Management of solid waste in mining: a study at mineração Corumbaense Reunidas S.A.

Gestão de resíduos sólidos em mineração: estudo na mineração Corumbaense Reunidas S.A.

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Fernando Thiago
Doutor em Administração
Universidade Federal de Mato Grosso do Sul
fernando.t@ufms.br
https://orcid.org/0000-0002-7947-0667

Jean Henrique de Souza Camargo
Bacharel em Administração
Universidade Federal de Mato Grosso do Sul
jeanhsc5@gmail.com
https://orcid.org/0000-0003-0531-3017

Caroline Gonçalves
Pós-doutora em Economia e Doutora em Administração
Universidade Federal de Mato Grosso do Sul.
goncalves.caroline@ufms.br
https://orcid.org/0000-0002-2514-4022

Wilson Ravelli Elizeu Maciel
Doutor em Administração
Universidade Federal de Mato Grosso do Sul
wilson.ravelli@ufms.br
https://orcid.org/0000-0001-7165-3592

ABSTRACT

Waste management, a relevant action to minimize environmental impacts in the locations where organizations are located, becomes a relevant tool for companies. Due to the optimization of the production process and the growth in demand, an increasing amount of waste is processed in the mining industry, which must be managed to comply with environmental laws and the development of society. This research aimed to analyze the management of solid waste generated by the company Mineradora Corumbaense Reunida

S.A. (MCR), located in Corumbá/Brazil. The methodology used was documentary research and participant observation. The results showed that the organization performs waste management by type of waste and its disposal is carried out in three ways: sending it to a landfill, donating recyclable materials and unused equipment to social and public organizations, and auction sales. The work of waste management at MCR proved to be adequate to current legislation and actions of a social nature. This study contributes to managerial practice and science by discussing an organization that applies good economic and social practices in the management of its solid waste.

Keywords: environmental management, solid waste management, mining

RESUMO

A gestão de resíduos, ação relevante para minimizar impactos ambientais nas localidades onde se situam as organizações, torna-se uma ferramenta relevante para as empresas. Devido à otimização do processo produtivo e o crescimento da demanda, na indústria de mineração é processada uma quantidade cada vez maior de resíduos, os quais devem ser geridos de forma a atender às leis ambientais e o desenvolvimento da sociedade. Esta pesquisa teve como objetivo analisar a gestão dos resíduos sólidos gerados pela empresa Mineradora Corumbaense Reunida S.A. (MCR). A metodologia utilizada foi pesquisa documental e observação participante. Os resultados mostraram que a organização realiza a gestão de resíduos por tipo de resíduo e seu descarte é realizado de três formas: aterro sanitário, doação de materiais recicláveis e equipamentos não utilizados para organizações sociais e públicas e vendas por leilões. O trabalho de gerenciamento dos resíduos na MCR se mostrou adequado à legislação vigente e com ações de natureza social. O presente estudo contribui para a prática gerencial e ciência com a discussão de uma organização que aplica boas práticas econômicas e sociais na gestão de seus resíduos sólidos.

Palavras-chave: *gestão ambiental, gestão de resíduos sólidos, mineração*

1. INTRODUCTION

In Brazil, averages of 79 million tons of urban solid waste are generated per year, registering a per capita generation of 379 kilograms per year (Abrelpe, 2020). The management of this waste has been the focus of concern for researchers from the most diverse areas of study, in addition to becoming one of the great challenges for cities over the coming decades (Santiago & Dias, 2012). In large companies, this intense generation of waste is noticeable, with constant technological advancement, in which production increases every day and, consequently, the waste generated from this production follows the growth.

Along with this, in the increasingly competitive market, companies have sought differentiation about competitors. Thus, the great advancement of technology points to the need for restructuring processes in organizations when investing both to improve the quality of their products and services and to improve their image in society, thus guaranteeing their prominent position in a highly competitive market. (Araújo, Silva, & Oliveira, 2019). At this point, actions that promote the sustainability and health of the environment that are inserted can provide this competitive advantage.

Falkenberg and Brunsæl (2011), Baird, Geyland and Roberts (2012), Gerstlberger, Præst Knudsen and Stampe (2014) and Rahman, Reynolds and Svaren (2012) define that being environmentally sustainable implies doing business in a way that reduces waste, save energy and promote environmental health, preventing damage to the natural environment.

In this scenario, there is the mining industry, considered essential for the country's economy, in addition to being the foundation of the production chain as the products generated by its operations are present in an expressive way in the daily lives of the population (raújo, Silva and Oliveira, 2019).

Brazilian mineral production is one of the largest and most profitable in the world, with the mineral sector in the country reaching 227 million tons of commercialized production in the first quarter of 2021, representing an increase of 15% compared to the same period of the previous year. The sector earned BRL 70 billion in the quarter, representing an increase of 95% compared to the BRL 36 billion obtained in the period of the previous year (Brazilian Institute of Mining, 2021).

However, aside from its relevance, mining activity has the capacity to promote major negative environmental impacts, such as deforestation (Ranjan, 2019, Zhang, Yang, Li, Li, Wang, & Ye, 2012, Goswami, 2015), pollution of watersheds (Baeten, Langston, & Lafreniere, 2018, Zhang et al., 2012), reduction of biodiversity (Goswami, 2015) and disposal

of mining waste such as rubble and tailings (Žibret, Gosar, Miler, & Alijagić, 2018), being able to change the mined area and neighboring areas. It is therefore necessary to discuss environmental issues related to the final disposal of waste generated in this activity.

Every company in its productive activities ends up generating waste and, in the case of Mineração Corumbaense Reunida S.A (MCR), being a large company, this waste is generated intensively, with the company having a specific sector in its production area for the management of these wastes. The Discarded Material Center (DMC) is the MCR area responsible for managing waste from all four collection points within MCR.

Faced with the quest to improve processes aimed at reducing waste and complying with current legislation, it is important to reflect on what is done with leftovers from the production process, the destination of materials, the consequences of incorrect disposal, in short, technological advances in the sustainable management of this waste.

Therefore, this research intends to answer the following question: How is the Waste Management process at MCR and its role in sustainable development? This activity has practical relevance not only for the company but also for society as a whole, still having little visibility. Therefore, this work seeks to investigate the activities developed by MCR. Analyzing how the DMC's activity is at MCR in two aspects: waste management in the MCR areas and its influence on the productive activities of these areas.

MCR is part of Vale's portfolio of companies, considered one of the largest mining companies in the world and one of the largest Brazilian multinationals, which is considered a relevant case to study the research topic, with the possibility of contributing to the area of environmental management.

Another motivating factor for carrying out this research, although mining activity is economically important, it can cause considerable environmental impacts such as deforestation (Ranjan, 2019, Zhang, Yang, Li, Li, Wang, & Ye, 2012, Goswami, 2015), pollution of watersheds (Baeten, Langston, & Lafreniere, 2018, Zhang et al., 2012), reduction of biodiversity (Goswami, 2015) and disposal of mining waste such as rubble and tailings (Žibret, Gosar, Miler, & Alijagić, 2018), which can change the mined area and neighboring areas. It is necessary to discuss environmental issues related to the final disposal of waste generated in this activity. Thus, the objective of this work was to analyze the management of solid waste generated by the company Mineradora Corumbaense Reunida S.A., located in the municipality of Corumbá-MS/Brazil.

2. THEORETICAL FRAMEWORK

The concept of Waste Management concerns activities related to strategic decision-making and the organization of the sector for the activity, including institutions, policies, instruments and means. Whereas, waste management concerns the means and instruments for the activity (Schalch, Leite, Fernandes Júnior, & Castro, 2002). Waste management is seen in a broader sense, in which waste management is an essential part of managing environmental impacts.

The great development of industrial activities that generate wealth and goods is linked to the need for a considerable volume of natural resources that, consequently, generate waste that does not have adequate disposal or reuse (Žibret et al., 2018).

According to the National Solid Waste Policy (PNRS) (2010), the classification of solid waste is shown in Table 1:

Table 1. Classification of solid waste

I – As for the origin	**Characteristics**
Household waste	From domestic activities in urban residences.
Industrial waste	Generated in production processes and industrial facilities.
Health service waste	Generated in health services, according to Sisnama and SNVS rules or regulations.
Construction waste	Generated in constructions, renovations, repairs and demolitions of civil works.
Waste from transport services	Originating from ports, airports, customs, road, rail and border crossings.
Mining waste	Generated in the activities of research, extraction or processing of ores.
I – As for the dangerousness	**Characteristics**
Dangerous	Those that due to flammability, corrosivity, reactivity, toxicity, pathogenicity, carcinogenicity, teratogenicity and mutagenicity pose a risk to public and environmental health.
Not dangerous	Those that do not fit the listed characteristics of hazardous waste.

Source: Law n. 12.305 (2010).

Population growth, industrial development, and accelerated urbanization aligned with an individualistic attitude of society have contributed to the increased use of natural resources and waste generation, which causes concern in society as a whole (Mazzer & Cavalcanti, 2004). In addition, Mazzer and Cavalcanti (2004) point out that these residues often return to the environment inappropriately, causing various environmental, social and economic damages.

Companies, every day, seek to adapt to environmental demands with a focus on obtaining competitive advantage, within this perspective. The concern for the environment in view of the need to increase production, and the search for technological advances, are shown as themes to be discussed recurrently in large companies, especially in companies in the mineral sector.

At this point, according to the Ministry of the Environment (2020), sustainable production is the incorporation, throughout the entire life cycle of goods and services, of the best possible alternatives to minimize environmental and social costs. In this way, every investment in processes and sustainable production is relevant, since it can promote benefits for the environment, for society as a whole, and for the company itself.

According to Mazzer and Cavalcanti (2004), companies that have technology aligned with a culture of control of their processes, present cost reduction since they consume less raw material and inputs, generate fewer by-products, reuse, recycle, profit from their waste and spend less on pollution management and control and environmental recovery.

In this regard, proper solid waste management provides efficient solutions to meet these objectives, which are dealt with in the next subsection.

2.1. Solid waste management and sustainability

The environment has been a topic of discussion by politicians, businessmen, union leaders, non-governmental organizations (NGOs) and among citizens in general, gaining evident space on the streets, in auditoriums and in the press (Monteiro, Karpinski, Kuhl, & Morozini, 2016). The fact is that the concern with sustainability generates changes in organizations.

Walsh and Dodds (2017) consider that environmental sustainability has proven to be a way to gain a competitive advantage, whether by encouraging efficiencies, attracting customers, or obtaining business. When companies assume a commitment to sustainable development, they change their way of acting, seeking to reduce social and environmental

impacts, which causes a new way of understanding innovation to a concept that favors this development (Barbieri, Vasconcelos, Andreassi, & Vasconcelos, 2010).

Sustainable development seems to be one of the most important themes at the beginning of this century and millennium regarding social movements (Barbieri et al., 2010). The concern for production and the economy is increasingly linked to concern for the environment, especially for future generations.

However, companies gain competitiveness through environmental management, for their survival in the international market and for the control of environmental aspects, which has guaranteed them the sustainability of the development process, improving the environmental quality and life of the population (Mazzer & Cavalcanti, 2004). Sustainable development promotes important benefits these days, concern for the environment is considered by customers, especially the most demanding ones.

In this way, through the protection and maintenance of the natural systems that make sustainable development possible, they contribute to solving current problems and guaranteeing life (Monteiro et al., 2016). As a result, as development takes place aiming at the least impact on the environment, the greater the benefits for society.

A new ethic emerges that goes beyond obtaining profits, but that is aligned with social interests, their change in behavior regarding the performance of companies, and the benefits of direct open relationships with all parties affected by the productive processes of organizations, among them their industrial waste (Alves & Gonçalves, 2019).

Although companies have been concerned with sustainable development, it is important to emphasize that the National Solid Waste Policy (Law n. 12,305, 2010) establishes guidelines for Waste Management and companies that do not follow these guidelines are subject to fines and penalties, above all, by the law of environmental crimes: Law n. 9,605 (1998).

However, waste management may have different characteristics according to the type of activity performed in production, as is the case with mining, which is discussed in the next subsection.

2.2. Solid waste management in the mining industry

The issue of consumption of natural resources in mining is quite peculiar since its base activity is the extraction of resources from nature (Sanchez, 1994). In this way, the concern of the mineral sector with the environment is intense, always seeking the least possible impact, and acting in the recovery of degraded areas.

Brazilian legislation focused on mineral activity and the environment began in the colonial period, however, it was in the republican period that the main regulations for mining activity were generated, the Mining Code, established by Decree-law n. 227 (1967). At the beginning of exploration activities in Brazil, in the colonial period and later in the imperial period, it was linked to international economic movements, later in the republican period that the "sectoral environmental codes" were elaborated at a time of implementation of public policies, aimed at structuring and modernizing the Brazilian industrial park.

The mining activity can generate major environmental impacts, especially with regard to its enormous capacity to generate waste (Žibret et al., 2018). Thus, efficient waste management is necessary to reduce impacts on the environment.

In the mining activity, there are two types of solid waste: overburden and tailings. The overburden is waste arising from the extraction activity in the stripping of the mine and is usually stored in piles, while the tailings are the waste arising from the beneficiation process to which mineral substances are subjected (Silva, Viana, & Cavalcanti, 2012).

The generation of solid waste in mining has increased significantly due to the trend toward a gradual decrease in the average grades and cuts of mined minerals, especially metallic ores (Sanchez, 1994). Thus, waste management enters this flow, preventing this intense production of waste from having greater impacts on the environment, as Sanchez (1994) says, waste must be allocated in places with environmentally safe conditions, whether the waste is inert or not.

The characteristics of waste management in mining manifest themselves at the economic, planning, financial, and environmental management levels. Thus, environmental management in mining presents problems different from industries, starting with the very diversity of the mineral sector (Sanchez, 1994).

As highlighted by Sanchez (1994), the mineral sector has distinct characteristics in terms of environmental management, which includes waste management. Some challenges are faced by the mining area in environmental management, such as pollution control, impacts on ecosystems, social impacts, consumption of natural resources, risk management, management of solid and recyclable waste, and long-term environmental impacts.

The recycling of materials is one of the characteristics of waste management and, according to Sanchez (1994), this recycling, especially of metals, has been increasingly important from an economic and environmental point of view. At this point, income generation with recyclable materials is considered an important strategy in obtaining even revenue for the company. From an environmental point of view, the decomposition time of

these recyclable materials in the environment is very long, metals, for example, take approximately ten years, which reinforces the importance of the correct disposal of waste in the environment.

Technological risks in industrial activities are inevitable features in most organizations, in which the risks are often greater than the risks arising from mining. However, the risks of this sector deserve a lot of attention (Sanchez, 1994), as it was reported, some mining areas had accidents of great proportion in Brazil, as in the case of Brumadinho and Mariana, in the State of Minas Gerais.

3. METHOD

With the objective of analyzing the management of solid waste generated by the company Mineradora Corumbaense Reunida S.A., located in the municipality of Corumbá-MS/Brazil, research with a qualitative approach was carried out. As for the objectives, the research was characterized as descriptive, as it seeks to describe the characteristics of a given population or phenomenon or, the establishment of relationships between variables (Gil, 2017).

As for the approach, it is qualitative research with descriptive objectives that, as highlighted by Gil (2017, p. 42), “seeks to describe the characteristics of a given population or phenomenon or, the establishment of relationships between variables”.

As for the data collection technique, documentary and field research was carried out. According to Marconi and Lakatos (2019), documentary research refers to the type of research whose source is restricted to documents, written or not, constituting what is called primary sources. Regarding field research, it is the collection of data and records of relevant variables related to the observation of facts and phenomena as they occur spontaneously, as indicated by Marconi and Lakatos (2019).

The data collected by the documentary research technique came from documents: monthly reports of DMC destinations, Operating Procedures (OPs), and certifications, among others, made available by DMC or available in the Internal Information System or on the Internet.

The data collected from the field research were obtained through the observation technique, in which the researcher accessed the sectors in which the mining residues were processed.

The data collection period comprised from March to October 2020.

For data analysis, thematic analysis was used, extracting data from documents related to the processing and disposal of solid waste produced at the mining company's facilities, and organizing them into themes for further analysis.

4. RESULTS AND DISCUSSIONS

Waste management at MCR's DMC, throughout its process, has shown figures that are favorable to sustainability and working as a facilitating agent for each area of MCR. To this end, the next subsections present a contextualization of the organization where the research was carried out, as well as an analysis of the research data.

4.1. Contextualization of the organization

Located in the city of Corumbá, Mineração Corumbaense Reunida S.A. It has been a subsidiary of Vale since 1976, when the then Companhia Vale do Rio Doce (CVRD) joined the consortium that created Urucum Mineração S.A. Later, in 1994, it acquired 100% of the shares operating in Corumbá and Ladário, a milestone for the company was the acquisition of 100% of the operations of the Rio Tinto group in Corumbá in September 2009 (Vale, 2019).

The company Vale has been active in the cities of Corumbá and Ladário in various aspects, whether social, environmental, or economic. The explorations of iron and manganese ores are Vale's core activities in Corumbá, making mineral exploration one of the city's economic centers, along with tourism (Vale, 2019).

Vale's "Balance Vale +" report (Vale, 2019) presents Vale's operations in Mato Grosso do Sul, figures that show the importance of its presence for the city's social and economic issues and its concern for the environment.

On the social side, Vale currently has 5 programs that integrate the company with the population of Corumba and Ladar, which are: the Participatory Community Program, Children and Adolescents Fund, Young Talents Program, Direct Attention to Communities and Vale Saber/Mina dos Belgas.

The Participatory Community Program is a program in which Vale provides financial support to organizations that work in the areas of Professional Training, Job and Income Generation, and Social Promotion and Protection in the municipalities of Corumbá and Ladário. The Moinho Cultural Sul-Americano Institute is one of the institutions that benefited from Vale in this program (Vale, 2019).

Since 2010, Vale has contributed more than R$1.1 million to the Childhood and Adolescence Fund (Fundo da Infância e Adolecência - FIA). The Young Talents Program, in partnership with Senai de Corumbá, has provided technical qualifications for more than 350 young people from Corumbá and Ladário since its launch in 2011, thus contributing to the training of these young people for the job market (Vale, 2019).

In order to generate and share values, Vale has strengthened relationships through direct attention to communities, working together with the community to find solutions to their needs and demands. Vale Knowing is Vale's program in which the company opens its doors to visits from partner schools and institutions showing a little of the history of mining in Corumbá. More than 3 thousand people visited Vale's operations in Mato Grosso do Sul in the last two years (Vale, 2019).

Economically, Vale has also contributed significantly to the development of Corumbá and Ladário, some figures point to this contribution, for example, in the generation of jobs and income, in which 1,334 people work in Vale's Midwest operations, including own employees and permanent contractors. In the first half of 2019, 116 new employees were hired. R$ 56.9 million was Vale's payroll for the first half of 2019 in Mato Grosso do Sul (Vale, 2019).

Driven by its concern for the environment and sustainable development, in the first half of 2019 alone, Vale in Mato Grosso do Sul invested R$ 10.3 million in environmental actions.

A total of R$ 21.3 million were transferred in taxes to the State of Mato Grosso do Sul, including CFEM, ICMS, TFRM, and ISS. In purchases made by Vale from suppliers in Mato Grosso do Sul, R$ 73.8 million was invested in the first half of 2019. Sales of iron ore and manganese from Mato Grosso do Sul totaled 1.6 million tons in the first half of 2019, with iron ore being the third largest export product in Mato Grosso do Sul with 952.5 thousand tons (Vale, 2019).

4.2. Solid waste management at Mineração Corumbaense Reunida S.A.

The generation of waste in mining, such as Vale, becomes a challenge given the volume generated. Between January and October 2020, just over 2,300 tons of wastes were generated from all areas of MCR which, if disposed of incorrectly, could cause significant damage to the environment.

In the operations of the organization studied, several types of waste are generated, among all, we highlight the most generated waste as shown in Table 2.

Table 2. Types and amount of solid waste generated in MCR.

Kind	Quantity in kg *
Class I waste in general	26.260,86
Scrap iron	24.055,60
Wood scrap / Packaging waste	1.597,60
Paper / cardboard scrap	1.127,00
Plastic scrap, rigid plastic, soft plastic.	863,18

Source: Data collection (2020). ***** data for the month of September 2020.

As noted, the largest amount of waste and, consequently, demand greater attention, are scrap iron and class I waste in general. Class I waste is the one with the greatest risk, as it is classified by the National Solid Waste Policy as hazardous waste.

According to Sanchez (1994), environmental and waste management can be understood as a set of technical operations and managerial activities that aim to ensure that companies operate in accordance with the required legal standards, reduce their environmental impacts and still meet business objectives, such as maintain a good relationship with the community.

One of Vale's values is sustainable development (Vale, 2019), acting in this way, Vale does not allow the incorrect disposal of any waste produced in its operations. DMC acts as the responsible agent in Vale's waste management. Responsibility in waste management is great since it excludes any possibility of damage to the environment due to incorrect waste disposal. In case of delay in waste collection in operational areas, activities are paralyzed, highlighting the importance of DMC.

Sanchez (1994) cites the challenges that are faced by the mining area in environmental management such as pollution control, impacts on ecosystems, social impacts, consumption of natural resources, risk management, management of solid and recyclable waste, and environmental impacts of long term. In this way, it is discussed how the waste management part is done in the DMC of MCR.

Prior to collection, the areas themselves must already practice prior segregation of waste, since each waste has its own container in the areas and its signaling. Table 3 presents the organization in colors and identification plates of the waste containers.

Table 3. Standard colors of collectors and/or bucket identification plates for selective collection in MCR's administrative and operational areas.

Color		Residue	Color		Residue
	Blue	Paper/cardboard		Orange	Dangerous waste
	Red	Plastic		Black	Wood
	Green	Glass		Gray	Non-recyclable waste
	Yellow	Metal		Brown	Organic waste

Source: Valley (2020).

Waste collection by DMC works as shown in Figure 1.

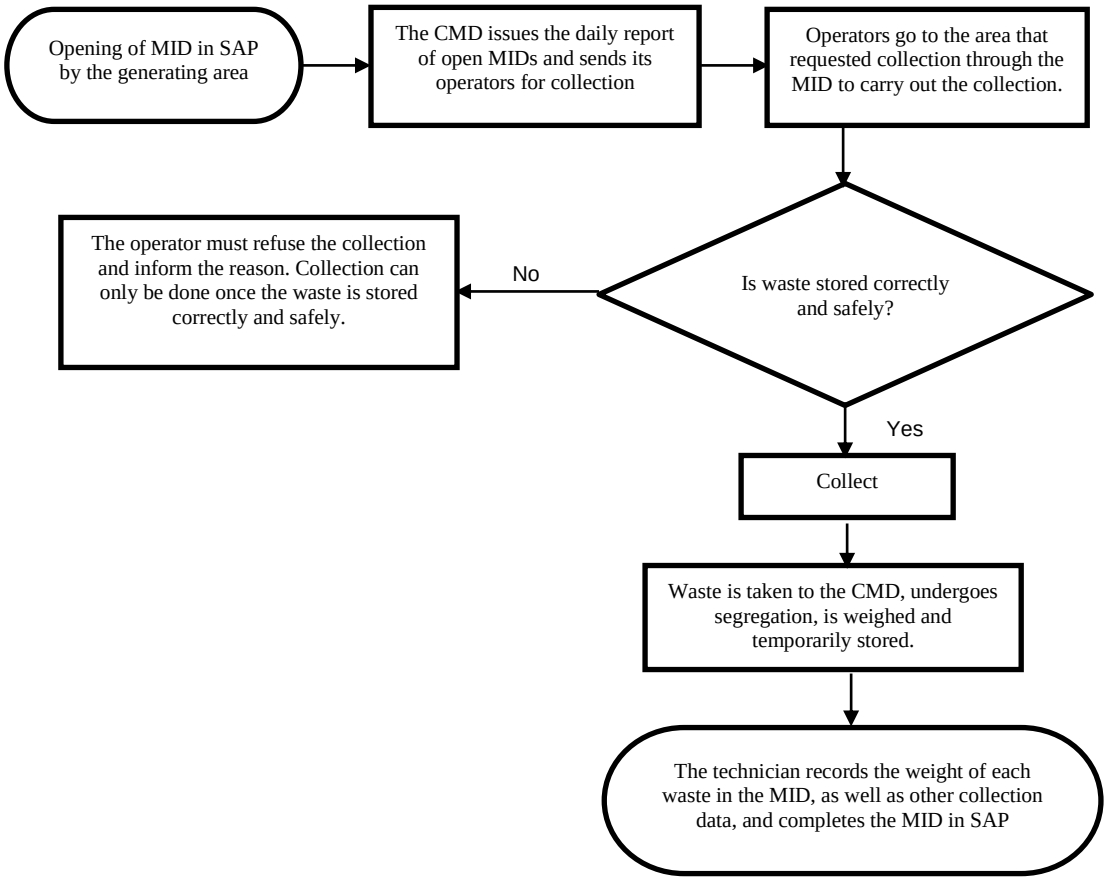

Figure 1. Flowchart of the waste collection process.

Source: Data collection (2020).

As shown in Figure 1, the collection process is carried out as follows: each area has its specific containers for each type of waste and, as soon as this container reaches a certain limit, a trained representative of the area opens it in Systems, Applications, and Products for Data Processing (SAP) issues an Internal Disposal Manifest (MID). Each area has its responsible for issuing MID that automatically appears in the DMC MID report, in which the DMC has up to five days to collect the material and up to seven days to segregate the waste if necessary, weigh, and register in the system and thus completing the MID. The generated MID presents information such as the area/sector that is generating the MID, what type of waste will be collected and, later by the DMC, the correct weight is recorded, this information being important to dimension what is collected, how much is collected and where it is collected from. When the waste leaves the DMC for its final destinations, a Waste Transport Manifest (MTR) is generated, recording the type of waste and quantity that is leaving, and providing information for writing off the relevant stock.

All the materials collected by DMC can have different destinations according to their classification and composition. Table 4 shows the types of waste and their respective destinations.

Table 4. Types of waste and their destinations.

Waste	**Allocation**	**Goals**
Organic waste	Composting area, Urucum CDM.	Perform composting producing fertilizer for planting seedlings.
Common garbage	Industrial landfill	Licensed environmental control
Plastic, paper and cardboard scrap	Donative	Recycling and socioeconomic contribution to the community.
Unserviceable movable assets in operation	Donative	Referral to institutions that can make use of it.
Class I - dangerous	Outsourcing	Hiring a third-party company to carry out the appropriate destination with certification.
Scrap iron, hard plastic and tires	Commercialization	Sale with revenue generation.
Scrapped vehicles and unused parts.	Auction	Sale with revenue generation.

Source: Data collection (2020).

Common garbage is sent to DMC's own industrial landfill, which is located in the Urucum Mine DMC at the foot of the mountain range. MCR's DMC industrial landfill in Corumbá is the only one licensed by Imasul – Instituto de Meio Ambiente de Mato Grosso do Sul until the final date of data collection.

The organic waste collected in the cafeterias of each Mine is sent to the Urucum DMC where it is reused in the composting process. This compost is used in the process of planting and reforesting areas used by the company. According to Sanchez (1994), among the management actions, habitat recovery is included.

Plastic and paper/cardboard scrap is stored at the DMC until it reaches the stock limit to later be donated to the Vale da Esperança Recycling Association. According to the Balanço Vale + da Vale report (2019), in the 1st half of 2019, 17.9 tons of recyclable materials were donated. This donation enables MCR to act in its role of preserving and reducing the impacts of its operations, it also contributes to the income of the association of each family that composes it.

Other scraps can be donated as long as there is a request through an official request from an institution that has a CNPJ, such as, for example, electronic scraps that were donated to laboratories of some institutions.

In addition to scrap, other materials such as for example, furniture, cars, and utensils, among others that are in DMC in working condition, but that for some reason the company no longer uses, can also be donated. For example, in 2020 an ambulance was donated that was in the DMC yard and would no longer be used. Complete preventive maintenance was carried out and later donated to the City Hall of Corumbá.

Class I waste, classified as hazardous, has some type of component capable of contamination. For this type of waste, the collection has a greater safety requirement than the others and, in this case, a specialized company is hired to carry out the final destination of this class of waste. After the service has been performed, the company issues a final destination certificate and passes it on to the DMC. For the collection of class I waste, it is required that it comes in an approved and sealed drum, with an identification form for the waste and the person responsible for disposal, and a safety data sheet that can be issued by Vale's internal OP.

However, revenues are also generated by DMC through the sale of scrap and MRO parts, such as scrap iron, rubber, tires, and rigid plastic. These materials are marketed by contract with interested companies. In 2020, according to the SAP report of DMC destinations, just over 730 tons of scraps were sold.

Still in revenue generation, MRO parts are sold by auction. These parts are usually new parts that, for some reason, are no longer needed in Vale's activities, so they are sent to DMC to form batches that are later sold. Some high-value scraps are also sold at auction, as is the case with scrapped cars and trucks.

In this regard, and according to Mazzer and Cavalcanti (2004), major problems can be caused by the incorrect disposal of waste in the environment, such as intense changes in the soil, water and air, in addition to the possibility of causing damage to all forms of life. , resulting in problems that may compromise future generations. In this way, the importance of the work done by the DMC of MCR in the protection of the environment becomes visible.

For Sanchez (1994), the recycling of materials, especially metals, has become increasingly important for reasons that are not only economic but also environmental. As seen, the recycling of materials, such as scrap iron, is capable of generating revenue for the company, at the same time, it avoids damage to the environment with incorrect disposal, since in nature, and the decomposition of some metals can reach 500 years.

Therefore, the results showed that the management of waste at MCR/Vale, in addition to promoting the health of the environment in which it is inserted by correctly disposing of it, returns economically with its commercialization and socially with the donation of materials that can be used in recycling processes by the Recycling Association, as well as movable goods donated to public and social institutions.

5. CONCLUSION

Waste management at MCR's DMC has shown its importance to MCR every day, presenting advantages in several sectors. Considering the high competition in the market and a population that is increasingly aware of social aspects and their responsibilities, environmental protection has become an exercise of citizenship, showing the need for companies to demonstrate environmental responsibility towards the community, customers, and environmental agencies.

The waste management work at MCR proved to be adequate to the current legislation and with the practice of actions of a social nature. In this regard, the analyzed data showed the steps that involve the entire waste management process and its application both for the company, the environment, and the community.

The types of waste, their quantity, and destinations were presented: Scrap and parts from MRO batches sold generating revenue for MCR; scraps that are donated to the recycling

association contribute to the generation of income for its members; and reuse of organic waste in the composting process, producing fertilizers for reforestation; donations of useless goods for MCR but useful for interested institutions and correct disposal by a company specialized in the treatment of hazardous materials (Class I Waste). These actions contribute to the protection and reduction of impacts on the environment in the locations where the company operates.

Law No. 12,305/2010 regulates waste management in organizations and if companies do not meet these requirements of the law, they are subject to fines and other penalties. In the case of MCR as a company belonging to Vale that has sustainable development as one of its values, the practice of responsibility with the correct disposal of waste has been something that the company seeks to work on as important values both for the company and for each individual. A collaborator who works there. This makes it possible for people who are part of the organization to take these good practices to other organizations or even to their homes.

This study contributes managerially with the presentation of an organization that applies good practices in waste management, reducing its environmental impact, improving its finances with the mitigation of fines and the sale of unusable goods and materials, and supporting society with donations from waste.

It also contributes to the theoretical discussion based on empirical analysis, bringing elements that corroborate current research studies carried out outside the Pantanal biome.

Due to problems and security measures that had to be taken in the face of the Covid-19 pandemic, some limitations were observed in order to meet the objectives of this study, such as the decision not to conduct personal interviews with people, with this research being carried out by collecting data through the technique of documentary research and observation of waste management processes.

However, the present investigation suggests, as future researches, advancing in other sources of evidence to analyze the explained phenomenon, adding direct opinions from internal and external clients and society as a whole.

Therefore, it was possible to discuss the role of the DMC in the MCR waste management process, showing how the service has been carried out. Seeking sustainable development, the organization studied, in addition to reducing the impacts of its operations on the environment, has brought benefits in different ways for everyone and all this activity of protecting the environment deserves to be shared with society as well, and therefore the middle of this work.

REFERENCES

Abrelpe –Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. (2020). *Panorama dos resíduos sólidos no Brasil 2020.* São Paulo: Abrelpe. Retrieved from https://abrelpe.org.br/download/5692

Alves, E. J., & Gonçalves, C. A. (2019) Inovação em Serviço Orientada para Gestão de Resíduos: Estudo de Caso em uma Prestadora de Serviços na Região Metropolitana de Belo Horizonte. *Revista Alcance, 26*(1), 94-109. Retrieved from https://doi.org/10.14210/alcance.v26n1(Jan/Abr).p094-109

Araújo, R. B., Silva, M. B. L., & Oliveira, E. L. D. (2019). Responsabilidade social empresarial: um diferencial competitivo essencial nas organizações. *Revista de Empreendedorismo e Gestão de Micro e Pequenas Empresas*, *4*(2), 79–93. Retrieved from https://www.revistas.editoraenterprising.net/index.php/regmpe/article/view/207

Baeten, J., Langston, N., & Lafreniere, D. (2018). A spatial evaluation of historic iron mining impacts on current impaired waters in Lake Superior's Mesabi Range. *Ambio*, *47*(2), 231–244. https://doi.org/10.1007/s13280-017-0948-0

Baird, P.L., Geylani, P.C. & Roberts, J.A. (2012). Corporate Social and Financial Performance Re-Examined: Industry Effects in a Linear Mixed Model Analysis. *Journal of Business Ethics, 109,* 367–388. Retrieved from https://doi.org/10.1007/s10551-011-1135-z

Barbieri, J. C., Vasconcelos, I. F. G. de., Andreassi, T., Vasconcelos, F. C. de. (2010). Inovação e Sustentabilidade: Novos Modelos e Proposições. *RAE-Revista de Administração de Empresas*, *50*(2), 146-154. http://dx.doi.org/10.1590/S0034-75902010000200002

Decreto-Lei n. 227, de 28 de fevereiro de 1967. (1967). Dá nova redação ao Decreto-lei nº 1.985, de 29 de janeiro de 1940. (Código de Minas). Retrieved from http://www.planalto.gov.br/ccivil_03/decreto-lei/del0227.htm

Falkenberg, J., & Brunsæl, P. (2011). Corporate Social Responsibility: A Strategic Advantage or a Strategic Necessity? *Journal of Business Ethics, 99***,** 9–16. Retrieved from https://doi.org/10.1007/s10551-011-1161-x

Gerstlberger, W., Præst Knudsen, M., & Stampe, I. (2014), Sustainable Development Strategies for Product Innovation and Energy Efficiency. *Business Strategy and the Environment, 23*, 131-144. Retrieved from https://doi.org/10.1002/bse.1777

Gil, A. C. (2017). *Como elaborar projetos de pesquisa.* 6a ed. Rio de Janeiro: Atlas.

Goswami, S. (2015). Impact of Coal Mining on Environment. *European Researcher, 92*(3), 185-196. Retrieved from https://doi.org/10.13187/er.2015.92.185

Instituto Brasileiro de Mineração. (2021). *Dados IBRAM – infográfico 1 semestre 2021*. Recuprado de https://ibram.org.br/publicacoes/

Lei n. 12.305, de 2 de agosto de 2010. (2010). Institui a Política Nacional de Resíduos Sólidos; altera a Lei no 9.605, de 12 de fevereiro de 1998; e dá outras providências. Retrieved from http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm

Lei n. 9.605, de 12 de fevereiro de 1998. (1998). Dispõe sobre as sanções penais e administrativas derivadas de condutas e atividades lesivas ao meio ambiente, e dá outras providências. Retrieved from http://www.planalto.gov.br/ccivil_03/leis/l9605.htm

Marconi, M. A., & Lakatos, E. M. (2019). *Fundamentos da Metodologia Científica.* 8a ed. São Paulo: Atlas.

Mazzer, C., & Cavalcanti, O. A. (2004). Introdução à gestão ambiental de resíduos. *Infarma, 16*(11-12), 67-77. Retrieved from http://revistas.cff.org.br/infarma/article/view/299

Ministério do Meio Ambiente (2020). *Responsabilidade Socioambiental.* Brasília: Autor. Retrieved from https://www.mma.gov.br/responsabilidade-socioambiental.html

Monteiro, C., Karpinski, J., Kuhl, M., & Morozini, J. (2017). A gestão municipal de resíduos sólidos e as ações de sustentabilidade: um estudo realizado em um município do centro oeste

do Paraná. *Revista Brasileira de Gestão Urbana, 9*(1), 139-154. Retrieved from http://dx.doi.org/10.1590/2175-3369.009.001.ao010

Rahman, I., Reynolds, D., & Svaren, S. (2012). How 'green' are North American hotels? An exploration of low-cost adoption practices. *International Journal of Hospitality Management, 31*(3), 720-727. Retrieved from https://doi.org/10.1016/j.ijhm.2011.09.008

Ranjan, R. (2019). Assessing the impact of mining on deforestation in India. *Resources Policy, 60*, 23-35. Retrieved from https://doi.org/10.1016/j.resourpol.2018.11.022

Sánchez, L. E.(1994). Gerenciamento ambiental e a indústria de mineração. *RAUSP Management Journal, 29*(1), 67-75. Retrieved from http://www.spell.org.br/documentos/ver/18539/gerenciamento-ambiental-e-a-industria-de-mineracao/i/pt-br

Santiago, L. S. (2015). Construção de uma matriz de indicadores de sustentabilidade para a gestão de resíduos sólidos urbanos. *Revista Eletrônica de Gestão e Tecnologias Ambientais, 2*(2). 203-212. Retrieved from https://doi.org/10.17565/gesta.v2i2.12799

Schalch, V., Leite, A. C. W., Fernandes Junior, J. L., & Castro, A. A. C. M. (2002). *Gestão e gerenciamento de resíduos sólidos.* São Carlos. USP.

Silva, A. P. M., Viana, J. P., & Cavalcante, A. L. B. (2012). Diagnóstico dos Resíduos Sólidos da Atividade de Mineração de Substâncias Não Energéticas. Brasília: Instituto de Pesquisa Econômica Aplicada. Retrieved from http://repositorio.ipea.gov.br/bitstream/11058/7702/1/RP_Diagn%C3%B3stico_2012.pdf

Vale (2019). *Balanço Vale + social, ambiental e econômico. Mato Grosso do Sul. 1º Semestre de 2019.* Mato Grosso do Sul: Vale, 2019. Retrieved from http://www.vale.com/brasil/PT/sustainability/vale-nas-comunidades/mato-grosso-sul/Documents/Balanco_MS_2t19.PDF

Walsh, Philip R., & Dodds, Rachel. (2017). Measuring the Choice of Environmental Sustainability Strategies in Creating a Competitive Advantage. *Business Strategy and the Environment, 26*(5), 672-687. Retrieved from https://doi.org/10.1002/bse.1949

Zhang, X., Yang, L., Li, Y., Li, H., Wang, W., & Ye, B. (2012). Impacts of lead/zinc mining and smelting on the environment and human health in China. *Environmental monitoring and assessment, 184*(4), 2261-73. Retrieved from https://doi.org/10.1007/s10661-011-2115-6

Žibret, G, Gosar, M, Miler, M, Alijagić, J. (2018). Impacts of mining and smelting activities on environment and landscape degradation—Slovenian case studies. *Land Degradation & Development*, *29*(12), 4457– 4470. Retrieved from https://doi.org/10.1002/ldr.3198