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CO_2 EMISSION REDUCTION PROPOSAL FROM LIGHT ALLOY WHEEL PACKAGING

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Abstract: The challenges in recent years in the business environment, presents new concepts in the vision of how to manage your company. The market is currently breaking paradigms to adapt to the most competitive market. Faced with these new concepts of managerial modernity, integrated logistics establishes standards to optimize the system as a whole, minimizing the cost of activities and integrating the process through sustainable supply chain management. The objective of this work is to raise and propose solutions and improvements to reduce the high cost of packaging in the transport of the alloy wheel with the application of Green Logistics. An exploratory research was carried out with a literature review on costs, sustainability, green and reverse logistics. Data were collected from indirect sources and analyzed qualitatively. In which it was possible to reduce solid waste and the costs generated in the transport of the light alloy wheel with sustainability in the supply chain through Logística Verde and Logística Reserva in the integration of the distribution center for automotive manufacturers, making economic development sustainable, enabling the reduction of discards and waste in the automotive sector, reusing cycle resources properly through new packaging processes in the distribution center.
Keywords: Packaging. green logistics. costs.

INTRODUCTION

The automotive sector has an important participation in the world industry. In Brazil, it represents about 22% of industrial GDP. According to Sindipeças (2020) indicates that the steel and derivatives sector represents one of the most important inputs for all subsectors of the automotive chain, especially for auto parts.

In this way, it is observed that the sector has an important impact on the level of activity in the manufacturing industry, and the growth of automotive production can, through its supply chain, drive the growth of several other sectors of the industry. In which, alloy wheels, which is made up of aluminum, is an important item in the automobile industry. The first models were made available on the market more than forty years ago. Alloy wheels are packaged to protect against possible damage such as scratches and dents, which depreciate and damage the product.

However, the packages used in light alloy wheels, in general, have primary packaging that require a large amount of materials. According to Santos (2019), they generate a high cost for the company that receives the load of light alloy wheels, and consequently generates a large volume of solid waste that needs to be properly disposed of. A great challenge is to reduce the consumption of natural resources, such as those used in packaging, and the economic sustainability of the processes.

For this, companies are looking for process improvements to become competitive. However, the adoption of sustainable practices such as Green Logistics (PLVB, 2019) generate a great differential as is the case of the automotive sector, in which negative environmental impacts have been sought, such as the reduction of the carbon footprint such as the emission of Greenhouse Gases (GHG) from its processes and products. With this, influencing everyone who makes up the logistics chain of the company that uses light alloy wheels in the assembly of automobiles.

Although the economy is not stable for large investments, organizations need to adapt to the market, improving their competitive edge so that they have the opportunity to grow at the lowest possible cost.

For the company to be successful in the global market, it is necessary to know the costs of its entire economic chain and work

with its partners to strengthen the links in the chain to manage costs and maximize returns.

In a diagnostic work (SANTOS, 2019) it was identified that the costs of packaging the alloy wheel are high. So, can there be technological alternatives for packaging that generate cost reduction and CO_2 emission reduction?

The present work has the objective of raising and proposing solutions and improvements regarding the cost of packaging in the transport of the alloy wheel with the application of the concepts of Green Logistics.

Assuming that the use of fewer inputs in the packaging of the product can generate savings, reduction of solid waste generated and consequent reduction of Greenhouse Gas (GHG) emissions, meeting the principles of Green Logistics.

The methodological course of this work was an exploratory research with a literature review on sustainability, solid waste, green logistics, reverse logistics, packaging. Data were obtained from indirect sources such as reports, scientific articles and books. The data collected were tabulated and analyzed qualitatively.

This work is organized in a theoretical basis of costs, Sustainability, Green Logistics, Reserve Logistics, Input Reduction and the Carbon Footprint; work development; and results

THEORETICAL BASIS

Sustainability in organizations is being increasingly discussed, even without a consolidated concept. Sustainable development can be defined; "one that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 1991).

For this, it is important to raise awareness of society that has been promoted by the social environment and of employees by the corporate environment. (JACOBI, 2010; KRAEMER and TINOCO, 2011) Such practices are in accordance with the Brazilian Global Compact (UN, 2020) with the environment as one of the pillars. In which the adoption of Green Logistics and Reverse Logistics practices.

For Bowen and Hall (2001) green logistics resources must be used to reduce losses, through reuse of resources and improvement between suppliers and customers to perform a sharing of reduction of resources used so that it plays a differential in the market, using technologies clean, adaptations to environmental legislation and awareness of their role in the environment.

Lamming and Hampson (1996) pointed out that they would increase the cost of organizations to comply with new environmental legislation, but could reduce costs by eliminating losses and waste of resources, thus reducing environmental impacts.

Being reverse logistics, part of green logistics, which according to PNRS (2010), is:

> "instrument of economic and social development characterized by a set of actions, procedures and means aimed at enabling the collection and return of solid waste to the business sector, for reuse, in its cycle or in other production cycles, or other environmentally appropriate final destination."

SOLID WASTE

According to the National Solid Waste Policy (PNRS), Law no · 12.305/2020, organizations must manage their waste, so that they have reverse logistics, making responsible planning for the collection and disposal. Organizations are aware of their role and social responsibility, thus developing the destination and disaggregation of waste, for the necessary packaging, collection and adequate sorting.

Revlog (2012) the PNRS are focused on three pillars;

A. Environmental legislation: that companies return with their products and take care of the necessary treatment;

B. Economic benefits: that the use of products that return to the production process, to the detriment of the high costs of correct waste disposal;

C. Environmental awareness: that consumption does not exceed its need.

Over time the mentality of companies is changing, before the mentality was to produce products as quickly as possible driven by market demand, consequently the levels of discards were high. With logistics reserves the transport costs that are high, they can guarantee the desired profitability. (IPEA, 2012).

The new logistics model ensures that if we use resources properly, we can reduce solid waste, respect the environment, reduce costs and thus generate more profitability for the company. (BARBIERI, 2004; DORNIER 2000).

CARBON FOOTPRINT

In the 1990s, it was marked by the theme "climate change" resulting from human activities. In this context, the carbon footprint aims to establish targets for addressing phenomena impacting climate change generated by human activities in the environment, mainly in gas emissions. (RADU; SCRIECIU; CARAOTA; 2013).

Anthropogenic activities are generating large amounts of carbon dioxide (CO_2 eq), among other GHGs, through their production processes. (LIU; WANG; SU; 2016).

For companies to have a better sustainability, they developed a way to calculate the emission of carbon dioxide. In this calculation, the points to be improved can be analyzed. (RADU; SCRIECIU; CARAOTA; 2013).

In Liu, Wang, Su (2016) view, this new carbon emission management is focused on two pillars:

A. Amount of carbon generated over the life of the product.

B. Amount of carbon generated for the production of the product.

Companies are using this tool for the dissemination of data and communication of their target audience, to differentiate themselves from their competitors. (PERTERS, 2010).

The carbon footprint is not only focused on the emission of gases but also on the proper use of resources, from its manufacture to the end of the product's life. With the management of these resources, companies are able to make improvements in their activities, make new innovations in the process, improve the company's image and reduce the environmental impacts caused by the era. (Pine; 2009).

PACKAGING

Cobra (1990) details that the packaging must adapt to consumption, in the basic quantities, the needs of the consumer customer. It must be a facilitator for the transport of the product by the consumer. It must be as simple to handle as possible; it must allow the repetitive use of the product in addition to being sufficiently resistant. It must be suitable for display on shelves. It must indicate the storage and transport conditions, in addition to adequately protecting and conserving the product for its useful life. Many areas and factors within companies have evolved over the years and with technological development. Consequently, the packaging too. It has become one of the tools that professionals tend to get involved a lot.

When packing the alloy wheel for national transport, an EPA plastic is placed to protect

the paintwork on the front of the wheel, in the proper accommodation of the wheel in the box and in the palletization of the wheels.

THEMATIC DEVELOPMENT

In this part of the work, diagnostic data will be presented (SANTOS, 2019) and improvement proposals regarding the Cost associated with packaging suggestions, recyclable solid waste generated and CO_2 emission resulting from the reduction of solid waste generated. Since the Logistics cost, the resources consumed for the activity of Distribution of the light alloy wheel, presented in table 1, the cost of the current packaging of the product to be transported increases the cost of the activity in the COMPANY. Table 1 shows the costing of resources for the cost of packaging the 30,000 alloy wheel raised by SANTOS (2019).

With the understanding of the costs generated in the packaging, there is a need to find a suitable packaging for the transport of the product.

In figure 1 wheels will be grouped in layers with four units, they have to be grouped to be stretched with the *stretch* film.

With the foundation of how the alloy wheel is now transported, you can develop improvements so you can improve the current process.

Figure 1 - Stretched light alloy wheel pallet in cardboard box packaging – current packaging.

Source: CLUB-FX (1990).

RESULTS AND DISCUSSION

In this part, there are some improvements to reduce the cost of packaging the alloy wheel. With the study of the activities assigned to packaging the product, it was raised that there are alternatives to improve the packaging. Because the activities for the packaging of the product cost some time, to carry out the task, shown in figure 6. The packaging after arriving at the customer did not add value to the product, as the product is removed from the pallet and taken to the assembly sector and the pallet is sent for recycling.

Packing cost for shipping			
	The amount	Unitary value	Annual Value
Cashier	30,000	BRL 4.00	BRL 120,000.00
pallets	1,875	BRL 12.30	BRL 23,062.50
stretch	160	BRL 30.00	BRL 4,800.00
Fumigation	10,800	BRL 1.67	BRL 18,036.00
Total			BRL 165,898.50

Table 1: Cost of Packing the Alloy Wheel.

Source: SANTOS (2019).

According to the proposal of the work, some activities in the logistics process can be reduced, thus reducing the cost of the operation, such as developing a new method to send the wheel to the customer.

With the new market challenges to reduce costs and implementation of new methodology such as Green and Reverse Logistics, the study sought improvements to have a differential in the active market.

The challenges of implementing Green and Reverse Logistics respecting the environment, we have improved in removing wooden pallets and placing plastic pallets, to increase the life of the pallet and its use. Remove the single cardboard box and place the wheels on the wire rack with separators, this way we will reduce the cardboard packaging and the waste of the stretch film to lock the wheels on the pallets.

From these new methodologies, it is possible to reduce solid waste and the emission of carbon dioxide in the distribution chain, becoming a model supplier for its customers.

It is suggested that the pallet could be exchanged for a wire rack, to be reused for transport at other times. The racks are made of iron making them more durable, around 50 years. (figure 2) Plastic pallets last longer than wooden ones. The other proposal would be to reuse the wooden pallet.

Figure 2 - Wire- framed metal rack (King of Pallet RR–02).

Source: KING OF PALLET (2020).

The wooden pallet costs around R$12.30 reais to make the investment viable, thus reducing the number of pallets so that there is greater distribution turnover, as the wire rack costs R$1,100.00. (KING OF THE PALLET, 2020).

Wheel box sizing: 51x51x21 cm with 15 kg. So the dimension of the wooden pallet with 16 wheels is 0.84 x 1.1 x 1.1 meter, cubed weight of 164kg.

As the cost reduction proposal and the implementation of new methodology, the monthly costs of this process is R$ 7,227.90. (table 2).

Current packaging costs				
Item	Unitary value	The amount Yearly	Annual Value	Monthly value
Packing	BRL 4.00	17,200	BRL 68,800.00	BRL 5,733.32
pallets	BRL 12.30	1,075	BRL 13,222.50	BRL 1,101.88
stretch	BRL 30.00	157	BRL 4,710.00	BRL 392.50
TOTAL			BRL 86,732.50	BRL 227.90

Table 2: Cost of current packaging - stretched.

Source: Authors of the Work.

Table 3 shows the investment values to put the new process into practice, such as the Reserve Logistics of the wire rack and separator.

To implement the new process, it is necessary to invest according to table 2, visualizing the return on investment in 3 months and 15 days, as the monthly cost is R$ 7,227.90 shown in table 3.

According to the adoption of Green and Reverse logistics, the generation of solid waste can be reduced by 1,915 kg and, annually, 23,418 kg. Waste that will no longer be thrown away, respecting the sustainability of the environment. (table 4).

According to TJPR (2019) for each ton of solid waste emits 0.9636 ton of carbon gas, for each ton of carbon gas it takes 6,884.4 trees to dissipate the gas in the atmosphere.

With the analysis of table 4, the daily solid waste reduction is 65 Kg and it will not emit 62,634 TON of CO_2 per month, so it will need to make the compensation with 448 trees. (figure 3).

In the current process of transporting the light alloy wheel, it uses the reuse of the wooden pallet, around five years depending on where the pallet is based on its conditions. In the analysis of the research, we observed that even with the reuse of the pallet at each end of its life, it generates in the process of packaging the wheel the emission of 10,599.6 Ton of CO_2 with the cardboard and stretch plastic packaging, together they give 11.5 kg, as shown in Figure 4.

It is possible to reduce about 23,580 kg per year of solid waste (table 4) that would be thrown away even if a part of it is recycled. There will be a reduction in the emission of carbon gas generated by the manufacture and movement of the input around 751,608 TON per year.

To put this new process into practice, there will be an investment of around R$ 25,680.00 with the purchase of 20 wire racks, with a return on investment in 3 months and 15 days. The reduction is around R$ 86,732.50 per year with packaging, of 23,580 kg per year of solid waste that would be discarded, even if part of it was recycled. There will be a reduction in the emission of carbon gas generated by the manufacture and movement of the input around 751,608 TON per year.

FINAL CONSIDERATIONS

Organizations are readjusting their process so that they implement new processes that fit the new established needs of the market, so that it has success and gains in the active market.

Currently, in the Brazilian market, logistics distribution is one of the costs that most raise the price of the product. With this high cost, organizations have been adopting technological innovations so that they can reduce their costs through Reverse Logistics, promoting the longevity of the life cycle of products, and using resources properly in the cycle of the respective production chain.

With the understanding of the packaging process of the alloy wheel, it was diagnosed that it was a process with many activities and resources that thus took a certain time to be carried out, making the price of the product high. Based on this need to reduce costs, a survey was carried out on how the product is packaged and transported and if it could be at a lower cost.

For this, it is possible to propose the reduction of product packaging costs with the implementation of a new packaging process, Reserva Logística in the packaging of the alloy wheel. Implement Reverse Logistics on wooden pallets by wire rack, to reuse packaging transport, increasing packaging reuse in the chain cycle.

With the wire rack, it will not be necessary to pack the wheel and the pallet stretching,

National proposed packaging cost			
Item	Unitary value	annual amount	Investment value
Metal Rack-RR-02	BRL 1,100.00	20	BRL 22,000.00
separator	BRL 46.00	80	BRL 3,680.00
TOTAL			BRL 25,680.00

Table 3: Cost of the proposed packaging - metallic rack - RR-02.

Source: Author of the Work.

Resources withdrawn from the process				
Item	product weight	Daily	Yearly	percentage
Packing	0.2 kg	9.5 kg	3,420 kg	15
wooden pallet	18 kg	54 kg	19,440 kg	82
stretch	4 kg	2 kg	720 kg	3
Total		65 kg	23,580 TON	100

Table 4: Resources taken from the packaging process using the metallic rack.

Source: Authors of the Work.

Figure 3 - Calculation of CO_2 (Ton) emitted by solid waste removed using the Metal Rack.

Source: TJPR (2019).

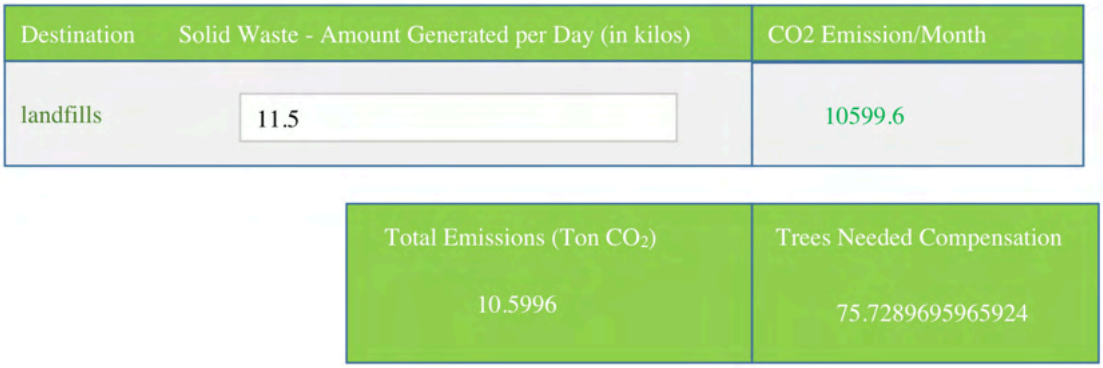

Figure 4- Calculation of CO_2 (Ton) emitted by solid waste removed.

Source: TJPR (2019).

thus reducing the time with the packaging and stretching activities, thus reducing cost and solid waste destined for recycling or even garbage. In the client.

Reducing the use of stretch plastic, wooden pallets, and the consequent reduction of CO_2 emissions, thus reducing the impacts generated on the environment by its services.

The objective of the work was reached in order to develop improvement to reduce the high investment of the packaging process for the transport of the light alloy wheel, in the development of the work presents an alternative to reach this objective and make the company more sustainable. The alternative would be to exchange the wooden pallet for a wire rack, removing the cardboard packaging and the stretch, making the process faster and at a lower cost. The differential of this alternative was the reduction in the amount of solid waste that the company will no longer generate in its packaging service. Remembering that the more solid waste generated by the company, the greater the CO_2 emitted into the environment.

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