

Analysis of Solid Waste Treatment Practices in Footwear Factories

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Abstract

In this research, the practices adopted in two footwear industries, located in the southern region of Brazil, Vale do Sinos, to treat solid waste were investigated. Scientific literature, either national or international, converges on the perception of relevance of the environmental impact generated in this production chain, both due to the total volume of shoes that are manufactured and sold annually, and in view of the difficulties related to the disposal of footwear, at the end of its useful life. From this perspective, this study is justified and aims to identify and analyze, in the light of the reviewed scientific literature, which deals with waste from the footwear industry, the practices adopted in the treatment of solid waste in that economic sector. In order to achieve the objective, a case study strategy was carried out in two companies, using a qualitative approach, with the collection of empirical data through semi-structured interviews with organizational managers, indicated by the management of the organizations, in addition to documentary survey and participant observation systematic. The results showed that the two companies, one large and the second small, have a clear perception of the need to adopt sustainable practices and have already made several adjustments to the organizational system to promote alignment with sustainability principles. However, the actions and initiatives adopted to date show that the two organizations are still

at an early stage of sustainability, especially in the solid waste treatment process.

Keywords: Solid waste treatment practices, Footwear factories, Brazilian companies, Sustainability

1. Introduction

The footwear industry is considered one of the oldest and most traditional in humankind. However, in the same way as other human activities, with a similar profile, several modifications in the shoe manufacturing process were necessary, due to the change from handcrafted to industrial production, during the Industrial Revolution. Among the main changes, the focus on production in greater volume stands out, providing economies of scale, reducing unit costs and prices, making the mass production model viable. With the reduction in unit cost, footwear manufactured on an industrial scale has become accessible to a large part of the population (Zorn, Possa and Scherer, 2007; Santos, 2015).

In order to enable the incorporation of footwear into other mass consumer products, it was necessary to organize the entire supply chain of inputs, which, in that historical period, were of renewable, with natural origin. However, based on scientific and technological advances, notably in the last century, in areas of knowledge, such as chemistry and petrochemistry, the development of polymer-based inputs also advanced, which proved to be adaptable to a wide range of uses in the industrial scope, including footwear manufacturing. In addition to the aforementioned characteristics, polymerized inputs also stood out for their reduced unit cost, when compared to inputs from renewable sources (Rodrigues and Salomão, 2018).

Such replacement of inputs used in the manufacture of shoes and their components also highlighted the need for improvement and/or development of new machines and equipment, as well as reconfiguration of operational processes. Manufacturing methods and techniques were adjusted several times to make serial production viable, maintaining the reduced unit cost strategy (Plentz and Tocchetto, 2014).

However, in the last decades of the last century, footwear became part of the set of items related to fast fashion, which required extraordinary efforts from manufacturing organizations to reorganize the production system, to enable footwear launches in increasingly shorter periods of time, with a differentiated design and value proposition aligned with your target audience. Footwear has become a fashion accessory, fast fashion, incompatible with the useful life of the product, contributing to an exponential increase in volumes of discarded footwear, still within its useful life (Reichert and Schmidt, 2006).

With the growing awareness of society, at a global level, regarding the relevance of sustainable development, as an economic model and way of life, aiming to preserve the environment and ensure the quality of life on the planet, economic activities that are in the opposite direction of this new vision of the world began to be pressured to adopt measures to promote sustainable practices (Pereira and Curi, 2012). The footwear industry is among these economic activities.

To contribute to the topic at hand, this research was carried out with the objective of

identifying and analyzing, in the light of the reviewed scientific literature, which deals with waste from the footwear industry, the practices adopted in the treatment of solid waste. In order to achieve this objective, it was opted for a case study strategy in two companies, using a qualitative approach, with the collection of empirical data through semi-structured interviews with organizational managers, indicated by the management of the respective organizations, in addition to documentary and systematic participant observation. The empirical data was subjected to content analysis.

The work begins with a theoretical review of the main raw materials used by the footwear sector, inputs that generate greater environmental impact and the treatments that are adopted for the solid waste generated. After the theoretical review, the methodological procedures adopted are detailed. Finally, the results of the research are presented and discussed, finishing the work with final considerations and the list of works consulted in the theoretical review, in the references.

2. Inputs, their Environmental Impact and Methods of Treatment

According to the technical dossier prepared by the Footwear Technological Center (Zorn, Possa and Scherer, 2007), over time, the design of shoes has changed. There were many innovations, but, according to the study, for a better classification of the raw materials used, it is important to consider which audience this footwear is intended for, whether female, male or children (Plentz and Tocchetto, 2014). Another relevant fact to be observed is what use this shoe is intended for, as there are several possibilities, sports shoes, such as sneakers, shoes for use on beaches, such as sandals and flip-flops, safety shoes at work, among many other uses (Lopes, 2014).

In this line of thought, the Brazilian Association of Component Companies for Leather, Footwear and Artifacts (Assintecal, 2018) prepared a study that highlights the main raw materials used in the manufacture of footwear at the current time, which can be described as follows (and demonstrated in Figure 1):

- a) **Upper:** to craft the upper part, some raw materials can be used, such as leather, polyvinyl chloride (PVC) laminates, polyurethane (PU) laminates, fabrics, among others. According to Andrade and Corrêa (2001), the upper is nothing but the upper part of the shoe and is divided into the vamp, which is made up of the front, back and side of the shoes, where several pieces and reinforcements are used, which have the basic function of providing firmness and protecting the individual's foot. These parts change depending on the model and the design of the shoe;
- b) **Lining:** In the shoe lining, materials very similar to those used in the upper are used, such as leather, PVC laminate, PU laminate, textile, among others;
- c) **Sole:** In the case of the sole, many components can be used, depending on the shoe model, including polyvinyl chloride (PVC), thermoplastic rubber (TR), polyurethane (PU), thermoplastic polyurethane (TPU), styrene butadiene rubber (SBR), rubbers (latex and lacquer), as well as ethylene vinyl acetate (EVA), leather, among others, as described by Andrade and Corrêa (2001)

- d) **Ornaments:** they can be made of metal, plastic, stone, textile and other materials;
- e) **Adhesives:** adhesives vary depending on their function and can be solvent-based, water-based, based on thermo-meltable components (hot melt), adhesive films and others;
- f) **Full plastic:** Made from rubber, PVC, TR, PU and EVA.

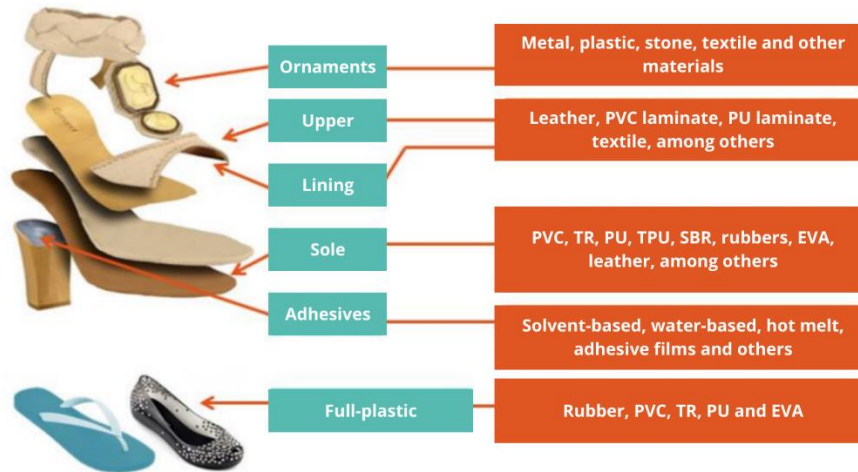


Figure 1. Main inputs used by the footwear sector nowadays

Source: Assintecal (2018)

It is important to highlight that, over the years and the progress of the chemical sector, footwear companies have been replacing the use of leather with alternative substances, such as PU and PVC synthetics, thermoplastic rubbers, whether vulcanized or not, thermoplastic polyurethane, EVA, among others (Reichert and Schmidt, 2006). However, these materials also need to be treated and can never be disposed incorrectly in the environment. Considering, also, the use of these new raw materials, manufacturers and consumers have been getting advantages, not only in the aesthetics of the shoes, but also in their final cost (Andrade and Corrêa, 2001).

Regarding the inputs currently used, not only by the footwear sector, but also by other branches of the industry, Arruda, Ferroli and Librelotto (2018) highlight that organizations will need to develop new technologies in order to adapt the needs of environmental protection. According to the same author, it will be essential to improve existing materials and also give due importance to the use of waste, as well as the life cycle of products.

About this point, Santos (2017) states that, along with the use of alternative inputs that have emerged over the years, there has also come a need to create technologies, both for the classification of waste generated and processes for the treatment of these, whether for the purpose of recycling or even for new reuse. However, for some materials, reuse technologies have not yet emerged and this leads many industries in the sector to choose to send their waste to industrial landfills. The high costs for adequate treatment are another point that leads

organizations, even today, to opt for landfills (Calandro and Campos, 2013).

When talking about the impacts generated by the footwear sector's production chain, an important aspect needs to be taken into consideration. According to Gatelli, Zeve and Sikilero (2010), this sector has many related activities, that is, the footwear production chain has many ramifications that also need to be considered in the case of analysis. According to the authors, this is a sector that is in full development, since footwear has a prominent place in the economy, when considering the manufactured products that are produced in Brazil. The state of Rio Grande do Sul, in addition to being one of the largest producers of footwear and leather goods, is also an important producer of inputs for the sector, with national representation. However, despite the accelerated growth of the footwear chain, both in Rio Grande do Sul and throughout Brazil, concerns about pollution and environmental impacts are a relatively new issue that has not received due attention from companies (Francisco et al, 2014).

There are specific standards for classifying waste, which take into account the risk it poses to the environment. The Brazilian Association of Technical Standards, together with other organizations, prepared NBR 10004 (ABNT, 2002), which aims to help organizations be able to adequately classify and treat their waste, being able to identify which inputs are used in the manufacture of footwear that generate greater environmental impact.

According to Sousa (2006), there are around two thousand companies that process leather, whether tanneries or finishers, and around five thousand footwear and artifact industries distributed throughout Brazil. As there are many organizations, the volume of waste generated is also significant; Despite this, it is worth highlighting the importance of the sector for the Brazilian economy. Around 15% of the inputs used in the manufacturing process are discarded as waste, either as scraps or leather shavings, this type of solid waste being classified as class I. When dealing with this topic, Cultri and Alves (2008) state that, furthermore, not only solid waste is generated for leather production, but also liquid effluents and atmospheric emissions, which also need to be treated correctly. However, what generates the greatest environmental impact and danger, both in the leather footwear chain and in footwear companies, is solid waste, with greater emphasis on leather, as has already been exposed during this research.

Furthermore, regarding this, Masiero (2018) highlights that, in addition to leather and its variations, other solid waste is generated and needs to be considered, such as shoes that have a manufacturing defect and cannot be placed in storage for sale. Another waste that is rarely talked about is that from factory sweeping and which, in the same way, needs to be treated. Figure 2 shows the main waste generated in the footwear production chain.

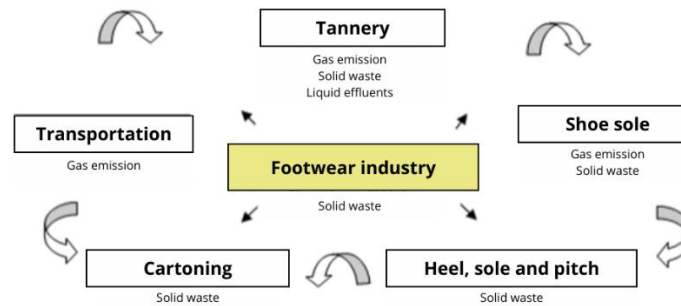


Figure 2. Main waste generated by the footwear industry

Source: Floriano, Souza and Corrêa (2007, p. 13)

According to Souza et al. (2013), organizations focused on the production of footwear and similars need to think of a way to face the impacts they generate on the environment, due to the large amount of waste, with emphasis on substances classified as dangerous, among them, chromium, a very used substance in tanneries.

Schmitz (2016) states that it is necessary for companies to prepare a Solid Waste Management Plan (PGRS), which is a document containing all relevant information regarding the waste generated, as well as everything related to the correct treatment form of it, from its generation to its final disposal, highlighting that all stages must meet and contemplate current environmental standards and laws. Figure 3 shows the management plan, as recommended by Ibrahim, Ibrahim and Cantuária (2015, p. 99).

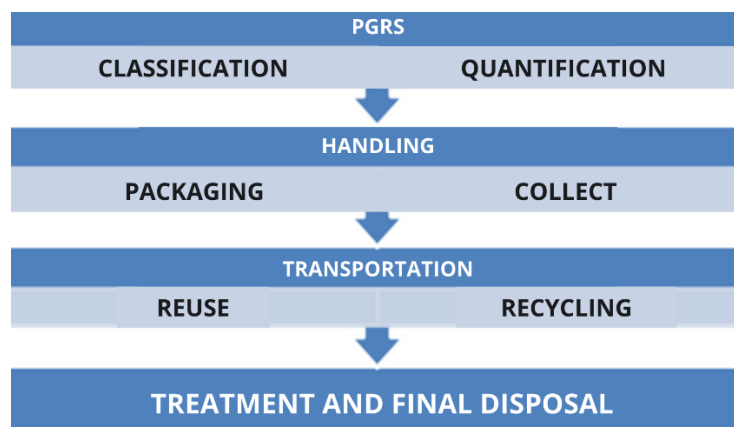


Figure 3. Steps of the Solid Waste Management Plan (PGRS)

Source: adapted from Ibrahim, Ibrahim and Cantuária (2015)

An important aspect is that the obligation to respond for solid waste generated in a production process lies with whoever generated it, as well as who will have to bear any damage that it

may cause to the environment and, consequently, to society. Furthermore, in this aspect, the entity that generated the waste has the responsibility of finding alternatives to eliminate or even reduce waste (Barbosa and Ibrahim, 2014).

Environmental management, or as it is called by many organizations, waste management, is something that no longer goes unnoticed. Companies are beginning to understand that the appropriate treatment of waste needs to be part of the planning and goals that they aim for and that, in order to survive and generate profits, it is necessary to know how to manage environmental liabilities and also transform this into something that may, if it does not generate profit, at least not add many costs (Gatelli, Zeve and Sikilero, 2010).

Moving on to the next analysis, Souza et al. (2013) clarify that there are some ways of treating one of the main waste generated by the footwear industries, whether in Vale do Rio dos Sinos or even in other national production centers. However, the authors clarify that, even if there are ways to treat leftover leather, these only delay and do not definitively resolve the issue. Despite this, it is worth informing the alternatives that organizations are already using to treat leather, such as the transformation of leather shavings into reprocessed leather, the manufacturing of cold-pressed bricks, cement and asphalt, among others.

As a result of this approach, Souza et al., (2013) indicate that there is still the possibility of transforming chromium into sodium chromate, which, for now, can be used again by industries in the leather tanning process and chemical products as pigments. This is possible through the process of incinerating the leather and treating the ash, however, the author emphasizes that this process, unlike those mentioned above, is more expensive, however, it is a definitive solution.

3. Methodology

This research can be considered as applied, since, during the course of it, information was presented with the aim of solving a specific problem, with its application being of a practical nature (Prodanov and Freitas, 2013). Regarding the research strategy, this is a case study. According to Yin (2015), when research focuses on case studies, there is, on the part of the researcher, an interest in portraying reality, be it life cycles, or even, as in this research, which will have as a basis for studying industrial processes and their peculiarities. Regarding its approach, the present work is a qualitative research. According to Marconi and Lakatos (2017), in research of this type, there is no statistical analysis resource and there is no focus on measurements or even homogeneous units. The empirical data collection instruments, namely the script of questions and checklist items, for documentary survey and participant observation, were validated by experts from the Brazilian Institute of Leather, Footwear and Artifacts Technology (IBTEC), located in city of Novo Hamburgo (RS).

For data collection, two companies in the footwear sector were chosen. The choice of both did not occur randomly, but rather, considering that they already have consolidated techniques in terms of sustainability and waste reuse. As the organizations that served as the study unit preferred not to be identified, in the course of the work, they were called Company A and Company B. Company A is one of the largest footwear manufacturers in Brazil. It

began its activities in the city of Igrejinha, in Vale do Paranhana (RS), in 1975, and currently has thirteen branches, and eight thousand employees, considering only direct employees, but there are also outsourced employees, who also provide some type of service. Company A produces footwear that serves all audiences and, in recent years, has been expanding its product line, also offering clothing aimed at the fitness universe and sunglasses (Company A website, 2023).

Company B, on the other hand, focuses on the production of footwear that caters exclusively to women, the majority of which are made of leather, with a higher added value. The organization in question began its activities in 1997, with just six employees, and currently has 140 employees in two of its own pavilions. Company B underwent a reformulation shortly before the Covid-19 pandemic, when it stopped being just an outsourcer for other companies and closed important partnerships with major designer brands. From this moment on, the company began to develop all the modeling for these brands and also be responsible for producing all the footwear that they sell in their stores, and currently has around eight hundred registered and active retailers. Following this change, Company B began to purchase all the raw materials to make the shoes sold by partner brands, as well as being responsible for all logistics and credit control.

Company A uses synthetics of different types as raw material for its shoes, Company B uses almost entirely leather. It is important to highlight this information, as this leads to significant changes in the way waste generated in each research unit is treated. Below is Table 1, with the profile of the two interviewees.

Table 1. Interviewees profiles

Interviewee 1 / Company A	Interviewee 1 / Company B
Age: 42 years old	Age: 36 years old
Gender: Male	Gender: Male
Technical graduation: Occupational Safety Technician	Technical graduation: Electrical Technician
Higher graduation: Environmental management	Higher graduation: Administration
Position in the Company: Safety and Sustainability Manager	Position in the Company: Production Manager – Managing Partner
Company time: 10 years	Company time: 15 years

Data collection in this research also occurred through documentary survey. Lozada and Nunes (2018) states “that this technique can be considered non-invasive, [...] as it involves the use of non-reactive sources, regardless of the presence of the researcher”.

For the interview, a script with three questions was prepared, and for the documentary survey and systematic observation, a check-list of three items, correlated with the questions in the script used in the interviews (detailed in the topic of analysis and discussion of results).

Even before the interviews were carried out with the chosen companies, they underwent a moment of validation of the interview script, that is, they were sent to five selected professionals, considering their academic training, but, mainly, their professional experience in different footwear companies. The sending was carried out by email and, in order to inform

the respondent about the subject, a specific script for validation was prepared, and before each question a summary of the theory from which the question originated was added. The questions were sent by email, from April 3 to 6, 2023.

Soon after validating the interview script, scheduling of interviews began. Initially, the interview was scheduled with Company A, which took place in person on April 6, 2023, at the company's branch located in the city of Sapiranga (RS). In the case of Company B, the in-person interview was only carried out on April 28, 2023, due to the organization's availability, and took place at the industry headquarters in the city of Estância Velha (RS). It is worth noting that both interviews were recorded and that, in the case of both Company A and Company B, all questions were duly answered.

The empirical data were subjected to content analysis and interpretation, in light of theoretical review) through three processes, the first being data reduction, the second the data presentation and the third the extraction of conclusions and verifications (Roesch, 2013). The form of analysis is supported by Prodanov and Freitas (2013) who state, “in qualitative analyses, the researcher makes an abstraction, in addition to the data obtained, searching for possible explanations (implicit in speeches or documents), to establish configurations and flows of cause and effect.”

4. Results Analysis and Discussion

Regarding the first question, about the companies' operational processes and whether they are reviewed in order to promote sustainability, the interviewee from Company A highlighted the concern with the costs represented by solid waste, expressing that adjustments are constantly made, in order to transform the waste generated and return it to the production process in the form of raw material. However, he reported that no changes were necessary to the operational processes in order to be able to introduce these inputs. Regarding this issue, Alves (2016) clarifies that organizations, as well as society as a whole, are changing their perceptions regarding issues related to natural resources, beginning to understand that they are finite.

During the systematic observation, in Company A, it was possible to demonstrate that it is concerned with the waste generated and that these are segregated, in order to facilitate what was exposed in the answer to question 1 by Interviewee 1. Furthermore, combined with this, it was possible to verify, through documents available on electronic media, that the company has an internal committee focused on issues involving sustainability and that encompass its pillars. In Figure 4, it is possible to identify the parties involved in the constant process of sustainability.



Figure 4. Parties involved in Company A's sustainability process

Source: Company A Website (2023)

In Company B, the interviewee reported that, when there is a need to adapt the operational process, these are carried out in a way that does not compromise production. However, he made a point of informing that they are always open to new alternatives, in order to treat the waste generated correctly. Furthermore, he stated that the main objective is really to reduce the generation of waste and that, in this regard, the company has been looking for alternatives to reduce the leather shavings generated in the cutting sector.

Interviewee 2 explained that they are studying the purchase of equipment that provides better use of the material and, in this way, they intend to reduce scrap, which in a certain way could provide a gain in the cost of the product, since, if the company can purchase the equipment, it will reduce losses. It is clear that companies need to be more attentive to new technologies every day, in addition to mapping their processes, to able to work on efficient ways to reduce environmental impacts (Assis, 2020).

When analyzing the two responses, it is clear to say that both are consistent with what the researched literature brought, because, according to Assis (2020), organizations need to develop practices in order to reduce environmental damage, but also, linked to this, develop improvements in order to reduce impacts and also costs. However, it was possible to perceive resistance regarding changes in operational processes, however, as already mentioned, both industries are open to changes that could bring some type of positive return with regard to waste generation.

Table 2. Operational processes x sustainability

Company A	Company B	Authors
Concern about the costs of solid waste. Adaptations to transform waste generated into raw materials. No changes to operational processes were necessary. The company has an internal committee focused on matters involving sustainability. The waste generated is segregated to facilitate its return to the production line.	When there is a need to adapt the operational process, these are carried out in a way that does not compromise production. Open to new alternatives in order to treat the waste generated correctly. Focus on reducing waste generation, especially leather shavings generated in the cutting sector. Purchase of equipment that provides better use of the material and, in this way, aims to reduce scrap. Resistance to changes in operational processes.	Alves (2016) Assis (2020)

Source: results of the research (2023)

The second question was formulated with the aim of verifying how the two organizations evaluate the perception of the final consumer and how they can understand whether or not they prefer products that value environmental sustainability. Interviewee 1 pointed out that his organization sees little demand for sustainable products. He reported that some major magazines have already requested models with a focus on environmental sustainability, and they even developed footwear that they called 100% sustainable, where they looked for alternative materials that could be recycled after use.

According to the interviewee, the Research and Development (RandD) sector took some time to be able to develop the first prototype, and there were some requests, but acceptance by the end consumer was beyond expectations. Furthermore, he highlighted that the company believes this is due to the consumer culture of believing that footwear with a sustainable appeal is more expensive or even does not meet fashion trends. This is in line with what Santos and Silva (2017) state, that it is necessary to know, as well as act with the market, how sustainability can bring results and provide profits for the company that decides to develop actions in this direction.

As a result of this approach, Interviewee 2 informs, when answering the question, that he produces the models as requested by his clients. All modeling is carried out with a focus on research from Europe, but brands require that the organization follows some sustainable production standards. Despite not yet having any 100% sustainable products, it seeks to use raw materials that generate the lowest possible environmental impact, in addition to relying on the product development sector, which researches innovative materials, which, in addition to generating less environmental impact, also be less aggressive towards employees who handle them when producing the footwear.

The manager also informed that the brands for which his company produces require, on a monthly basis, a complete survey of the waste generated and also documents that prove the appropriate destination of the waste, in order to comply with current legislation. Correct treatment and the constant search for alternative materials, in order to generate less environmental impact, has become a matter of strategy for organizations. These began to measure the costs incurred to store and treat their waste and, following this approach, look for

alternatives that can combine profitability and environmental sustainability (Gatelli, Zeve and Sikilero, 2010).

Table 3. Consumer market x sustainability

Company A	Company B	Authors
<p>Little demand for products with sustainable appeal.</p> <p>Large consumers have already requested a sustainable product, they have already produced it, but it has had little acceptance.</p> <p>Low demand, due to consumer culture of believing that sustainable footwear is more expensive or does not follow fashion trends.</p> <p>RandD sector researches less aggressive and innovative raw materials.</p>	<p>It produces models according to its customers' requests, all modeling is carried out with a focus on research from Europe.</p> <p>The organization follows some sustainable production standards, despite not yet having any 100% sustainable products.</p> <p>It seeks to use raw materials that generate the least environmental impact.</p> <p>It has a product development sector, which researches innovative materials that, in addition to generating less environmental impact, are also less aggressive to the employees who handle them.</p> <p>The company receives models that it must create in envelopes, it must only copy and not create.</p>	<p>Santos and Silva (2017)</p> <p>Gatelli, Zeve and Sikilero (2010)</p>

Source: results of the research (2023)

Question 3, asked to both interviewees, asked them about what procedures are adopted to treat solid waste, especially regarding recycling and reuse. Regarding this issue, Interviewee 1 informs that, in his company, there is a constant concern regarding the solid waste generated. All leftovers that are no longer useful are separated, as each material has a different destination. For example, synthetics are separated by color, paper, plastics and cardboard are also segregated, other materials, such as empty cans, insoles, threads, sponges and contaminated materials, are also separated in appropriate locations within the units, in order to have an environmentally correct destination and in a way that meets all legal requirements. This is in line with Jacobi and Besen (2011), that each waste needs to have a different destination and their treatment must be carried out in accordance with the guidelines set out in current legislation.

Interviewee 1 clarifies that the organization is currently able to recycle around 60% of all solid waste generated. What they cannot recycle is sent for co-processing in a company that transforms the waste into a blend, meaning that it receives the waste, performs a type of crushing and, after, it is sent to another cement industry, which uses this waste as an assistant in the ovens. The respondent highlights that the organization invests time in research, in order to define the best technologies available, in order to treat waste, but also to make this process less costly. Furthermore, it argues that all these processes need to be described in the company's PGRS.

According to the provisions of Interviewee 1, it is evident what Floriano, Souza and Corrêa (2007) discuss, that large organizations have, over time, been going through a process of awareness, in order to promote actions with the aim to ensure growth without causing damage to the environment in which they are located.

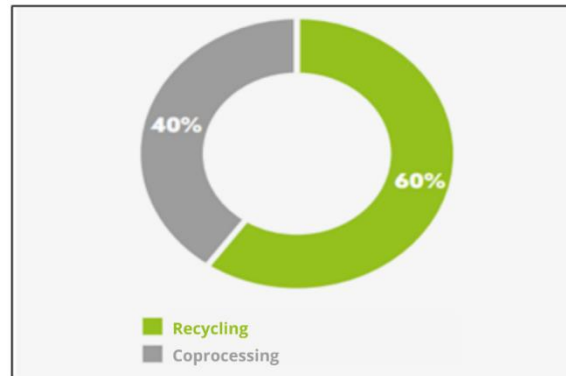


Figure 5. Shows percentage of waste treatment from Company A

Source: 2020 Sustainability Report / Company A website (2023)

In this line of thought and, also, considering the document on environmental sustainability prepared by Company A (available on its website), it is possible to clarify that domestic and organic waste generated within the organization's various branches are destined for municipal selective collection in the cities where are inserted.

Regarding question 3, the interviewee from Company B clarifies that he can recycle, almost entirely, all cardboard and plastic that, in some way, arrive at his company. The majority of cardboard waste comes from packaging and is sent to a company in Vale do Rio dos Sinos that produces insoles. With this, the company receives a discount on the value of the spreadsheet, due to the cardboard that is sent to be used in this component, which is one of the main inputs for your company.

The plastic is destined for a company in the city of Campo Bom (RS), which works with recycling and production of parts such as rods used as support inside shoes. He states that these rods can be made from recycled material, explaining that he has also managed to reduce the cost of this material significantly; In this way, it is understood that it is yet another waste that no longer generates costs but has added value. The recycling of these materials is in line with what Masiero (2018), that companies are looking for ways to reuse their waste, in order to reduce both costs and environmental impacts.

Although Company B is already able to recycle part of its solid waste, this is not possible in the case of leather shavings. They were sent to the company Utresa Resíduos e Gestão Ambiental, however, some time ago, the organization started sending them to Fundação Proamb, where co-processing and sending to cement companies takes place. In this case, it is worth noting that both interviewees, both from Company A and Company B, reported that

they treat part of their waste with co-processing technology. Interviewee 2 also informs that there is constant concern about reducing leather waste as much as possible, as the value of treatment is significant for the organization. In this sense, Santos and Silva (2017) address business sustainability models where industries begin to encompass practices that combine development and environmental preservation.

Table 4. Management of Solid Waste

Company A	Company B	Authors
<p>Constant concern regarding the solid waste generated. All leftovers that are no longer useful are separated, as each material has a different destination, for example, synthetics are separated by color, paper, plastics and cardboard are also segregated.</p> <p>Constant concern regarding the solid waste generated. All leftovers that are no longer useful are separated, as each material has a different destination, for example, synthetics are separated by color, paper, plastics and cardboard are also segregated.</p> <p>All waste generated is separated in appropriate locations within the units, in order to have a correct environmental destination and to meet all legal requirements.</p> <p>The organization is able to recycle around 60% of all solid waste generated, and what they cannot recycle is sent for co-processing.</p> <p>The documents indicate that the company can recycle around 60% of its waste.</p>	<p>It can almost completely recycle all cardboard and plastic. The cardboard is sent to a company in Vale do Rio dos Sinos that produces insoles, generating a discount on the purchase of this raw material.</p> <p>The plastic is destined for a company in the city of Campo Bom, which works with recycling and production of parts such as rods used as support inside shoes.</p> <p>The leather shavings were sent to Utresa, however, some time ago, the organization started sending it to Proamb, where it is co-processed and sent to cement companies.</p> <p>The documents presented indicate that the company treats its leather waste through co-processing.</p>	<p>Jacobi and Besen (2011)</p> <p>Floriano, Souza and Corrêa (2007)</p> <p>Masiero (2018)</p> <p>Santos and Silva (2017)</p>

Source: results of the research (2023)

5. Final Remarks

Given the relevance of the footwear industry, both from the perspective of generating employment and income, and the environmental impact resulting from said economic activity, research was conducted in two footwear industries, located in the southern region of the country, to highlight the set of practices adopted, within the scope of environmental management, with a specific focus on solid waste treatment and consolidation of sustainable practices.

The two organizations were chosen because they are recognized in the region where they operate, for “green”/sustainable initiatives, in addition to socio-environmental practices. The companies were not identified in the study, at the request of their directors, and were referred to as company X and Y. However, the other data presented, including their characterization and history, are true.

Empirical data were collected through semi-structured interviews with managers appointed by the organizations, one in each of the two companies, as well as consultation of internal

records made available to researchers (documentary survey), being complemented with systematic non-participant observation. After collection, the data was subjected to content analysis.

The results highlighted initiatives by both companies in the environmental management process, with emphasis on recycling and reusing waste, reintroducing them into the production process, modernization of machines and equipment, aiming to reduce the volume of waste generated in the operational process, ecodesign or sustainable design, with the replacement of inputs with greater environmental impact for others with reduced environmental impact, green marketing, aiming to raise consumer awareness of sustainable products, adequate disposal of waste and training of employees in sustainable practices.

The study's limitation is that it is based on the analysis of only two footwear industries and is restricted to two interviewees, one per company. It is suggested to conduct new studies, with the same focus, in more footwear industries, using both a qualitative and quantitative approach.

Despite the aforementioned limitations, it is understood that the study offers important contributions to academia, deepening the discussion on the environmental management process in the footwear industry, with scarce scientific literature on the topic, as well as offering elements of analysis for organizational management, identifying elements that can serve as input for decision-making in management modeling, with a focus on sustainability.

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Authors contributions

Dr. Dusan Schreiber was responsible for study design and revising. Débora Alessandra da Silva was responsible for data collection and drafted the manuscript. All authors read and approved the final manuscript. Both authors contributed equally to the study.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Obtained.

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The Publication Ethics Committee of the Macrothink Institute.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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