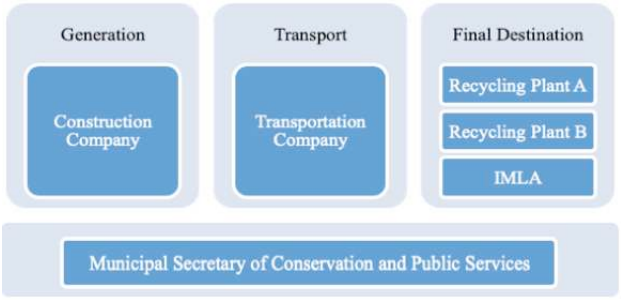
Considering that the construction industry is able to absorb almost all its residues[1], the Resolution of the National Environmental Council (CONAMA) No. 307 was implemented with the purpose of facilitating the reuse of waste through the use of a classification according to the CDW reuse or recycling capacity[8]. This resolution was further supported by the approval of the Solid Waste National Policy (SWNP)[9], which establishes guidelines for the integrated management of solid waste to generators, public authorities and economic instruments[10].

With respect to the waste reuse capacity, there are several possibilities of using CDW components as filler, sub-base of highways, insulation products, among others[11]. In accordance with studies carried out by ABRECON[9], the main causes of the difficulty in the sale of recycled products are the lack of legislation to encourage consumption, a lack of knowledge by the Market and a low waste quality. As a result, most of the CDW is still sent to landfills, reused or cremated precariously[19].

3. METHODOLOGY

This research focuses on the analysis of the individual and collective activities of the CDW 's reverse logistics in Fortaleza – Ceará, aiming to describe all phases and members from generation to reuse and reinsertion of the waste into the construction industry. Public and private sector representatives from the CDW management process were interviewed (Figure 1). To do so, the methodology involved a construction company, two recycling plants, an inert material landfill area (IMLA), a transportation company and the Municipal Secretary of Conservation and Public Services (MSCPS).

Figure 1 – Research participants



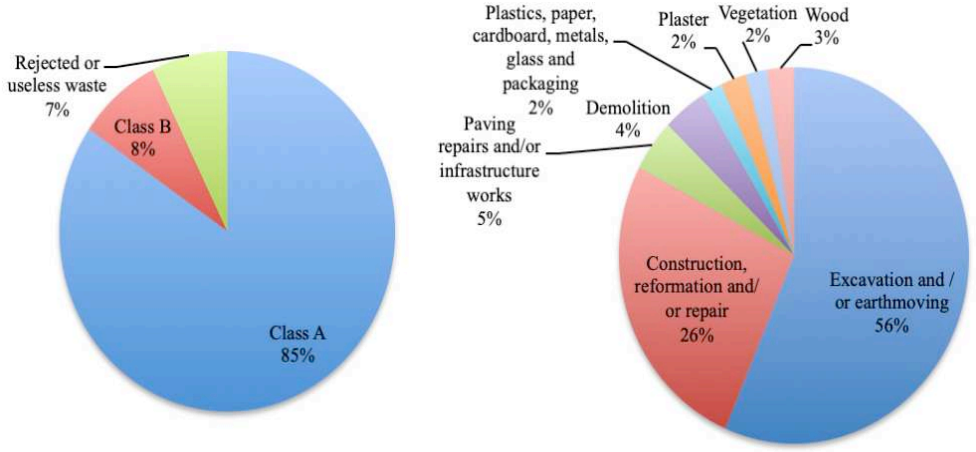
The stakeholder research was conducted through the application of semi-structured interviews, composed by legal questions, logistics and financial. The data were treated and concatenated, giving rise to information such as the characterization of each participating company, the main CDW components generated in Fortaleza, the description of the entire reverse process, as well as the main difficulties of each participant.

4. RESULTS AND DISCUSSION

4.1. Characterization of the CDW production chain actors of Fortaleza

The waste generators are firms responsible for activities or businesses that generate CDW. According to the construction company, the Civil Construction Waste Management Plan (CCWMP), required by the Law No. 12.305[13], is the main step taken by the company to properly manage the CDW. Through this plan, many actions that will guide the management of waste throughout the execution of the work are defined, such as environmental awareness.

Figure 2 – Class and composition percentage of reusable waste (classes A and B) of Fortaleza 2016 - 2018



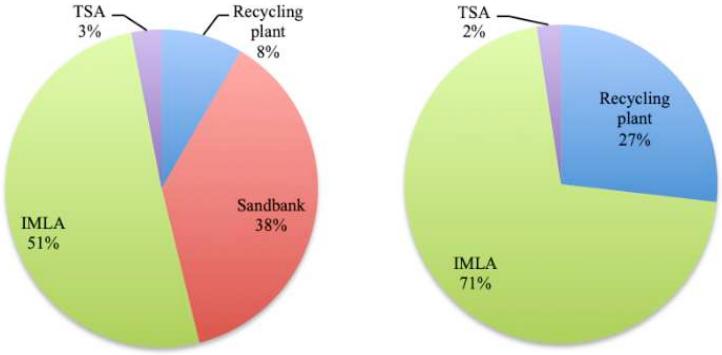
According to [14], the CDW average volume generated monthly in the city has been relatively stable in between 2016 and 2018. Regarding the percentage of waste generated by class between these years (Figure 2), the same data suggest that of all the CDW produced in Fortaleza, 85% correspond to class A materials and 8% correspond to class B materials. Considering only the reusable residues, 56% of its composition corresponds to sandy materials resulting from the preparation and excavation of land and 26% of ceramic components, mortar and concrete. This information corroborates with researches related to the composition of CDW in the country[15] and reveals a pattern for buildings based on the use of concrete and ceramic.

The conveyors correspond to the companies responsible for collecting and transporting the waste. In order to transport the CDW, the company interviewed uses multicranes with up to ten years old, and

bucket trucks for transportation of excavation, demolition and earthmoving waste. In order to better control solid waste collection and transport services, the vehicles have a GPS tracking and monitoring system capable of providing MSCPS real-time access to the primary geo-referencing data as well as the display of the historical tracking data of all accredited vehicles.

The areas of waste disposal are sites designated for the processing or disposal of waste. In this research, these areas are represented mainly by recycling plants, IMLAs, transhipment and sorting areas (TSA) and sandbanks. According to [14], it is noticed that about half of the total CDW generated in the city is destined to IMLAs. Subsequently, the sandbanks correspond to 38% of the destination of the CDW. Recycling plants, which are responsible for the waste treatment, correspond to 8% of waste disposal destination, followed by TSAs, which are responsible for the correct sorting and disposal of 3% of the material (Figure 3).

Figure 3 – All classes waste and class A (except A1) waste percentage according to final destination 2016 - 2018



Considering only class A waste (Figure 3), except class A1 waste (sandy materials resulting from the preparation and excavation of land), about 71% are destined to IMLAs, followed by recycling plants (27%) and TSA (2%). It can be seen that most of the CDW is focused on the deposit of the material. In addition, the Metropolitan Region of Fortaleza has only two recycling plants in operation, leaving the TSAs and IMLAs to the final destination of the waste.

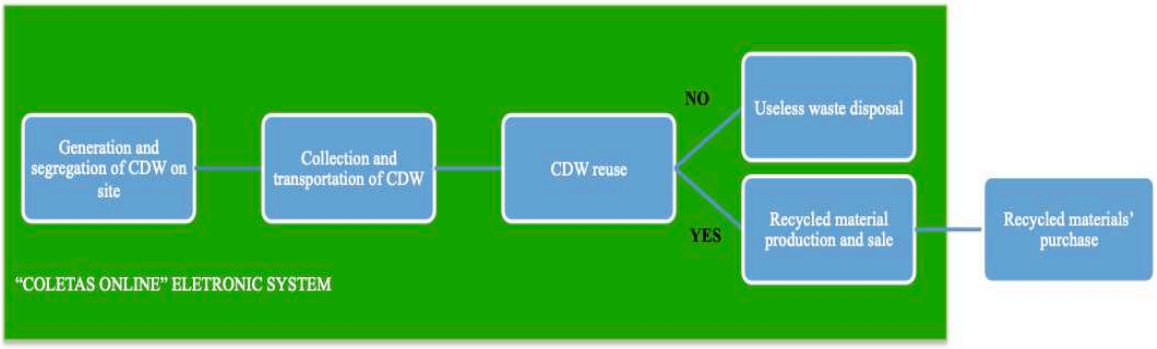
MSCPS plays a key role in the waste management policy of Fortaleza. An example of this is the creation of the Solid Waste Management Action Program, characterized by the implementation of progressive actions in various districts and regions of the city, involving solutions in areas such as

environmental legislation review, ecopoints creation, the electronic system Coletas Online control, accreditation and monitoring of transportation vehicles, among others.

4.2 Steps for CDW reverse logistics

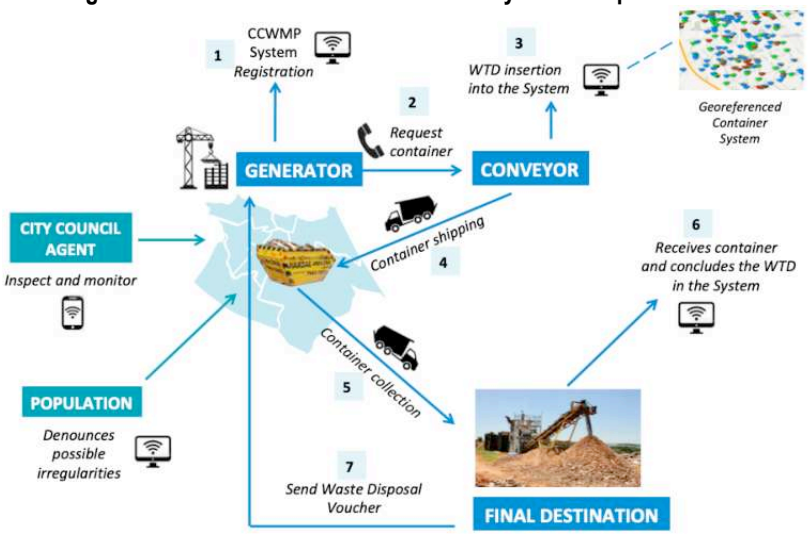
The CDW's reverse logistics consists of a sequence of activities performed by the actors described above, in order to know its operation, identify failures and propose improvements for the system. The builder starts the process by generating waste, seeking to reduce volumes, segregating the waste on site and depositing it in containers (Figure 4). The CDW transported by a licensed and accredited company may or may not be reused, depending on the class of the waste.

Figure 4 – Processes' flow



In cases of impossibility of treatment, the waste is disposed on landfill areas. Otherwise, the material is allocated for recycling plants, TSAs or IMLAs according to the waste reversibility potential. Finally, the production and sale of recycled products is responsible for the return of the material to the consumer market inside and outside the construction industry.

Figure 5 – Solid waste control electronic system's implantation (16)



Throughout this reverse chain, the Coletas Online system works as a tool to support the management of these activities. The first step consists of the CCWMP registration in the system by the construction company, followed by the choice of an accredited company available on the City Council website (Figure 5). The WTD input begins with the notification of the dispatch of the requested containers. When the shipment records and/or the removal of buckets are made in the system, both the municipality and the other stakeholders have control of the location of the buckets, as well as the delays for removal and transportation of the CDW to the landfill. The WTD confirmation is given after the container delivery and the checking of the CDW classification at the final disposal site. After completing this step, the waste destination confirmation is sent to the participants.

4.3 Obstacles to the progress of waste management in the city of Fortaleza

It widely known among the parties interviewed that the lack of concern or mentality regarding environmental issues is one of the main obstacles to improve the construction waste management. The lack of knowledge and interest on the subject and the prevalence of financial issues over environmental aspects can also be included. During the interviews, all the participants mentioned the difficulty in changing the thinking of managers and construction workers as the possible cause of other problems, such as lack of supervision and government incentives.

The preferential – which implies a non-obligation – segregation or sorting of the waste at the origin, described in CONAMA resolution No. 307[8], leads the generators to a discretionary attitude regarding the separation of the CDW components. In addition, in practice, the Fiscalization Agency of Fortaleza is also knows by its deficiencies in the inspection of such requirements, which makes it difficult to take preventive and corrective measures.

The absence or inefficiency of supervision ends up being compromised with companies that act in an irregular way. Examples include the lack of a license for the execution of Works and the non-reduction and non-segregation of waste on site by the builders. The delay in the useless waste disposal and the receiving of waste outside the Coletas Online system is also a recurring issue among the interviewees. In addition, in the case of conveyors, the activities of several non-accredited

companies, not sending the WTD and the use of uncredited vehicles to increase the operational capacity of accredited companies are some of the complaints presented by the interviewees.

It is perceived that the expenses that a regularized company spends to meet sustainable goals end up making its contracting financially less advantageous than an irregular company. According to MSCPS data, garbage collectors and unlicensed transportation companies offer services at prices that correspond to one-third of the prices practiced by the regular market. As a result, the third obstacle, which deals with the lack of government incentives, becomes more understandable, since the implementation of various advantages, such as tax deductions, ends up making companies adhering to environmentally sound practices more competitive than the others .

According to those responsible for transportation and final destination, the lack of punishment inexorably drives the action of clandestine companies to remain active in the market. However, at the same time as the survey participants reveal a loosening of the law enforcement to fight clandestinity, they point out excessively heavy penalties on companies with legal action in the market.

The performance of some construction companies in disagreement with the SWNP prescription was strongly emphasized during the survey, being considered the main responsible for not reusing much of the CDW. In addition, cases where only part of the waste is transported by licensed companies during the day while another part is disposed of in irregular locations at night have been mentioned as frequente, as they represent a significant reduction of costs. It is noticed that shared responsibility is not always considered, since there is no concern on the part of the construction company in knowing the end given to the residue.

In addition, a common concern among generators and conveyors, the additional costs related to sustainable measures were cited as barriers to compliance with environmental guidelines. The purchase of materials for the waste segregation, a larger number of containers rental, personnel training, the need for eventual purchase of vehicles and expenses with the recycling plant and/or landfill area are examples of requirements that burden substantially the expenses of the stakeholders.

Finally, the final waste disposal sites face specific problems, even though they have strategies to combat them. If on the one hand these residues have a scientifically proven potential to act as substitutes for construction materials, on the other hand, the poor quality of their contents, lack of

techniques or high treatment costs limits the production of recycled materials that attract the consumer market, both in terms of quality and in relation to uncompetitive prices. Added to this, the bureaucratization for the opening and maintenance of this type of company has served as a great discouragement for the growth of this market in the city.

5. CONCLUSION

The research proved the need to study the CDW reverse chain – including its actors, functions and activities – to propose appropriate solutions to the obstacles listed by its participants. This need is due, in large part, to the interdependence of the actors in the chain, which ends up conveying the positive or negative consequences of an action for other participants, such as price increases and less use of waste.

Through the analysis of the processes' flow, it was verified that financial incentives such as reduction of taxes for producers and consumers of recycled products are necessary. There is a need for greater severity in the imposition of penalties and the establishment of an environmental target plan that stimulates accountability. Along with this, awareness policies and the normalization of sustainable behaviors are measures capable of mitigating the negative impacts of the reported obstacles.

Methods of waste quantification, such as the Coletas Online system, also represent useful aid instruments for generators and inspectors. This type of tool assists both in the estimation of volumes produced as well as in the verification of the estimated and the actual CDW volume transported to the final destination. In addition, systematization of data on the actual generation of waste by work, by surveying the exit volumes of the builders and entering the mills and landfills, would facilitate the control and investigation of possible deviations for irregular destinations.

The interviews allowed the knowledge of the generated waste, as well as the first components reused in the recycling plants; the actions taken to reduce waste on site; and the ways of treatment and reinsertion of the recycled product in the production chain. Thus, it was concluded that the objectives of analyzing the waste generation chain in Fortaleza under a sustainable perspective and proposing improvements to the reverse logistics process were achieved. For future research, it is suggested the search for a greater number of stakeholders, the creation of local indicators and the survey of international legislation on the subject.

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