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Identification of the principles of cleaner production in a red ceramic industry in the municipality of Paudalho-PE

Identificação dos princípios da produção limpa na indústria de cerâmica vermelha no município de Paudalho-PE

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Palavras-Chave
gestão de resíduos
processo de produção
gestão sustentável

Atividades industriais, incluindo cerâmica vermelha, causam mudanças no meio ambiente. O presente trabalho teve como objetivo avaliar as etapas do processo de produção da indústria de cerâmica vermelha a partir da metodologia de Produção Mais Limpa (PC). Para tanto, foi realizado um levantamento de dados secundários, baseado em pesquisa bibliográfica em artigos, sites e teses relacionadas ao tema e dados primários, por meio de método observacional e entrevistas. Observou-se que a empresa em estudo apresenta alguns princípios da CP quanto ao gerenciamento de resíduos de produção, porém, não existe de fato um planejamento visando a execução desta ferramenta em seu processo produtivo. Verificou-se, portanto, a necessidade de pessoal especializado para implantar um modelo de gestão sustentável na empresa, para atender às especificações legais, aumentar a produtividade, competitividade e minimizar o consumo de recursos naturais, sendo a CP uma possível ferramenta a ser aplicada para esse fim.

Key-word
wast management
prodution process
sustainable management

ABSTRACTS
Industrial activities, including red ceramics, cause changes in the environment. The present work had as objective to evaluate the stages of the production process of the red ceramics industry from the Cleaner Production (CP) methodology. For that, a survey of secondary data was carried out, based on bibliographical research in articles, websites and theses related to the theme and primary data, through observational method and interviews. It was observed that the company under study presents some principles of CP regarding the management of production residues, however, there isn't in fact a planning aimed at executing this tool in its production process. Therefore, it was verified the need for specialized personnel to implement a sustainable management model in the company, to comply with legal specifications, and increase productivity, competitiveness and minimize the consumption of natural resources, being CP a possible tool to be applied for this purpose.

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Introduction

With globalization and intensification of business competitiveness, organizations are seeking more efficient processes and mitigation of the environmental impacts caused by their activities. This movement is perceived in extractive companies, processing industries, as well as service providers. In this sense, several researches have been developed regarding more sustainable production alternatives (ABREU, 2016), the measurement of environmental impacts, as well as identification of cleaner methodologies. Oliveira Neto, Shibao and Godinho Filho (2016) carried out a bibliographical research and bibliometric analysis in order to quantify the works related to Cleaner Production (CP) in Brazil and verified that in recent years there have been advances, however, there is still a lack information on the subsidies provided by the government for these types of business programs. Oliveira Neto et al. (2015a) still evaluated the types of tools that Brazilian companies use and identified that among the companies studied, 68% adopted planning and control of production with environmental education seeking to reduce emissions and waste in the production process, as well as use ecological inputs to obtain a more environmentally friendly product.

This entrepreneurial orientation towards a greater alignment to the environmental issues also has relation with the stakeholders who are responsible for the change in the environmental posture of the companies, since, according to Oliveira Neto et al. (2015b), society starts to adhere to green purchasing and denounce misleading business practices. In addition, public policies tend to tax carbon emissions and there is a low-cost financing of environmental projects.

The methodology of CP has been used in different types of organizations and industries and different papers show its applicability, such as those of Silva, Moraes and Machado (2015) who carried out the work in a manufacturer of rain assemblies, Orth, Baldin and Zanotelli (2014) in an automobile industry, Molinari, Quelhas and Nascimento Filho (2013) in a dyeing industry.

According to Maciel and Freitas (2013) the CP are applications of strategies of technical, economic and environmental basis, that through the integration with the existing processes in the organizations, it is sought to increase the efficiency in the use of resources, raw materials, water and energy, by avoiding the degradation, minimization or recycling of waste and emissions generated.

The red ceramics industry still operates in a very traditional way, and a large number can be considered as family businesses. This type of industry uses high amounts of clay (PAZ et al., 2015) causing environmental impacts and the production process consumes a high amount of water. Different aspects confirm the need for environmental planning and the use of clean methodologies. In spite of working with a productive process without many innovations, there is a direction of the sector towards environmentally correct practices (PAZ et al., 2013) and for the use of CP methodology, even in very small quantities.

In this way, the present article sought to evaluate the stages of the production process of the red ceramic industry based on the Cleaner Production methodology.

Material and methods

The methodological steps for the development of the research were, initially, the bibliographical research, being consulted scientific articles, dissertations, reports and sites, seeking to know the state of the art of the problematic approached; And then the search of primary data, from field research, through the observational method and realizations of interviews to understand and characterize the object of study (GIL, 2008). It was chosen the case study, with a view to the in-depth observation of a contemporary phenomenon in a real context (YIN, 2014), in a red ceramic industry located in the municipality of Paudalho-PE.

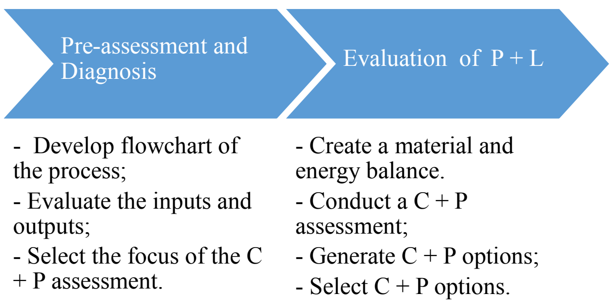
The selection of the industry for research was done intentionally, after search of the industries located in the state through a list of industries associated with the Syndicate of Red Ceramics Industry for Civil Construction in the state of Pernambuco (SINDICER-PE).

Of these, those considered as benchmarking of the sector in terms of human resources, financial and investments in research and innovation were selected from the companies qualified by the Sectoral Quality Program (SQP) (ANICER, 2017). With this information, an industry located in Paudalho - PE was selected, due to its qualification to the SQP and acceptance to carry out the research. Thus, the Industry was denominated Industry X, in order to keep the company anonymous, as adjusted for the beginning of the research.

The field research consisted of a technical visit to Industry X, with the follow-up of the work routines, evaluation of the stages of the production process and interviews with the leaders of the organization.

For this study, it was analyzed the steps in the pre-evaluation and evaluation stages (Figure 1) among the five phases proposed in the CP implementation methodology indicated by the National Center for Clean Technologies (CNTL), described in Senai-RS (2003).

Figure 1 - The steps used for analysis and suitability for CP.



**Cleaner Production (C+P)*

Source: Adapted from Senai-RS (2003).

Results and Discussions

The company

Industry X is a company that has been working for more than 16 years in the manufacture of ceramic blocks (sealing, structural, slabs, among others).

It is made up of 100 employees, standing out for investing in technology, being the only ceramics in the region to count on a fully mechanized and semi-automatic tunnel kiln.

The company's largest production period in 2013 was in the months of March, April and November and the highest costs are in the consumption of electricity and labor. On average, this organization has a production volume of around 3 million blocks/year.

The productive process and the negative impacts

In order for the CP Program to be implemented it is essential to carry out a Life Cycle Assessment. The ISO 14040 standard of the Brazilian Association of Technical Standards (ABNT) (2009) conceptualizes Life Cycle Assessment (LCA) as "the compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its Life cycle".

Thus, LCA is a tool of the environmental management system with the objective of ascertaining potential environmental aspects and impacts associated with a product, process and/or activity, and investigating recommendations of measures for decision makers (COSTA; MELO, 2014).

For Maciel and Freitas (2013), among the segments that cause environmental impacts, the red ceramics stand out due to the specificities in the structure and because they have particular characteristics.

The process of manufacturing red ceramics consists of the steps of raw material extraction, mass preparation, modeling, drying and firing and post-manufacture by distribution, use and end of life.

The main raw material of the red ceramic sector is clay, in this case a non-renewable natural resource. As Paz, Morais and Holanda (2013) explains, the term clay refers to a fine granulometric material that acquires plastic behavior when in contact with a limited amount of water.

In relation to the first stage of production, the extraction of the raw material, it was observed that for Industry X, obtaining the clay has a low cost, because what could make the product more expensive would be the matter of the distance of the quarries to obtain the matter the cost of transportation. But the company is strategically located at a distance of approximately 60 km from the mine. The extraction is carried out by third parties and all stages of this process are licensed for this purpose, having an appropriate planning for the preservation and recovery of degraded areas, reducing the environmental impacts originated. In the preparation of the mass, it was observed that the main negative impacts are caused by the energy consumption of the equipment, the use of water in the preparation of the ceramic mass, lubricants for maintenance of the machines and emission of particulate material.

According to Oliveira (2011), in the preparation of the mass, the clay passes through two rolling mills to be crushed into smaller parts, there are disintegration of clods that are still in the mass to increase their homogeneity and is processed in the mixer for moisture control.

Then, it follows the modeling and cutting stage, in which the impacts are similar to those of the preparation phase of the mass.

Oliveira (2011) explains that in the modeling stage the rollers compact the clay mass to eliminate the air bubbles leaving them less porous and denser.

Thereafter, the extruder, also known as "maromba", is responsible for forming the dough through the chosen mold. Subsequent to the extruder's exit, the still wet material, already molded, passes through the cutters whose function is to leave the pieces in the appropriate sizes (Oliveira, 2011).

The drying process, if done in an artificial way, has the output of atmospheric emissions. The drying process is performed to remove the moisture from the pieces. It can be in a natural or artificial way, the latter being done with 24-hour exposure in a ventilated environment.

The next step is the firing, where the pieces are taken to the kiln and calcined at high temperatures and constitutes the most important stage of manufacture of the ceramic products in the thermal sense. In Industry X, the kiln used is fed with two types of fuels, firewood and vegetable oil.

The impacts are atmospheric emissions, ashes and ceramic residues, which cannot be reused in the process, because the chemical characteristics of the material have changed.

The products are subjected to high temperatures, ranging from 800 °C to 1000 °C, which cause physico-chemical changes such as mass loss, grain soldering and development of new crystalline phases (Machado, Gomes & Melo, 2010).

Burning consumes about 95% of all thermal energy demanded by the red ceramic industry, the remaining 5% being used in drying (ANICER, 2014a).

The main source of energy used in these companies is firewood. The red ceramic sector is the main consumer of this type of input in the ceramic industries, because the biomass corresponds to 90% of the fuel used (50% firewood and 40% wood residues), contributing to deforestation and consequent environmental degradation (CRUZ, 2014).

According to the analysis of the production process, the following levels of priorities were verified in the company according to the CNTL: to avoid the generation of waste and emissions, level 1.

The waste generated needs to be mainly reintegrated into the productive process of the company, Level 2. Waste that cannot be avoided and/or reinstated in the process should be sold or donated for level 3 external recycling (SENAI-RS, 2003).

Waste from the production process and applicability to the principles of cleaner production

Waste generated from Industry X is seen in the cutting, drying, burning and storage stages.

In this way, the residues from each step of the processes were identified qualitatively and the destination or reuse (Frame 1).

Frame 1 – CP measures for waste from the red ceramic industry.

Source	Residue	Measures of CP
Court	Products Pieces	Return to the molding step
Drying	Defective products	Return to the molding step.
Burn	Ashes	Ashes are used in mortar for the closure of Hoffman type ovens due to low quantity produced and donation as agricultural fertilizer.
	Defective products	Defective products are donated to employees, used in internal works, sold by means of acceptance and/or processed into pieces for disposal.
Storage	Breaking of products (shards)	The shards are used in roads without pavement to reduce dust and donated to public works such as squares and sold for insertion in other productive processes.

Source: Authors (2014).

In the cut-off stage, the generated residues are reincorporated into the process (Figure 2), thus meeting the SENAI-RS (2003) level 1 requirement, because the residue generated in this step falls directly on the mat to return to the modeling. Such equipment used was already a technology change implemented by the company.

Figure 2 - Cutting area of red ceramics

Source: Authors (2014).

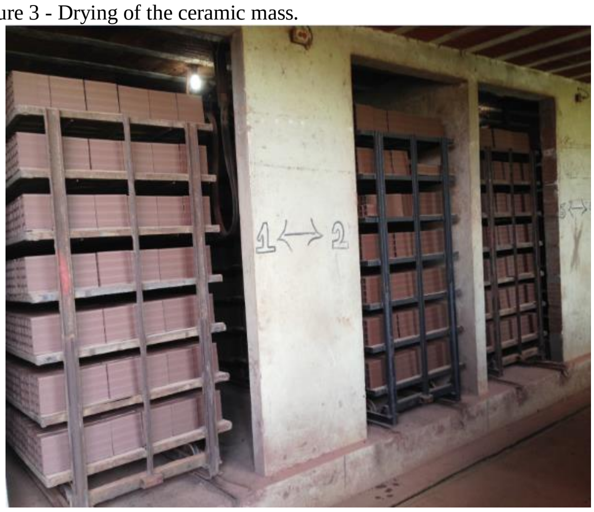
In the drying process (Figure 3), losses can occur due to problems of imperfect parts, which are reincorporated into the process. In the burning are generated two types of residues, the ashes and the products that present some fault.

Ashes are donated as fertilizers for agricultural activities and faulty parts are also donated to the signature of a failing product acceptance term, meeting level 3, thereby performing external recycling. In the storage stage, product breakdown may occur.

In such circumstances, imperfect parts are used as shards, which are on the way to institution X, that is, internal recycling, at level 2, or donated to public bodies, which is considered level 3.

In an interview, the managers of Industry X reported not knowing about the subject of Cleaner Production. Industry X does not have a team responsible for environmental issues, a fact that would pose difficulties for the application of the CP tool.

Figure 3 - Drying of the ceramic mass.



Source: Authors (2014).

Regarding the knowledge of the waste, it knows the waste generated in productive activities and seeks to control it. However, Industry X does not contain control of the amount of waste generated, nor does it meet the National Solid Waste Policy requirement to have a "waste management plan" (BRASIL, 2010), even presenting mechanisms for reincorporation into the process or recycling.

Company X addresses environmental problems with behavior of basic concern, since the involvement of top management occurs sporadically, and only corrective maintenance is performed, when the equipment is broken.

Pollution control occurs with typical remediation actions at the end of the process, but it is perceived that the inputs generated in the process are being reincorporated, thus having a proactive start.

Conclusion

Despite the identification of some principles of the methodology of Cleaner Production, proposed by the CNTL, in the company under study, specifically in relation to production waste management, this is not a practice executed and planned by the top management.

It was only observed that there is an environmental concern on the part of the organization and the need for greater efficiency in its activity, in order to reduce the waste of the raw material base of the productive process. However, for the application of CP, it is necessary to hire specialized environmental personnel and training, to train a team or sector responsible for these issues, as well as the involvement of managers, who need to have a vision strategy to reduce costs and increase productivity.

It was observed that the application of CP in the red ceramic industry can be a valuable tool in the search for sustainable development, since there are already good practices and technologies available and possible to be incorporated into the production process, which could mean gains competitive for these organizations.

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