Current Scientific Journal
Internationally Indexed Scientific Journal
Current Scientific Journal - **ISSN 2764-1759**

REVERSE LOGISTICS AND PRODUCTION RECYCLING PROCESSES

DOI: 10.5281/zenodo.7046476

Marcio de Freitas Santa Ana
Industrial Process Consultant, Production Engineer and MSc in Material Sciences and Technologies, ciedistanciamail.com

Roseli da Conceição Silva de Freitas Santa Ana
Environmental Management Consultant, Environmental Management and Graduate in Engineering
Environmental and Quality Indicators

ABSTRACT
Due to increasingly strict environmental legislation, the manufacturer's responsibility for products is expanding. This work reuses products and materials that had their production cycle ended, making the process inverse to that of traditional logistics, which is based on the flow from the origin of the product to its point of consumption. The general objective is to Aggregate the waste, in order to do a job of reusing this waste and in a manner, but it specifies understanding the concept of environmental, social and economic sustainability, understanding the configuration of the plastic materials production chain and its production performance. The same is justified by the growing importance of the complexity of production systems - caused by globalization and the Third Industrial Revolution. Thus, the relevance of this project in carrying out improvement studies through production processes on the ideal conditions for the decomposition of waste is justified, where it seeks a great interest in “Reverse Logistics”. The methodology follows the line of bibliographical research and scientific and environmental solutions. The application of scientific knowledge in the characterization of a real problem, as well as the development of notes capable of contributing to its equation and through bibliographical research. therefore, it is concluded that reverse logistics is an indispensable tool in the search for competitive advantage and operational control of companies, in addition to meeting legal requirements and sustainable development.
Keywords: Productive Cycle, Waste, Reverse Logistics.

1 INTRODUCTION

The plastic and organic waste recycling production processes as work activities that range from organizational issues, go through managerial issues, pricing, strategic planning, goal setting, the manufacture of products or the provision of services and receive an input, undergo an aggregation of value and generate an output

The growing and diversified generation of solid waste in urban areas and its inadequate management constitute one of the most serious environmental problems worldwide (SHIMURA et al, 2001), demanding solutions committed not only to increasing recycling, but also to reducing the volume of waste. of material treated as waste and destined for landfills.

Garbage accumulation is a phenomenon unique to human societies. In a natural system there is no waste: what is no longer useful for a living being is continuously absorbed by others. However, our way of life produces, daily, a very large amount and variety of garbage, causing the pollution of soil, water and air with toxic residues, in addition to promoting the proliferation of disease vectors. (HESS, 2002).

In solid waste management, environmental and social sustainability is built on models and integrated systems that enable both the reduction of waste generated by the population, the reuse of discarded materials and the recycling of materials that can serve as raw material. for the industry, reducing waste and generating income.

According to Cavalcanti, environmental problems, among which the generation of waste stands out, are directly and largely related to the current urban population density and to the stage of global development characteristic of contemporary society, as well as to production and of consumption sustained by it.

The problem generated by the amount of solid waste can be deposited in inappropriate places, causing several problems to nature and technically to the environment, thus causing flooding, diseases in animals, greater flow of transport on the street, very fine particles of solids or liquids suspended in the air and water, causing deterioration of the urban environment (DIAS, 2007; ARAUJO & CARDOSO, 2010; NASCIMENTO et al, 2015).

One of the most prominent issues lately among companies in practically all sectors, including the plastics industry, is the issue of environmental sustainability. This is because there is a growing awareness that the planet's resources are finite and that management changes need to be made as soon as possible to ensure more sustainable industrial production in the coming years.

Due to increasingly strict environmental legislation, the manufacturer's responsibility for products is expanding. Therefore, it is not enough to reuse and remove scrap that are directly part of its own production process, the manufacturer is being held responsible for the product until the end of its useful life. Therefore, reverse logistics is gaining importance in company operations (BOWERSOX; CLOSS; HELFERICH, 1986).

1.1 Justification

The importance of the study is given by the growing complexity of production systems – caused by globalization and the Third Industrial Revolution. These changes have contributed to the strengthening of doctrines according to which the competitiveness of firms does not depend only on internal factors, but also on the entire macroeconomic, political-institutional and cultural environment in which they operate, through production processes and forms of exploitation. continued under the ideal conditions in the decomposition of the residues. The relevance of this project is to carry out improvement studies through production processes on the ideal conditions in the decomposition of waste. Due to this fact, there is also a great interest in “Reverse Logistics”, with the process of planning, implementation and efficient and effective control of costs, flows of raw materials, finished products and related information, from the point of consumption to a point of reprocessing, linked to recycling

1.2 Objectives

1.2.1 General Purpose

Reuse products and materials that had their production cycle closed, doing the opposite process to traditional logistics, which is based on the flow from the origin of the product to its point of consumption and Aggregate the waste, in order to make a reuse work of that garbage.

1.2.2 Specific Objectives

- Configure the plastic materials production chain
- Analyze productive performance
- Facilitate the reuse of collected materials
- Analyze processes in relation to recycling

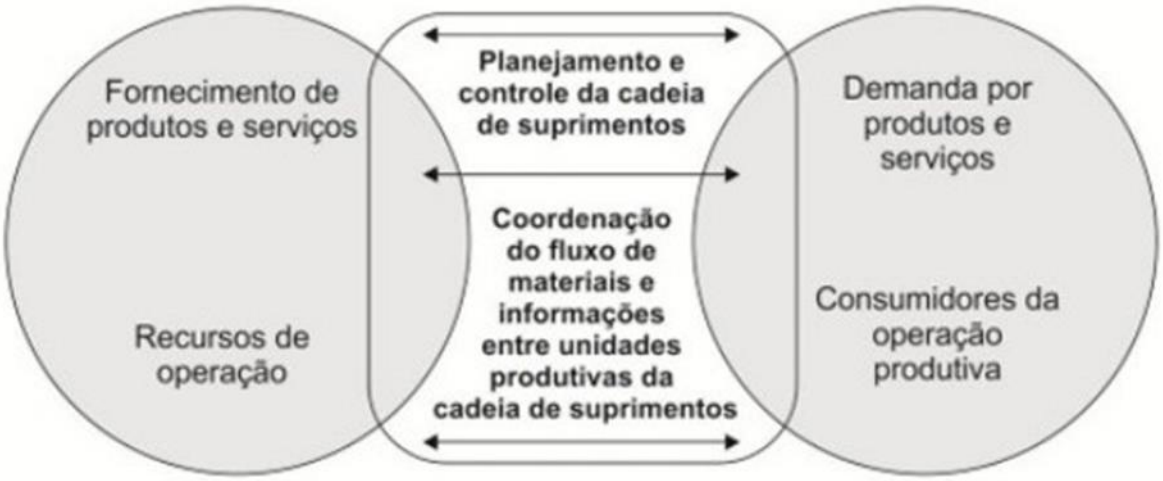
2 THEORETICAL FRAMEWORK

2.1 Logistics Concepts

The restriction imposed on production and consumption, due to the limited geographic scope, is one of the factors that most interest the development of logistics systems, since from its improvement, it becomes possible to establish a comparative advantage, that is, the no restriction of consumption of a certain product near the place of its production, which can be considered as the “essence of commerce”, established by Ballou (2006).

In order to present more accurately what business logistics is, and distinguish it from the military context, the definition given by the Council of Logistics Managements - CLM (Council of Logistics Management), through the Council of Logistics, is used here. Supply Chain Management Professionals – CSCMP (Supply Chain Professional Management Board), in 2010, in which “Logistics is the process of planning, implementing and controlling the efficient and effective flow of goods, services and related information from the point of from origin to point of consumption for the purpose of meeting customer requirements”. Figure 1 illustrates the relationship between supplies and demand, in order to allow a better understanding of logistics activities.

Figure 1 - The management of the supply network in relation to the management of the flow of materials and information between the production units that form the branches or "chains" of a supply network



Source: SLACK et al, 2002

2.2 Reverse Logistics

Reverse logistics is an area that is related to business logistics, with the objective of returning goods that were used by consumers to the business cycle 11, both after sales and post-consumption, in order to add value to the product. , in an economic, ecological, legal, logistical scope, or even with regard to corporate image (LINHARES, 2008).

According to Federal Law 12,305/2010, which establishes the National Solid Waste Policy (PNRS), reverse logistics is characterized "by a set of actions, procedures and means aimed at enabling the collection and return of solid waste to the sector". business, for reuse, in its cycle or in other production cycles, or another environmentally appropriate final destination" (Art. 3, inc. XII).

In practice, reverse logistics is carried out through systems that promote the collection, reuse, recycling, treatment and/or final disposal of waste generated after the consumption of various products - whether the product itself is no longer used, or its packaging is discarded. Figure 2 highlights the reverse logistics cycle.

Figure 2 - Reverse Logistics Cycle

Source: Ministry of the Environment

2.3 Recycling

Recycling is one of the most advantageous solid waste treatment alternatives, both from an environmental and social point of view. It reduces the consumption of natural resources, saves energy and water and also reduces the volume of waste and pollution. The materials normally sent for recycling are: glass (bottles, jars, pots, among others), plastic (bottles, buckets, cups, jars, bags, pipes, among others), paper and cardboard of all types and metals. (food cans, soft drinks, among others).

In order to attract more investments to the sector, it is necessary to join forces between the government, the private sector and society in order to develop adequate policies and dispel prejudices around the economic aspects and reliability of recycled products.

The recycling of waste has great advantages, in terms of sustainability. But, on the other hand, the environmental advantage of a recycling process may be life cycle (JONH 2000). Figure 3 has the example of materials discarded in a sanitary landfill.

Figure 3 – São Pedro da Aldeia Sanitary Landfill

Source: Dois Arcos, 2019

When new recycled materials are produced, a serious risk is the internal and external contamination of buildings that use these residues, either by water contamination, radiation or

volatilization of organic fractions (ZWAN, 1991 apud JONH, 2000). In addition, recycling has other benefits, cited by some authors:

- Reduction in the consumption of non-renewable natural resources, when replaced by recycled resources (JOHN, 2000).
- Reduction of areas needed for landfill, by minimizing the volume of recycled waste (PINTO, 1999), since the waste is productive and does not take up space in landfills.
- Reduction of pollution, since the emission of carbon dioxide is reduced, using blast furnace slag for cement production (JOHN, 1999).

3 SOLID URBAN WASTE COLLECTION

Brazil currently produces around 228,400 tons of garbage per day, according to the last basic sanitation survey consolidated by the IBGE, in 2000.

Selective collection prevents the spread of diseases and contributes to the waste being sent to its proper places. Separating waste between plastic, metal, paper and organic also contributes to ending toxic pollution that contaminates soil and river water, bringing immeasurable harm over time.

Selective collection is extremely important for sustainable development and has become an important action in modern life due to the increase in consumption and, consequently, the waste produced. The world's waste is expected to increase from 1.3 billion tons to 2.2 billion tons by the year 2025, according to estimates by the United Nations Environment Program (UNEP).

In Brazil, the collection of urban solid waste differentiates between regular collection and selective collection, where: (a) regular collection is carried out by public service concession companies or by the municipal administration itself, where all waste generated they are collected without distinction, that is, without separation at the generating source by types of waste (organic, dry materials, inert and tailings); (b) selective collection is characterized by a differentiated collection, which is usually carried out with other equipment, on specific days where the generator separates the types of waste that will be transported to sorting units and/or to production processes for reuse and/or recycling.

Figure 4 - Recycle Bins for Selective Collection

Source: Ministry of Health, 2020

3.1 Treatment and Final Disposal of Waste

One way to solve problems related to waste is pointed out by the Three R's Principle (3R's), Reduce, Reuse and Recycle. There are some possible ways for the treatment of waste and its final disposal in nature. In Brazil, the management of urban solid waste is the responsibility of Municipalities. The waste treatment processes are as follows:

Composting: It is a process in which putrescible organic matter (food scraps, cuttings and pruning from gardens, etc.) is biologically degraded, obtaining a product that can be used as fertilizer.

Incineration: It is the transformation of most of the waste into gases, through burning at high temperatures (above 900º C), in an environment rich in oxygen, for a predetermined period, transforming the waste into inert material and reducing its mass. and volume

Pyrolysis : Unlike incineration, in pyrolysis the burning takes place in a closed environment and in the absence of oxygen.

Anaerobic Digestion: It is a process based on biological degradation, with the absence of oxygen and a reducing environment. In this process, gases and liquids are formed. Reuse or Recycling: Already implemented in several Brazilian municipalities, these processes are based

on the reuse of components present in waste in order to protect natural sources and conserve the environment.

Sanitary Landfill: It is a method of landfilling waste on land prepared for the placement of garbage, in order to cause the least possible environmental impact.

3.2 Production Chain

The second concept presented is the "production chain". This is a concept used as a foundation for the development of the present study. In a nutshell, this concept is used as an instrument of the systemic view, and its specific function is to serve as a parameter for characterizing the segments and their components.

The plastic materials production chain comprises part of the Petrochemical Complex, which, according to Perrone (2010, p. 02) is usually structured in first, second and third generation producers, as they represent phases of transformation of various materials. -cousins.

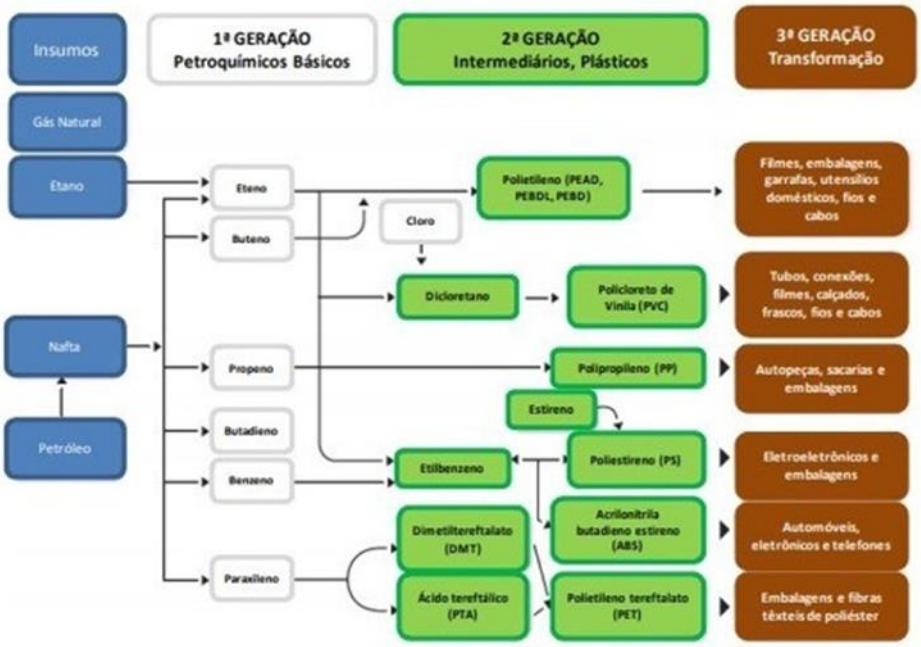
The final petrochemical products are raw materials for the plastics, fertilizers, detergents, pharmaceuticals industry, among others. Perron (2010)

> The interrelationship between products makes the petrochemical industry often present itself in the form of complexes. The diversity of applications of petrochemical products brings, as a consequence, the great multiplying power of this industry, which is inserted in practically all fields of the industrial matrix. (PERRONE, 2010, p. 02).

The production chain of plastic materials comprises in the production flow, in addition to a specific portion of the Petrochemical Complex, the Transformers and Reclaimers of Plastic Material (also known as recyclers). These are responsible for feeding back the production chain, through the collection, separation and reuse of plastic materials.

FIGURE 5 presents some plastic products and their productive chains.

Figure 5 - Production chain of some plastic products



SOURCE: ABDI (2009, p. 27).

3.3 Reverse Logistics and its Strategy

The transformation and ecological influence on business are increasingly felt and with increasingly profound economic effects. Organizations that take13 strategic decisions integrated with environmental and ecological issues will achieve significant competitive advantages, and the inclusion of environmental protection among the organization's strategic objectives substantially expands the entire concept of administration (TACHIZAWA, 2011).

Reverse logistics can guarantee participants in the supply chain, whether retailers or wholesalers, a share in the entire processing, thus reducing the risk of purchasing products that may not be sold within an expected period. In this sense, reverse logistics appears as a strategic function for participating companies, as it strengthens the value chain and reinforces competitive advantage (CHAVES, 2005).

Reverse logistics enables the creation of an alternative source of resources and also provides an appreciation of companies to their consumers. Thus, highlighting the importance of reverse logistics as a strategic tool, aiming at increasing competitiveness (BRAGA JR, 2006).

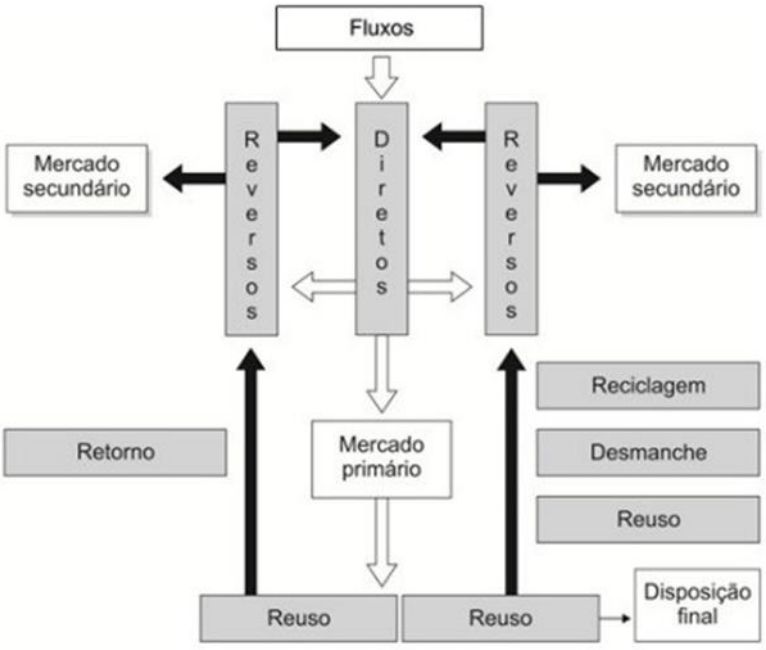
Souza (2008) in an analysis of cases described in the literature, in order to demonstrate the importance of reverse logistics for the supply of the recycling industry, found that there is

still little interest on the part of companies, because the volumes that are now handled represent a reduced monetary value compared to direct distribution

3.4 Reasons for Implementing Reverse Logistics

Lacerda (2002) states that there are several reasons that can be listed for the implementation of reverse logistics by companies, having as a determining factor the strategy implemented by the direction. Daher (2006) corroborates Lacerda (2002), when he mentions that the main reasons that lead companies to act with reverse logistics are: environmental legislation, economic benefits, environmental awareness of consumers, competitive reasons, protection of the profit margin, recapture of value and asset recovery. The concern of the logistics discipline with reverse distribution channels is recent (KOTLER, 19960).

Figure 6 - Direct and reverse distribution channels



Source: Adapted from Leite (1999)

4 METHODOLOGY

This work presents the recycling process and the productive chain of the production processes of some plastics. Sustainability to demonstrate the use and recovery of waste from the perspective of using resources and ensuring future generations.

4.1 Type of Research

This is a qualitative, exploratory and descriptive research. For Minayo (2010) qualitative research is characterized by its flexibility, requiring the researcher to be able to observe and interact with groups that are under investigation. The instruments used are known as tools that guide the researcher, and can be built on the basis of semi-structured and unstructured interviews, which provide greater opportunity for the research participant to express their concerns and anxieties.

According to Gil (2010) exploratory research will provide a greater familiarity of the researcher with the problem, this will certainly make it more explicit, for this it is important that there is a bibliographic survey in reliable databases, interviews with expertise in the subject.

Descriptive research aims to describe the characteristics of a group, population, phenomenon or experiences. This type of research involves the use of standardized data collection techniques: scripts, interviews and observations. Research Location

4.2 Methodological Procedures

The work is based on bibliographic research, which defines an exploratory and descriptive approach. Qualitative research methods collected significant data to carry out the work. For the accomplishment, it is necessary that all material is organized, and that a whole categorization is made, following previously established criteria and that are in accordance with the stipulated objectives (DUARTE, 2002).

To help consolidate the proposed objective, environmental, social and economic sustainability, the production chain of plastic materials and to analyze the performance, the productive efficiency and the ways in which the waste is treated were analyzed to show a flow considered ideal for the production process.

5 CASE STUDY

The use of plastic modules filled with clay taken from the construction.

Figure 7 - Plastic Module

Source: Author

5.1 Analysis of Results

The use of plastic in civil construction is consolidated as a relevant practice for sustainability, as it mitigates the environmental impact generated by the sector by reducing waste generation. In Figure 8, you can see a Prototype of a bathroom built of plastic modules.

Figure 8 - Model bathroom made of Plastic Module

Source: Author

5.2 Improvements

The Brazilian housing deficit has been studied by many researchers, where the sociopolitical issue of popular housing is discussed. What can be observed, however, is that the old problem of homelessness was added to the issue of the poor quality of Brazilian civil construction (SALGADO, 1996).

In general, among the causes of the housing problem in Brazil, there is the lack of income of the population to face all the necessary expenses. These expenses include the value of housing, the lack of a systematic process of urbanization and the rise in urban land costs. Another important cause to be mentioned is the ineffectiveness and inefficiency of public policies aimed at social housing (PEREIRA, 2005).

Today we will be able to build houses for future residents of a self-sufficient neighborhood by applying the product together with the transformation of the city's plastic waste. The key to the future success of a self-sufficient neighborhood is having access to the city's recyclable waste to generate income for residents. In Figure 9, you can see a prototype of a sustainable house built of plastic modules.

Figure 9 - Model House - Building Modules

Source: Author

6 FINAL CONSIDERATIONS

Reverse logistics is an indispensable tool in the search for competitive advantage and operational control of companies, in addition to meeting legal requirements. However, it still

needs restructuring to adapt the procedures and systems applications necessary for the flow of sustainable processes.

Law No. 12,305/10, which establishes the National Solid Waste Policy (PNRS) is very current and contains important instruments to allow the necessary progress for the country to face the main environmental, social and economic problems arising from the inadequate management of solid waste. Currently facing the problems related to the generation of waste urban solids can be considered one of the biggest challenges for municipal administrations.

The practice of this inappropriate disposal causes serious and harmful consequences to public health and the environment and is associated with the sad socioeconomic situation of a large number of families who, socially excluded, survive from the "dumps from which we take recyclable materials that they sell.

Man's perception of nature over time, under different aspects, was not always compatible with the need to maintain a balanced environment.

Concern for the environment gave rise to environmental awareness, which generated more concerned and demanding consumers regarding socio-environmental issues, mainly related to the environmental impacts generated by industrial processes or by any enterprise. Faced with the extreme need to adopt sustainable methods in their activities, aiming to guarantee a future for this and the next generations, companies started to commit and establish more cautious activities in relation to the environment.

Exploring synergies and complementarities is, therefore, a factor of competitiveness, promoting development and addressing sustainability issues. The best performance depends, however, on the intrinsic quality of the productive arrangements. In other words, it depends on the nature of the engagement and legitimacy, motivation, vision of the future and sharing of beliefs, meanings and values of the different involved, of the capacity to deconstruct, consolidate and maintain in permanent development an environment capable of generating economic, social, environmental and cultural results. In the long term, the effectiveness of interaction and cooperation mechanisms and the ability to sincerely recognize the legitimate interests of those involved.

Through the items raised in this article, we verified that reverse logistics is important for the company as long as it is properly managed during the product's life cycle and in accordance with the relevant legislation, bringing benefits to the companies.

7 BIBLIOGRAPHIC REFERENCES

BALLOU, Ronald H. Supply Chain Management/Business Logistics, 5. Ed. Porto Alegre, Bookman, 2006..

BOWERSOX, DJ.; CLOSS. DJ; HELFERICH, OK Logistical Management: A systems integration of physical distribution, manufacturing support, and materials procurement. New York: MacMillan Pub Co, 1986.

BRAGA Jr, SS, COSTA, PR, MERLO, EM, & NAGANO, MS(2008). A study comparison of reverse logistics practices in midsize retail. SIMPOI FGV-EAESP.

CAVALCANTI FCU, CAVALCANTI PCU. First citizen, then consumer. Rio de Janeiro: Brazilian Civilization, 1994.

CHAVES, GLD (2005). Diagnosis of reverse logistics in the processed food supply chain in western Paraná. Master's Thesis, State University of Western Paraná, Toledo, Paraná.

DAHER, CE, SILVA, EPS & FONSECA, AP(2006, enero-junio). Reverse Logistics: Opportunity for Cost Reduction through Integrated Value Chain Management. BBR Brazilian Business Review, vol. 3, no. 1, pp. 58-73. FUCAPE Business School. Brazil.

DIAS, JF Evaluation of Residues from the Manufacture of Ceramic Tiles for Use in Low Cost Paving Layers.São Paulo, 2004. 268f. Thesis (Doctorate in Civil Engineering) - Polytechnic School, University of São Paulo, São Paulo, 2004.

IBGE, Brazilian Institute of Geography and Statistics. National Basic Sanitation Survey 1998/2000/2008. 2009. Available at: www.ibge.gov.br. Access on: 20mar. 2014

JOHN, VM Waste recycling in civil construction – contribution to research and development methodology. São Paulo, 2000

HESS, S. Environmental Education: Us in the World, 2nd ed. Campo Grande: Ed. UFMS, 2002, 192 p.

LACERDA, L. Reverse logistics: An overview of basic concepts and operational practices. In: FIGUEIREDO, KF; FLEURY, PF; WANKE, P. Logistics and Supply Chain Management 19. Sao Paulo: Atlas, 2006

LINHARES, ACS, CARDOSO, PA, & CANCIGLIERIJr, O. (2008). Reverse logistic: The case of the destination of chemical products and glassware in an educational institution vocational training in Curitiba. XXVIII NATIONAL ENGINEERING MEETING.

PEREIRA, AC W Guidelines for the implementation of open building systems in social housing through modulation. 2005. 139 f. Dissertation (Master in Civil Construction) - Federal University of Paraná, Curitiba 2005.

PERRONE, OV The petrochemical industry in Brazil. 170f. Rio de Janeiro: Interciencia 2010./Industria_Petroquimica_no_Brasil_Otto_Perrone.pdf> Accessed: November 04, 2010

SALGADO, MS Methodology for selecting construction systems for the production of affordable housing. 1996. 210 f. Thesis (Doctorate in Production Engineering) – Federal University of Rio de Janeiro, Rio de Janeiro, 1996.

SHIMURA, S., YOKODA, I. and NITTA Y. (2001). Research for MSW flow analysis in development nations. Journal of Material Cycles and Waste Management, volume 3, p. 48-59.

SOUZA, SF, FONSECA, SOUTH (2009). Reverse Logistics: Opportunities for Cost Reduction Due to the Evolution of the Ecological Factor.
TACHIZAWA, T. (2011). Environmental Management and Corporate Social Responsibility - Business Strategies Focused on the Brazilian Reality (7th ed.). Sao Paulo: Atlas

ZWAN, JT Application of waste materials-a success now, a success in the future. In: WASTE MATERALS IN CONSTRUCTIONS: PUTTING THEORY INTO PRACTICE. great Britain, 1997