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## **TECHNOLOGIES IN SELECTIVE COLLECTION IN BRAZIL: AN ANTHROPOTECHNOLOGICAL PERSPECTIVE**

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### **Abstract:**

The problem that involves the management of solid waste is a subject that has been gaining more and more prominence in the literature. Brazil, an international highlight for developing means to integrate waste cooperatives with waste collectors, has instituted the National Solid Waste Policy to regulate the responsibilities of the recycling chain. From this policy, municipalities must develop means for the collection, treatment and disposal of waste including the cooperatives of waste pickers. This article aims to relate technologies in selective collection with the perspective of anthropotechnology. In order to reach the objective, studies were used in the literature on the work organization and the technologies used in the selective collection. It is concluded that in order to develop municipal solid waste plans, public managers must incorporate into the logic of the different actors that make up the recycling chain and, above all, the logic present in the work of the cooperatives that carry out the selective collection.

**Keywords:** selective collection, solid waste, anthropotechnology, technology

2000, 2008).

## 1. INTRODUCTION

In the 21st century, we face a global problem associated with the disposal and treatment of solid waste. Based on changes in political, economic, social and technological dimensions, countries currently share a search for ways to deal with a large generation of waste as a result of ever-increasing consumption (BAMPILIS, 2012).

This concern began in the 1970s and was embraced by governments, international organizations, scientific communities, ecological movements, non-governmental organizations, among others (BAMPILIS, 2012). This movement allowed for the growth and development of solid waste management systems and companies that recycled materials (SCHEINBERG et al., 2011).

However, this development occurred independently and did not allow for effective measures in the management and treatment of solid waste. Scheinberg et al., (2011) pointed out that developed countries, mainly the United States and European countries, faced with this independent approach, promoted more integrated forms of waste management that allowed for more effective approaches.

Meanwhile, developing countries still share ineffective approaches to solid waste management. For Idris; Inanc; Hassan (2004) in these countries there is a lack of interest on the part of political authorities, at all levels, in seeking appropriate ways of managing solid waste. Scheinberg et al., (2011) states that, in this context, solid waste management systems developed from the need to remove waste from populated areas and dump and bury it in distant locations.

In Brazil and as in other developing countries, the gap between waste generation and recycling companies was filled by informal collectors. Lack of access to the formal market; the lack of adequate public policies for waste management

solids; The industry's demand for cheap raw materials are some of the factors that lead to the emergence of collectors in the search for income generation (MEDINA,

This sector has developed and is one of the main suppliers of raw materials for the recycling chain (SCHEINBERG et al., 2011). In Brazil, 90% of the materials collected and treated in the country are the result of the activity of informal collectors, organized or not in Solidarity Economic Enterprises (IPEA, 2012). Thus, this article aims to relate technologies in selective collection with the perspective of anthropotechnology using as a resource a review of the literature on solid waste, anthropotechnology and selective collection.

### 1. Solid waste

Law No. 12,305, of August 2, 2010, which establishes the National Solid Waste Policy defines any solid waste as:

*discarded material, substance, object or good resulting from human activities in society, whose final disposal is carried out, is proposed to be carried out or is obliged to be carried out, in solid or semi-solid states, as well as gases contained in containers and liquids whose particularities make it unviable their release into the public sewage network or bodies of water, or require solutions that are technically or economically unviable given the best available technology (BRASIL, 2010).*

This definition prescriptively defines the limits of artifacts that should be considered solid waste, highlighting the need to consider the treatment and disposal needs of this waste. Even though it also addresses in a general way that waste comes from human activities in society, for a better understanding of the definition of solid waste it is necessary to have a better understanding of the meaning that the term "human activities in society" carries.

In fact, waste is generated from human activities, industrial production, commerce, governmental and non-governmental organizations, leisure activities, among others. And the waste generated by each actor present in this society will have a different composition and destination.

But society does not behave in a homogeneous and stabilized way. In different regions or contexts, the waste generated by the same actors will be different, because if we consider waste as artifacts and artifacts as technical acts

(DEJOURS, 1997), solid waste crystallizes in its form, composition and purpose the traces of the tradition of that region and these encompass particular economic, technological and social aspects. This is one of the reasons, for example, that made the continuity of Waste Recycling Plants imported from the United States and Europe by some municipalities unfeasible, since the mass of waste generated in Brazil differed from that of exporting countries (LELIS; PEREIRA NETO, 2001).

Therefore, the concept of human activities, from the point of view of waste generation, extends to a perspective of social construction in which several actors are present, a packaging, for example, before being discarded was associated with a consumption process, industrialization, design and raw material extraction and each of these stages also generated other waste.

Solid waste, once a consumer or industrial product, needed to be transported between different actors that participate in the transformation, commercialization and consumption process, such as industries, distributors, wholesalers, among others. This logistics involves decision-making processes regarding types of transport, the ideal amount of stock to deal with market fluctuations, vehicle routing, location of facilities, among others. Furthermore, it also involves companies specialized in the transport and storage of these products, such as transport companies and logistics operators (BALLOU, 2004).

After consumption, the actors who are responsible for managing and operationalizing the waste chain are others. According to Bortoli (2013), as of the 1988 Federal Constitution, municipalities became responsible for managing urban solid waste, a responsibility reinforced in the National Solid Waste Policy (PNRS). Therefore, the municipality, with the support of other spheres of government, has the duty to guarantee the collection, treatment and disposal of solid waste. Another important factor present in the PNRS was the guidance to municipalities on the need to incorporate organizations that collect recyclable materials into solid waste management, such as cooperatives or associations within the theme of solidarity economic enterprises (BRASIL, 2010).

In addition to cooperatives that collect and/or sort materials and public authorities, private companies contracted by municipalities to collect waste, private

companies that buy and sell waste (known as middlemen) are also present in the solid waste chain. ) and industries that recycle these materials. Added to these actors are individual collectors not associated with cooperatives or companies (IPEA, 2012).

Even though from a logistical point of view, solid waste is considered material to be transported and this transport is subject to the same decision-making processes listed above regarding the products to be consumed, the requirements of these decision-making processes are not the same, such as costs, slice market or sales strategy. The configuration of the service to be provided and guaranteed by the municipality establishes effectiveness requirements that may not necessarily be associated solely with costs, for example.

## 2. Anthropotechnology

Seadon (2010) states that the different actors that participate in solid waste management cannot be perceived as independent, decision-making processes and operations are dependent on a production system whose product is solid waste. However, seeing the solid waste chain as a production system requires a broadening of the field of vision to conceive these systems according to the different rationalities that compose them.

Michelle; Vinck (2013) showed these different rationales when reporting the design process of a container for collecting domestic waste. Throughout the project and its implementation, requirements emerged from users not considered in the initial project, in addition, the object itself became the mediator of its design process as different actors in society transformed it to adapt it to their needs. different uses. One of the author's conclusions was that mediation in the project cannot only be carried out through technical means, it is necessary to incorporate the social construction of the object that will reveal its reality, specificity and complexity.

We then borrow from the Ergonomics of production systems, more specifically from Hubalt (2004), which is precisely this complexity that must be managed and not reduced. Thinking about the operations and technologies that will make up a waste collection, treatment and disposal system involves deciding how to incorporate decisions

about how users will use and appropriate this system. This process takes place in the field of Anthropotechnology and the concept that guides it is the establishment of commitments between actors (HUBALT, 2004), that is, reconciling the search for a common technical divide with the social requirements revealed throughout the process.

Wisner (2000) defines anthropotechnology as an expression “proposed to designate the simultaneous use of natural and social sciences in order to better conduct technology transfers in countries undergoing industrial development” (pg.7). This practice emerged after the failure of imported technology packages in developing countries. The failure of these transfer processes on some occasions was due to the issue that the organization of work, intrinsically linked to the technologies, transferred could be in complete disagreement with the society that imported it. Therefore, from the point of view of planning a production system for solid waste management, one must also think about the users who will carry out their work activity in this system. Wisner (2000) concluded that the organization of work “is an object of observation and an essential mode of action of anthropotechnology” (p.10).

Solid waste management can be briefly divided into generation, collection and disposal. Waste collection comprises the collection of mixed waste and recyclable waste, therefore, a section will be made on the selective collection processes, pointing out the technologies present and how the work is organized.

### 3. Selective waste collection

Waste collection is understood as the “collection of solid waste previously segregated according to its constitution or composition” (BRASIL, 2010). According to Ciclossoft (2014), in 1994 only 81 municipalities had selective collection programs in Brazil, from the end of the 90s the number of municipalities with selective collection began to grow and reached 927 cities in 2014, 17% of the total of Brazilian municipalities. Based on these data, it is estimated that 28 million Brazilians have access to selective collection programs (CICLOSOFT, 2014).

The main selective collection models are the Door to Door model, present in 80% of municipalities, and the Voluntary Delivery Point (PEVs), in 45% of municipalities. It is

noteworthy, according to Ciclossoft (2014), that the most effective programs use a combination of these two models mentioned. Furthermore, the incorporation of waste picker cooperatives in the selective collection process has been rising and is now at 76%.

Gutierrez; Zanin (2013), in a study on the technologies involved in the process of collecting and sorting recyclable materials from a collectors' cooperative in the city of São Carlos, found that selective collection processes require the technologies highlighted in Table 1.

Table 1 - Selective collection and the technologies involved

Performed activities	Technology
Collection carried out door to door, PEVs and large waste generators	Human-powered carts, “Bags”, trucks and other resources
Voluntary Delivery Sites and large waste generators	Delivery location, container and truck

Source: adapted from Gutierrez; Zanin (2013, p.133)

The technologies described give signs of how the selective collection work is organized by the cooperative's collectors. The carts point to an individual task, while the trucks request a collector with a license to be able to drive them.

In his study, Moraes (2011) points out that the way in which selective collection work is divided at Cooperativa Acácia de Araraquara, according to the author, ten cooperative members are responsible for collection in the city. The city is divided into 5 zones (A, B, C, D and E), of the ten cooperative members, six are responsible for collecting in zones A, B, C and D, one of which is a leader who uses the cell phone to communicate with another member responsible for collecting the separated material with the cooperative's truck. There is also another member of the truck responsible for organizing the collected material. Two other members are responsible for collecting materials from condominiums in zone E.

In the situation highlighted above, one can point to the appropriation of techniques by cooperative members to increase work efficiency, such as the division of the city into regions and the incorporation of cell phones as a work tool.

Dias (2002) presents a different way of organizing the selective collection work of the ASMARE collectors'

association. Those responsible for street collection are divided into two fronts: collectors with fixed collection locations who must follow previously defined routes on different days of the week and collectors who do not have defined routes. The itineraries are also different, collectors who use human-powered carts have more flexible working hours, generally starting between nine and ten in the morning and finishing between ten and eleven thirty at night. The author also highlights that collectors carry up to 800 kg in their carts when fully loaded and carry out pre-sorting of materials at the collection points themselves.

## 2. CONCLUSION

Solid waste is an artifact that, in order to be correctly disposed of, must go through the entire recycling chain, at each link in the chain the waste is transformed according to the actors who interact with it. Considering the recycling chain as a production system makes it possible to understand it in its complexity, but it raises questions about which models and logics will be used to design operations in the waste collection, treatment and disposal subsystems: the logic of the recycling industry recycling, the municipality, the residents, the middlemen, the collectors of recyclable materials?

Ergonomics, from the point of view of production systems, directs us towards a conception that considers the logic of work and the logic of the company in order to develop compromises between the different parts that make up the system.

An emerging logic in this context is that of the work of cooperatives of recyclable material collectors. The technologies that are incorporated by these organizations within the context of the solidarity economy must serve as a basis for the development and acquisition of new technologies. Ergonomics, based on atropotechnology, is an important tool for understanding the sets of techniques used by workers and how they organize themselves according to these technologies. enormous desire to learn and make others learn.

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