

CLEISEANO EMANUEL DA SILVA PANIAGUA
(ORGANIZADOR)

Collection:

**APPLIED ENVIRONMENTAL
AND SANITARY
ENGINEERING
2**

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PRESENTATION

The e-book: “Collection: Applied Environmental and Sanitary Engineering 2” consists of fifteen chapters that present works that aimed to contribute both to improving the quality and health of the environment and man, as well as to the development of technologies to reduce costs and improve the quality of basic sanitation, remedying and reducing the environmental impacts resulting from human activities.

Waste management in Brazil is “invisible” in the eyes of government plans at the municipal level, which is why precarious sanitation conditions prevail in most municipalities. In view of this, the scientific community has been reiterating through numerous studies, the need to implement systems for the collection and final disposal of waste in an environmentally more correct way.

The basic sanitation system in Brazil has been restructuring itself due to security and information technology that helps to monitor and automate water and sewage treatment systems, the final disposal of waste, the loss of water resources due to failures or ruptures of pipe among others. Added to this, the numerous software that are developed to improve operating systems that can present information in real time and operation in continuous flow, helping operators.

Finally, the study and development of new treatment technologies from agro-industry residues or from new technologies that aim to implement and improve the efficiency of existing conventional processes,

In this perspective, Atena Editora has been working with the aim of stimulating and encouraging researchers from Brazil and other countries to publish their work with a guarantee of quality and excellence in the form of books and book chapters that are available on the Editora’s website and elsewhere. digital platforms with free access.

Cleiseano Emanuel da Silva Paniagua


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ABSTRACT: The absence of public policies aimed at minimizing the problems related to the collection and final disposal of solid waste, associated with the absence and/or poor quality of this public service provided to the society that finances it through its taxes and duties. The construction of sanitary landfills and the creation of a selective collection program are seen as unnecessary expenses, since “garbage”

can be disposed of in any area or place. Therefore, homes and the commercial sector are responsible for generating most of the waste that is collected and disposed of in an inappropriate way and in inappropriate places, and much of this waste could be recycled, reused or minimized in its generating sources. The lack of a well-established solid waste management program with short, medium and long-term goals causes several municipalities in Brazil and the state of Minas Gerais to generate volumes of waste that increase every day and consequently contaminate soils and consequently the water resources. Therefore, this work aims to present proposals for actions that can collaborate with municipalities to implement a solid waste management program that brings returns in terms of savings in public spending and the generation of employment and income to countless families who work with the collection and recycling of discarded materials.

KEYWORDS: Landfills; selective collect; trash; recycling and water resources.

1 | INTRODUCTION AND BACKGROUND

In the past, the waste produced by the population was, for the most part, easily degraded organic compounds. However, with industrialization, the production of non-durable goods and processed foods increased, leading to a change in the characteristics and volume of this waste produced, causing serious consequences for public and environmental health (GALVÃO; BASÍLIO SOBRINHO; SAMPAIO, 2010). For Galvão et al. (2010), the increase in the amount

and diversity of waste generated by society has contributed to the worsening of the sanitation problem in most municipalities due to the lack of effective planning, solid waste management, among others, factors associated with sanitation. The absence of public results of the creation of graves, of problems of creation of soil of the graves of initiatives of great problems of creation of individuals, of creation of problems of private initiative and of problems of creation of individuals of great importance, vector of problems of breeding serious individuals and breeding problems of major public health impact.

ABNT (1987) defines the term “garbage” or “solid waste” as the “remains of human activities that have no use, are undesirable and disposable, and can be presented in the solid, semi-solid or liquid state, provided that is not amenable to conventional treatment. For Poleto (2010) the term “garbage” can be defined as everything that is no longer wanted, that is, no longer desired and discarded, in other words; they are old, useless and devoid of any value to human beings. Therefore, the accumulation of garbage is an exclusively human activity, derived from the lifestyle that has developed over time, which results in the production of a very large amount and variety of garbage, causing soil, water and air pollution with waste. toxic or potentially toxic, in addition to promoting the proliferation of disease vectors (BRAGATO; SILIPRANDI; DAGORT, 2021; CAMPOS; BORGA; SARTOREL, 2017; HESS, 2002). As a result, the discussion about environmental impacts by different segments of society (governmental agencies, private initiative and society in general) has increased, with the objective of seeking ways to reverse and/or minimize the damage caused to the environment. environment. Such concern is justified due to the increase in the population, today with more than 7 billion people, with a growth projection to 9.6 billion by the year 2050. To maintain this number of people, with the current lifestyle, triple the amount of natural resources on planet Earth would be needed (FRACASSO et al., 2017; ONU, 2017). In addition, the increase in the generation of waste can trigger a greater number of diseases from the poor management of it, which causes the death of approximately 5.2 million people, 4 million of which are children, per year. In global terms, the volume of waste produced is expected to double by 2025 (DAMBROS; CRUZ, 2012).

In the Brazilian scenario, as pointed out by the Brazilian Association of Companies and Public Health (ABRELP), in 2015 the number of urban solid waste generated annually was 79.9 million tons with an average of 90% of collection. This means that 7.3 million tons of waste were improperly disposed of due to the lack of collection. It is important to emphasize that the 90% collection rate does not mean the most correct destination possible (sanitary landfill), since in most municipalities there is a predominance of dumps or controlled landfills that do not offer adequate final disposal, resulting in several environmental impacts that directly affect the health of the population, causing an increase in the leasing of financial resources for public health in this segment (ABRELP, 2015), resources that could be applied to improve and increase the service capacity of the health sector itself, as well as for other sectors of society that currently lack greater financial contributions from public managers.

Brazil has a huge territorial area (8.516.000 km²), being the fifth largest country in the world. Its population, according to the last census carried out by the Brazilian Institute of Geography and Statistics - IBGE - indicated a population of 209 million inhabitants distributed throughout the five regions of the country. However, this distribution is not homogeneous and was measured by the IBGE as follows: (i) 22% of the population lives in the state of São Paulo; (ii) 24% of the population lives in the country's 27 capitals; (iii) 57% of the population lives in only 5.7% of the country's land area; (iv) only three states, all in the North region, have less than 1 million inhabitants; and (v) only 0.8% of the municipalities have a population of more than 500 thousand inhabitants. This survey showed that the Southeast region has almost 88 million inhabitants, representing 42% of the entire population (IBGE, 2018). Within the Southeast region, there is the State of Minas Gerais with the largest number of municipalities (853) of the 5570 existing throughout the country, being the second most populous state in the country (21 million) with approximately 2.5 million inhabitants in the capital. (12%) followed by a population of almost 2 million inhabitants distributed in three cities: Uberlândia, Contagem and Betim.

Therefore, just over 21% of the population live in just four municipalities and the remaining 79% live in 849 municipalities (99.5% of the total). The state of Minas Gerais is divided into 10 regions, namely: Central, Midwest of Minas, Jequitinhonha/Mucuri, Zona da Mata, Northwest of Minas, North of Minas, Rio Doce, South of Minas, Triângulo Mineiro and Alto Paranaíba (IBGE, 2018).

Faced with the global and Brazilian reality, the municipalities of the state of Minas Gerais are not far from the lack of actions for better management of solid waste from households, commerce, health, industrial and civil construction sectors, needing to implement a management plan of solid waste with actions to be developed in the small, medium and long term.

In this sense, this work intends to present actions that can be developed at the initiative of the public sector, with the active participation of the population and the commercial and industrial sectors located in the municipalities, having chosen the municipality of Patrocínio in the state of Minas Gerais as a case study, to be presented and discussed in the present work.

2 | WORLD AND BRAZILIAN SCENARIO OF BASIC SANITATION

The deficit in sanitation services, in terms of collection, intermediate treatment and more adequate final disposal of urban solid waste, should be a priority in the government plans of municipal managers due to the direct impacts that can affect the quality of life of the population in various ways. However, large parts of Brazilian municipalities have not yet adapted to the regulatory frameworks of the sector due to the lack of qualified human resources to prepare a plan and present to state and federal governments the contribution

of financial resources for its implementation (BRASIL, 2016).

Through the federal government, the National Solid Waste Policy - PNRS was instituted through Law No solid waste, which was established in three concepts: (i) solid waste generators: individuals or legal entities that generate solid waste through their activities, including consumption; (ii) reverse logistics: return of solid waste to the business sector, for reuse, in its cycle or in other production cycles, or other environmentally appropriate final destination and (iii) tailings: solid waste that, after all treatment possibilities have been exhausted and recovery do not present any other possibility than disposal in sanitary landfills (PNRS, 2010). The PNRS establishes that people must properly package the garbage for its collection, making the separation where there is selective collection (KONRAD; CALDERAN, 2011). However, due to the almost non-existence of collection associated with the lack of awareness by the majority of society, which does not have the perception of the importance of their participation as a responsible agent to provide a better quality of life in their environment and consequently for the environment (SUESS et al., 2013).

The implementation of a solid waste management program needs to be seen as a public policy that, *a priori*, will require enormous efforts from the municipal government in partnership with the state and the union and that, *a posteriori*, will bring enormous benefits not only for society, but the drastic reduction of financial resources destined to public health to attend to health problems triggered by the bad management of solid waste. This can be explained by the composition and constitution of the waste: 57% organic matter (food scraps, spoiled food, toilet waste), 16.5% plastic, 13.2% paper and cardboard, 2.5% glass, 1.6% ferrous material, 0.5% aluminum, 0.5% aggregates and 8.1% other materials (IPEA, 2017; NOBRE et al., 2021).

Therefore, the creation and consequently the application of a waste management plan is of paramount importance to: (i) improve people's quality of life; (ii) reduce resources destined to urban collection and cleaning services; (iii) increase the useful life of sanitary or controlled landfills; (iv) reduce health costs related to diseases linked to poor management and handling of waste; (v) improve the preservation and conservation of different ecosystems, especially aquatic biota; (vi) reduce costs in treating water for drinking purposes; (vii) generation of employment and income for families that live on recyclable materials and (viii) reducing the speed of withdrawal of natural resources, through the creation of policies that encourage the use of recyclable materials, among others (SOUSA; CHAVES; ALVIM, 2015).

2.1 Introduction of toxic metals into the soil from vehicles or automotive parts

Vehicle service establishments, such as: dismantling, mechanical workshops, junkyards, parking lots, auto parts recyclers, vehicle collection and seizure yards can be considered as sources of environmental contamination by toxic metals (MAKARA et al., 2014; REVITT et al., 2014). This is due to the fact that the vast majority of these establishments

are not covered or have soil waterproofing (Figure 1), causing the metals to be leached through the soil, reaching groundwater and consequently contaminating it. In addition to metals, oils and greases from other services contaminate the soil and subsequently water bodies (LANGE, 2018).



Figure 1: Examples of junkyards and seizure yards in cities in the state of São Paulo.

Source: authors' collection (2022).

These places are also sources of refuge for venomous animals, rats, cockroaches and mainly breeding grounds for the *Aedes Aegypti* mosquito, which annually is responsible for the death and temporary disability of thousands of people throughout Brazil, making it necessary to declare an epidemic annually in several states and Brazilian municipalities. In order to avoid both soil contamination by metals and the development of breeding sites for the dengue mosquito, it will be up to the municipalities: (i) to establish and define a deadline for the owners of junkyards, as well as mechanical workshops between other places that store pieces close to the ground, waterproof the ground and cover the patios; (ii) the legislature may propose to the executive branch, the release of new permits and the renewal of the existing ones, under the pre-established conditions and including the waterproofing of the ground and the covering of the patio (total or partial), avoiding all the problems as mentioned earlier.

2.2 Encouraging and encouraging the participation of society

Society, in general, does not feel, much less sees itself as part of fundamental importance for the proper functioning of a project that aims to reduce waste generated in their homes and consequently the amount of waste destined for inappropriate places for their due disposal. The idea that "... not being close to me, it doesn't offer me risks..." is impregnated in Brazilian society, since the concept of pollution is directly related to what is seen and what is not known about its harm, the health. In this sense, this vision associated with the lack of a policy that encourages society to seek greater clarification leads people to not have a keener environmental conscience.

Faced with this scenario and knowing that through formal education, the training or reformulation process can take a long time, it is necessary to create mechanisms that lead people to adopt more appropriate solid waste management practices through incentives that will attract the interest of society immediately, among which we can mention: (i) creation and development of efficient programs of Environmental Education in the initial grades of the municipal school system, with the possibility of being expanded to the state network through agreements and partnerships with the state. In order to achieve this goal, it will be necessary to adopt some actions (suggestions), including: (i) teachers from the municipal school system must undergo effective training, aiming at a better understanding of the preservation and conservation of the environment during activities carried out in the classroom, with simple attitudes to be developed, such as: not throwing garbage in the street or land without buildings; the importance of personal hygiene and cleaning of their homes; not to dirty the rooms as well as other parts of the school; teach the importance of conserving and preserving the cleanliness of places of public use; and others according to the characteristics of each educational institution (NASCIMENTO; AGUIAR, 2021); (ii) implement, in a simple and playful way, the importance of returning plant residues (barks, branches, rotten fruits, among others) to the soil in schools located both in urban and rural areas; (iii) promote, at least, quarterly the day “taking care of mine and our environment” to be held, preferably, on weekends full time with the offer of: competitions and activities that work on the development of environmental awareness for parents and students; workshops that work in order to teach how to transform recyclable products into utensils, artistic and decorative objects and even the reuse of recyclable materials; offer of lectures by invited professionals or professors from the network who teach subjects directly or indirectly related to the theme; (iv) the days of the school calendar for the celebration of the day of water and the environment must be correlated with the issue of pollution caused by the generation of solid waste, since these directly or indirectly affect the quality and existence of these celebrated themes; and (v) offer a percentage discount on the IPTU value to be paid in the year following the implementation of this program, considering for the purpose of calculation the period (months) and the amount of recyclable material generated that will be accounted for by members of the association of collectors during residential collection.

2.3 The attributions and responsibilities of the municipality to implement the waste reduction program

The municipality will be responsible for: (i) leading the creation and constitution of an association of collectors of recyclable materials, helping them at all stages (opening, operation, training and management) and offering an initial infrastructure consisting of a land with a shed, waterproofed floor and small machinery to start the work of collecting and processing recyclable materials; (ii) technical support in order to professionalize the association, leading it to become independent after a certain period of time; (iii) provide

an area for receiving organic waste and materials of plant origin for composting and transformation into organic fertilizers to be sold to the citizens themselves or purchased by the municipality; (iv) make available small areas and infrastructure for the creation of points for receiving recyclable materials in its various districts and villages, with collection by the collectors association with a frequency to be stipulated according to the amount generated; (v) promote and encourage the attraction of a company specialized in material recycling, eliminating middlemen. Such a company can be implemented in the municipality through: availability of area for construction of the enterprise, tax incentives, among others.

2.4 In the organizational structure and public facilities owned by the municipality

Within the scope of the organizational structure of the physical facilities used by the municipality, it will be responsible for: (i) training the servers who work in garbage collection, offering information and training aimed at identifying only the waste that cannot be reused; (ii) implement actions to reduce or minimize waste generated in the municipalities, including: making scratch pads from the back of printed paper without further use; making mugs and distributing them to all municipal employees, thus eliminating the use of disposable cups; introduce the mug as part of the school supplies distributed to students in the municipal network; replace paper towels, used in restrooms, with a hand dryer with a sensor; gradually replace traditional faucets with faucets with presence or time sensor; increase inspection in relation to the continuous cleaning of land located in the urban area of the municipality, as well as fine the owners in order to carry out the removal of debris from houses demolished totally or partially; establish a partnership with the Commercial and Industrial Association of each municipality, as well as with its traders, the manufacture of gratings to be placed below the manhole, avoiding the transport of solid waste, especially during rains, reducing the frequency of maintenance and cleaning of the same, according to Figure 2.



Figure 2: Smart culvert collector models.

Source: authors' collection (2022).

Reuse tires for making protectors for central beds of avenues, gardens or vegetable beds in municipal schools, city squares, as well as reuse in the construction of future health

squares and use in existing ones, painting them with leftover paints used to street and avenue signs, as well as those that may be donated by merchants or people from society itself, improving the city's landscape, as shown in Figure 3.



Figure 3: Examples of tire reuse in the landscape structure of cities.

Source: Authors' collection (2022).

Another reuse for tires is related to the manufacture of artistic objects and utensils for public or private use, which may involve professionals in the artistic area, artisans and even the creation of an association of people with artistic skills, generating employment and income for the families involved, attributing higher value instead of delivering it to companies for recycling, as shown in Figure 4.



Figure 4: Examples of different applications for reusing tires that would otherwise be discarded.

Source: authors' collection (2022).

Only with these and other actions in relation to the reuse of tires, it is possible to attribute enormous market potential to the municipality, leading to the generation of resources, employment and income for several people and attracting even the foreign market that is already adept at using materials obtained from recyclables. Added to this, the possibility of creating a communication channel between the urban cleaning service and the community, in order to avoid that the central beds of avenues of the cities, become places of disposal of vegetal residues coming from Residential tree pruning, as shown in Figure 5.



Figure 5: Examples of tree pruning disposal in different locations.

Source: Authors' collection (2022).

In this sense, it is necessary to create a program to implement garbage baskets in all residences, both in the city and in its districts and villages. In cases where residents declare it does not have financial conditions, by proof, to pay the costs of the preparation and installation of the garbage basket, the City Hall could make and install through the payment to be credited to the IPTU of the posterior year or otherwise legal to finance the improvement to be paid by the resident in an easy way.



Figure 6: example of a place where garbage is disposed of in the central bed Source: Authors' collection (2022).

2.5 Within the scope of the legislative power of municipalities

The councilors will be able to present proposals and actions that will meet the implementation of a solid waste management program with subsequent approval and forwarding to the head of the executive power, a plan of measures to be implemented, such as: *(i)* demanding from the owners of land without improvements, the construction of walls and the total closure of land, preventing the undue release of garbage in these places, minimizing the proliferation of vectors of various diseases; *(ii)* present a bill in the form of a law, requiring the owners of commercial establishments that sell non-returnable bottled beverages, to start demanding from the consumer the delivery of the same amount of empty bottles at the time of purchase. Such bottles, along with paper, cardboard, cans, pet bottles, milk cartons and other materials will be collected by members of the collectors association; *(iii)* to order traders in the home appliance, cell and battery sector, among others (rich in toxic metals and others with high added value) that these establishments make the collection with subsequent destination to recyclable collectors.

3 | EXPECTED RESULTS

Based on the proposals presented, as well as their execution, it is expected to contribute to: *(i)* generation of employment and income for countless families that depend on the collection of recyclable materials; *(ii)* reduction of up to 80% of the garbage to be collected in the residences, which will imply in the reduction of garbage destined to “dumps, controlled and/or sanitary landfills”, increasing both the increase in the landfill’s lifetime and in the drastic reduction of pollution soil and, consequently, water resources; *(iii)* reduction of expenses with fuel and maintenance of vehicles destined to the provision of urban cleaning services, since the garbage collection can be carried out, a priori, three times a week and, a posteriori, reduced to twice a week; *(iv)* reduction in the number of employees who are hired to exclusively provide this service, and may be transferred to other sectors that lack manpower; *(v)* provide an effective environmental education for the whole society, involving them directly or indirectly in the responsibility for the generation of their waste; *(vi)* encourage the development of environmental education practices in schools from the initial grades of responsibility of the municipality; *(vii)* encourage the reuse of recyclable materials in homes; stimulate and encourage the creation of artistic and landscape objects from recyclable materials, which can generate another source of employment and income and *(viii)* reduce the number of vectors of diseases arising from poor solid waste management, resulting in a reduction in health expenses for this purpose goal.

4 | CONCLUSIONS

This work made it possible to present numerous problems in relation to the bad

management of solid waste that occurs in all municipalities, as well as a set of actions that can be adopted in the short, medium and long term in order to reduce costs with collection and final disposal of waste. Waste, public health spending and disposal in inappropriate areas or locations. Therefore, it is necessary to adopt the principle that investing in improvements in basic sanitation and in a strong policy of environmental education to be developed a priori in schools under the responsibility of the municipality and in partnerships with the state and a posteriori, in the entire community of the municipality with a view to improving the quality of life of the entire population and ensuring conditions so that other generations can live with quality of life generated by the environment in which it is inserted.

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