Application of Reverse Logistics of Waste Tires and their Proper Destination

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Abstract

Increased solid waste generation has become a major concern for society. Among the many types of waste, the tire stands out because of its worldwide consumption and because it is a threat to the environment. With the need to reduce improper tire disposal, several solutions have been developed to reduce or reuse this material. Many countries are creating new technologies and processes that can be used to recycle tires. Governmental actions have also been manifesting in the face of the situation, with the creation of legislation for both the corporate level and society in general, together with environmental inspection agencies to control this waste. The present work consists in making an analysis about the application of the reverse logistics of the waste tires, with the objective mainly in the issues that correspond to the proper disposal or the reuse of waste tires. Also present possible tire reuse alternatives, processes that can be applied to these wastes and show how harmful they are to the environment.

Keywords: Reverse logistic; Waste tires; Tire destination;

1. Introduction

With the economic and population increase, there is a great growth in the consumption of cars and companies working in the logistics sector. This causes an excessive increase in tires, which over time become unusable. Unfortunately, many do not properly dispose of this waste, depositing in inappropriate places and consequently causing environmental problems.

Created by Charles Goodyear, the tire, known as a tire, is an air-filled rubber tube placed at the rim of the vehicle's wheel, enabling vehicle traction. It can be inflated with air or water, and even be massive. The tire is commonly used in cars, bicycles, trucks, tractors and etc. It has a black color due to the addition of carbon black during the manufacturing process. A tire has a durability of 25,000 to 70,000 kilometers driven, depending on how it is used.

According to Gardin et al. (2010) gradually, waste tires cause problems of environmental hazards when improperly disposed of. The author highlights the need for society to be aware of its actions, correctly disposing of viable initiatives, because currently there are several suitable alternatives for the final disposal of waste tires. Thus, it is essential that corporations and society become aware of and act responsibly and ecologically correctly with regard to tire disposal, thus contributing to the biotic and anthropic environment.

Data released by the National Tire Industry Association (ANIP, 2014) show that in the first half of 2014, Brazil broke a record tire recycling rate, with more than 223,000 tons, which is equal to around 45 million tires. automobiles. This result was only possible because in 1999 a proposal was introduced to regulate solid waste in Brazil, through the National Policy on Solid Waste (PNRS), which results in a change in the National Environment Council (CONAMA) in relation to the standardization in Brazil. waste treatment. A work started in 1998 by CONAMA regulated waste treatment of various products, including batteries, tires, batteries, fluorescent lamps, among others.

According to BRAZIL, the National Environmental Council, based on CONAMA Resolution No. 416/2009 (2017), provides for the prevention and environmental degradation caused by waste tires, obliging companies, manufacturers and importers to dispose of tires in a to collect and dispose of in an ecologically sound manner. Thus, industry and companies working in the tire industry are responsible for the LR of the post-consumer waste tires to prevent the degradation of the environment in which they are inserted.

However, the objective of this paper is to approach bibliographical references about the process of application of the reverse logistics of the tire and the proper destination for it, presenting applications, developments and data made in relation to waste tires, so that it is necessary to raising awareness among the population and authorities of environmental preservation.

2. Theoretical References

2.1. Origin of Tire and its Composition

In 1839, Charles Goodyear casually discovered the process of rubber vulcanization, so in 1845 taking advantage of this discovery, R. W. Thomson created the rubber tire. For decades many experiments have been carried out to improve the properties of natural rubber. From World War I, in Germany a new technology was created for the manufacture of synthetic rubber, since until this period the tires depended entirely on the raw material natural rubber for its manufacture. (RAMOS, 2005).

Today, in addition to synthetic rubber, tires have several components, as it is a product that aims for a long service life, as they are “designed and manufactured to last in extreme physical, chemical and thermal situations. It presents a complex structure, with the objective of giving them the characteristics necessary for their performance and safety, made to be indestructible ”(KAMIMURA, 2002).

A tire is composed of different materials such as: steel frame, nylon, aramide fiber, rayon, fiberglass /

polyester; natural and synthetic rubber and various types of polymers; chemical reinforcers such as black carbon, silica and resins; anti-degradants (antioxidant paraffin waxes and ozone gas inhibitors); adhesion promoters (cobalt salts, metal wire baths and resins); curing agents (curing accelerators, activators, sulfur) and auxiliary products (PIRELLI, 2007).

2.1. Tire Recycling

According to Rodrigues and Henkes (2015), the reuse of tires is old, but its procedure occurred after World War II due to the complication in obtaining raw material for the production of new tires. Tires, when replaced with new ones, are discarded after the end of use. This disposal may occur in rivers, landfills and general waste collection sites. Proper disposal of the tire is the responsibility of all consumers, manufacturers, distributors, dealers and importers (BRAZIL, 2010). Proper destination will bring benefits to public health and the environment.

For Roy, Nollet and Beaulieu (2006), tire recycling is not profitable for tire manufacturers, as the government did not think of internalizing costs for manufacturers, but rather finding a solution to the ecological crisis that the industry was experiencing. passing and contribute to the development of waste tire recycling as a new industrial sector. Tire recycling can be done in a variety of ways, from the use of its casing to shredding for use in the production of various products and materials. The evaluation of the tires for correct destination goes through a screening of the carcasses and if they are able to be used they are sent to companies specialized in retreading, remolding or retreading (RESENDE, 2004).

According to Bertollo and Fernandes Júnior (2002), the reuse process of waste tires has a high cost due to the cutting and grinding process through which it is separated to allow the recovery of materials initially used in its manufacture. Rubber extracted by grinding waste tires can be reused to make slippers, automotive mats, industrial floors, shoe soles, rubber seals, sports courts, asphalt and concrete composition and also as an energy matrix in cement industries (RECICLANIP , 2015).

2.3. Reverse Logistic

According to Leite (2003), the Reverse Logistics method has developed since its inception in the 1980s. It began with the need for organizations that tried to return defective products to the factory. The milestone grew throughout the emergence of the environmental agreement in the world, when companies realized the economic benefits achieved by using this process.

According to PEREIRA (2014), Reverse Logistics is established in a wide area of business logistics that involves the classic concept of logistics, adding a set of operations and related acts, from the reduction of the use of raw materials to the disposal. final and correct use of products, materials and packaging with their continuous reuse, in recycling and / or energy production. Reverse logistics also receives titles of full logistics or reverse logistics.

According to LIZARNHOS; TENÓRIO, 2013, reverse logistics has been dated since the 1970s, where definitions such as reverse channels or reverse flows, mainly related to recycling, appeared. In Brazil, the term associated with companies emerged in the 1990s and was linked to logistics through raw materials, components and supplies that showed significant costs and which should be properly conducted when returning from after-sales or after-sales. consumption.

Conceptually, Reverse Logistics is the area of business logistics that designs, acts and controls the course of the corresponding information on the return of after-sales and post-consumer goods to the trade cycle or productivity cycle through the reverse distribution channels. , adding value to them of various natures, such as: economic, ecological, legal, logistic, corporate image, among others. (LEITE, 2009).

According to TEPPRASIT and YUVANONT (2015) with increasing concern about the environment, several countries enact laws in order to reduce the ecological problem of logistics that is linked to climate change, air pollution, waste, among others. In the recycling chain, reverse logistics is one of the important processes that makes the entire chain economically viable, whether in the process of reuse, recycling or energy recovery. This allows organizations to do the best from an economic, environmental and community point of view (TEPPRASIT; YUVANONT, 2015). In the case of tires, the process becomes challenging with regard to economic viability, as their transportation from collection points to recycling sites becomes high and is not advantageous for industry, distributors and traders (CHAN; CHAN; JAIN, 2012).

For Lacerda (2002), among the critical factors that influence the efficiency of reverse logistics are: the high index of activity informality and the lack of standardization and mapping of production processes. On the other hand, reverse logistics has been strengthened not only by concern for the environment, but also by pressure from environmental legislation and the pursuit of ISO 14001 certification by many companies.

2.4. Reverse Tire Logistics

Reverse logistics is a new field of business logistics. Under federal law No. 12,305, the business sector that markets packaging products must enable packaging recovery in a manner commensurate with the amount placed on the market annually through the structuring of reverse packaging logistics systems.

According to the Corporate Commitment to Recycling (CEMPRE, 2008), tires and inner tubes consume around 70% of national rubber production. In 2006 Brazil produced almost 55 million tires, where approximately one third of these are exported to more than 85 countries and the remainder serves to supply the domestic market.

On August 26, 1999, CONAMA Resolution No. 258/99 was approved, which set the targets and required manufacturers and importers to dispose of waste tires. Since 2002, tire manufacturers and importers must collect and dispose of waste tires. In addition, distributors, dealers, retreaders and end consumers are responsible for collecting used tires. Prior to the approval of Brazilian law, only 10% of the tires were recycled.

After the approval of the legislation, the number of companies registered to collect and destroy waste tires, which are in accordance with Normative Instruction No. 008/02 of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), went from 4 to 65. In 2010, there are 124 companies registered with IBAMA for the reuse, recycling and energy recovery of tires.

Companies are experiencing economic changes, which change the rules of wealth in conjunction with advances in awareness in a process of structural transformation of companies that accompany globalization (ROCHA, 2015). Growth is unprecedented in the evolution of technology that encompasses raw materials, manufactured goods, agricultural products, services of all kinds, labor, among others, making capital turnover work every day of the year. It is due to this evolution that companies make competitiveness the necessary supplement for the adoption of Reverse Logistics of their products.

3. Methodology

The methodology of this article was based on bibliographic and documentary research of national experiences, being sources for the elaboration of the review articles in scientific journals, books, theses, dissertations and congress abstracts. Websites related to tire production and collection were consulted, in order to present how the reverse logistics of waste tires are applied in the country and also to study possible ways of reusing and recycling them.

4. Application of Study and Results

In the study by Goto and Souza (2008), they evaluated the benefits of reverse logistics applied under solid waste, especially in the pneumatic sector. The authors collected data on tire reformers, dealers and consumers of the product. For the analysis, a solid waste management and reverse tire logistics management model was used to assess reuse, retreading, tire burnout and unsuitable tire problems in inadequate locations.

For the examination and data collection to take place, they used a schematic representation of reverse logistics processes, as illustrated in Figure 1.

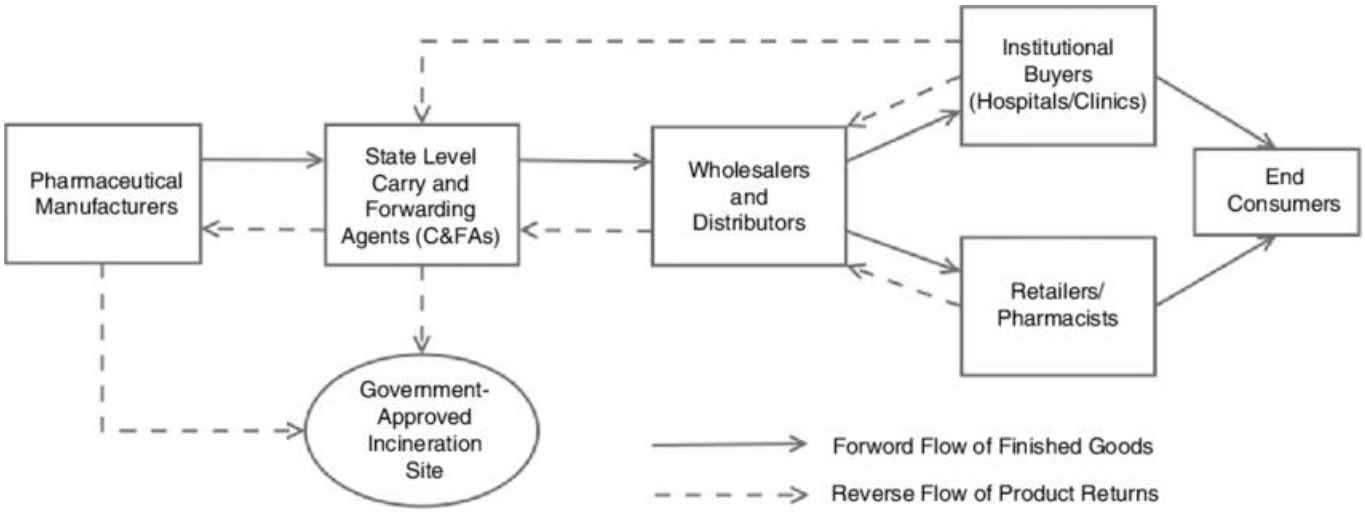

Figure 1 - Schematic representation of reverse logistics processes
Source: NARAYANA, 2014.

Regarding the reuse of the tire, found that consumers have been interested in buying used tires in good condition, thus taking advantage of the limit of life. Regarding tire retreading, although some retreaders have the INMETRO certificate, some consumers doubt the quality of the retreaded tire and the companies that perform this service (retreading) are required by CONAMA Resolution 258/99 to give a destination tires for recycling or incineration.

FLORIANI, Marco, et.al, (2016), presented in their study, the Reciclanip entity that developed a sustainable method of tire disposal. One of the main developments of the company has been creating wasteful tire collection points, which became known as Ecopoints. This method was done in partnership between the

company and the city hall. Tires destined by tire repairers, refills, carriers were also linked to these locations, awaiting withdrawal. Reciclanip is responsible for logistics from the removal of tires from collection points to the final disposal, environmentally appropriate. In 2013, the company totaled 824 collection points, illustrated in the table below.

Table 1 - Collection Points Per Year

Yeas	Collection Points
2013	824
2012	743
2011	726
2010	578
2009	437
2008	339
2007	270
2006	220
2005	135
2004	85

Source: Floriani, Furlanetto and Sehnem.

The government has designated a covered and protected area to function as a tire depot, with the tires being collected by Reciclanip or authorized partners. The action was seen as a great initiative by the government, encouraging sustainable development for their region, and could increase the use of these points, adding other recyclable products that cause problems to the environment.

In SIMONETTI's study, Camila (2018) addressed an environmental issue, highlighting the problems caused by improper tire disposal and the legislation on disposal. He pointed to the durability of the decomposition of the tires that did not have time to occur, showing that the tires are the main breeding grounds of the Aedes aegypt mosquito that is responsible not only for the transmission of dengue virus, but also for Zika and Chikungunya. They concluded that by consolidating CONAMA Resolutions, tire manufacturers and society are more responsible for the proper disposal of waste tires, helping to combat environmental problems.

According to data collected by the Ministry of Health (2012) from January to April 2011 and 2012, there was a decrease from 507,798 cases of dengue in this period of 2011 to 286,011 cases in the same period of 2012, from the increase in contribution of the final destination of waste tires, which went from 84.73% to 95.75%. However, based on data updated by the Ministry of Health (2014) for 2013, there was a large increase in dengue cases registered compared to the previous year, a 3.89% drop in the final destination rate of waste tires which contributed to a jump from 286,011 in the first quarter of 2012 to 1,111,003 in the same period of 2013 (BRASIL, 2012b; BRASIL, 2014b).

There are many options on how to reuse tires after their end of life. Many applications are being performed successfully, either by the collection points, the use of waste added in concrete and asphalts and the use of materials from them. Among so many applications and developments, stand out:

• Soil erosion containment, where whole tires, associated with large root plants, can be used to contain soil erosion (CARVALHO, 2004);

• Production of t-shirts (RECAUFAIR, 2004);

• Composting, where the use of crushed tires assists in the aeration of organic compounds (CARVALHO, 2004);

• Kiln fuel for cement, lime, paper and pulp production, where the replacement of coal by the tire has a great advantage, since the tire has a higher calorific value than the coal used in these processes (ANDRADE; PACHIEGA; EL-KHATIB, 2003).

• Road pavements, where tires are ground and mixed with asphalt, increasing their elasticity and durability (KAMIMURA, 2002);

• Artificial reefs for reproduction of marine animals, where the tires become an environment conducive to the development of fauna and flora (SANTOS 2002);

• Inertial barriers, where sand-filled whole tires are used to reduce vehicle impacts (KAMIMURA, 2002);

All of these developments applied to waste tires can be classified into the following applications: the use of crushed tires for construction or road paving, for energy production and for the production of new rubber products.

5. Final Considerations

With the bibliographic survey of this article, found that the tire is a common product worldwide and when it reaches the end of its life, can become a big problem if it is not properly disposed, causing threats to the environment and consequently health. public Therefore, it is important to comply with the laws imposed on the proper disposal of tires.

We have seen that there are ways to combat the incorrect disposal of this waste, as presented in the study by FLORIANI, Marco, et al. The Reciclanip entity has created waste collection points that since 2004 the points have grown gradually each year and will also increase. extend these points to collect other waste that causes damage to the environment.

Legislation created by government agencies regarding the incorrect disposal of solid waste was of great importance, as consumers, companies and tire importers are responsible for giving the correct disposal of the waste, whether to reformers or recycling companies, and also making the general population aware.

We also had big names from authors who developed important end-of-life tire applications, who came to serve as models for other authors and applications, such as durability-shredded paving, also for construction, production of fabric and among others.

The presented alternatives of reuse, new processes and technologies for waste tires is a great economic and ecological advantage, because with the great consumption of this waste can become raw material of new products.

In addition, the tire can be a major breeding ground for the dengue mosquito, a disease that is responsible for the high mortality rate in Brazil, where the Ministry of Environment and Public Health has been battling this problem for years with campaigns, awareness and lectures. . The important thing is that the destination of the tires show evolution, because a small amount of tires discarded improperly enough for the mosquito to proliferate. Burning this product can also cause serious health problems.

Awareness and disclosure among tire importing and producing companies is required to be responsible for the final disposal, creating collection points facilitating the disposal of this waste for other purposes. It is also noteworthy that it can be beneficial for companies as tires can be raw material for other processes.

The government could further encourage companies and even society to practice tire collection and recycling, as well as to create or update laws involving the proper disposal of solid waste. All this would make it possible to develop research and technologies for the reuse of this waste so that it would no longer be a threat to the environment.

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