TRADITIONAL MINING AND URBAN MINING: ASPECTS OF E-WASTE MANAGEMENT IN BRAZIL

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ABSTRACT: The present study aims to introduce a comparative analysis between the concepts adopted in traditional mining and urban mining, as well as explaining the opportunities brought by urban mining with a focus on the Waste Electrical and Electronic Equipment (e-waste) management in Brazil from the gold extraction case study. Based on data from the literature, both types of mining were compared regarding some key points, and it was observed that they present significant distinctions, especially on the phases of calculating the mining feasibility. Also, this study estimated the gold recovery from e-waste and from virgin mines in Brazil in t/year, observing that the former corresponds approximately to 19 times more than the gold production by the later. Therefore, although Brazil faces some challenges to implement the urban mining, such as the scale factor, there are clear advantages of urban mining as a way of boosting the Circular Economy for the coming years in Brazil.

Keywords: Urban mining, Circular Economy, E-waste, Brazil.

1. INTRODUCTION

Mining is seen as a strategic activity for the technological development of countries, due to its function of obtaining raw materials to supply the production processes. However, despite the positive side regarding economic development, the so-called traditional mining, based on the extraction of ores from nature, has significant socio-environmental impacts, besides expressive mining costs.

Although the concept of Urban Mining (UM) was inspired by traditional mining, conceptual differences can be pointed out. The term urban mining has been used in the last decade as an alternative for the recovery of materials from secondary raw material (Krook et al., 2015), as well as a proposal to mitigate the impacts derived from the improper disposal of waste (Cossu and Williams, 2015). Thus, the urban mining approach is clearly in line with the proposal of the Circular Economy as an alternative to the linear model adopted recently in traditional mining activities (Lepawsky, 2018).

Based on this understanding, the present study aims to present a comparative analysis between the concepts and steps adopted in traditional mining and urban mining, as well as explaining the opportunities brought by urban mining with a focus on the Waste Electrical and Electronic Equipment (e-waste) segment in Brazil from the gold exploration case study.

2. BACKGROUND

2.1 Traditional mining and its impacts

The traditional mining aims at extracting ores obtained directly from mines and is usually characterized by four main stages (Hartman & Mutmansky, 2002). In the prospecting and exploration stages, ores are researched and measured. The exploitation of an ore is the mining itself, while the ore processing aims to regularize the size of the ore extracted to a suitable size for the next steps. Finally, the mineral recovery includes metallurgical processes to obtain the metal of interest.

Despite the economic development of the mining regions, the negative impacts of these activities are evident in the social, environmental and economic spheres, such as displacement and well-being of the local population, deforestation, emission of particulates, reduction of biodiversity, acid mine drainage and expenses for the preparation of the extraction site (ELAW, 2010; Singh and Singh, 2016).

2.2 Circular Economy and Urban Mining

Circular Economy is defined as an industrial system that is restorative or regenerative by intention and design (EMF, 2013), and, therefore, prioritizes the reduction of the use of virgin raw materials in favor of the increased use of inputs from residues of the productive cycles.

Due to the limited and fixed stocks of raw materials and the increasing anthropogenic stocks of materials, the Urban Mining gained substantial attention recently (Cossu et al., 2012). This concept is considered as a strategic instrument for implementing the Circular Economy, since it aims the recovering of elements contained in the waste as raw materials, or secondary raw materials, closing the cycle. In addition, because of the contribution for the development of the recycling market, UM presents clear socioeconomic gains, especially in emerging economies. Urban mining can be developed, for example, from waste demolition and construction, e-waste, ashes from incineration and landfills.

The viability of urban mining, however, depends on ensuring frequent collection of minimum volumes of post-consumption material available to constantly supply the waste recovery cycle. Therefore, the scale factor is seen as a prerequisite for the success of urban mining, and often also as a challenge in many emerging countries, where the lack of selective collection programs take place.

2.3 E-waste Urban Mining

E-waste is defined as waste equipment that requires energy or magnetic current for its operation. E-waste can contain hazardous elements that lead to risks of individual contamination and potential negative environmental impact (EEA, 2002). However, the e-waste composition also includes various elements of high market value that justify an investment in adequate management for returning of these products for consequent treatment and value extraction.

Besides being a source of concentrated ores, e-waste is presented in increasing quantities (Awasthi et al, 2018), justifying its potential to supply the value recovery market.

3. METHODOLOGY

The methodological procedure in the present study was based on a literature review to obtain and compare information regarding the processes adopted in conventional and urban mining.

The case study of gold mining in Brazil used the approximate value of Brazilian e-waste generation as 1534 kt/year (Baldé et al., 2017). It is estimated that, for each ton of e-waste, there is a potential for recovery of up to 1 kg of gold (Mineworx Technologies, 2017). National Mining Agency also states that Brazil produces about 81.2 kg of gold per year from virgin mines (Gazeta Digital, 2019). From this information, it was possible to compare the urban mining of gold from e-waste with the production of gold from conventional mining.

4. RESULTS AND DISCUSSION

Table 1 presents the main stages and key points of traditional and urban mining, in order to highlight the similarities and differences between both processes.

Table 1. Main stages and key points of traditional and urban mining.

Traditional Mining		**Urban Mining**	
Stages	**Key points**	**Stages**	**Key points**
1. Prospection	Specific area	1. Disposal	Diffused
2. Mineral search and exploration (Deposit design and content calculation)	Steps to verify the economic viability of mining	2. Collection	Critical moment. Should be performed as soon as possible after disposal. Generally higher cost steps.
		3. Storage	
3. Mine planning		4.Pre-processing	Steps to verify the economic viability of urban mining
4. Mineral production / exploitation	Ore extraction itself	5. Destination	
5. Ore processing	Physical processes	6. Consolidation	
6. Mineral recovery	Metallurgical processes for ore refining (physical and chemical)	7. Recondicioning	Physical processes
		8. Recycling	Ore extraction itself

Despite sharing the same common objective (the extraction of material), from Table 1 it is possible to observe that both types of mining present significant distinctions, mainly due to the origin of the raw materials.The location of the urban mines, unlike traditional mining, depend on typically anthropic variables, such Gross Domestic Product, Human Development Index, income and demographic distribution, etc, that is, they vary around the previous scenario where such wastes (now raw materials) were originated.

While the mining feasibility occurs in the initial phases of conventional mining, in the UM, this process happens in the end, in which the contents of the ores become known. Also, natural mineral deposits, variations in the composition and content of ores are observed in urban mines, however, for different reasons, mainly resulting from the processes used in the secondary materials lifespan.

According to Natesh (2005), the computer main board (or mother board) is the major source of gold among the e-waste parts. The average amount of gold in different computer boards vary from 110 to 566 ppm of gold, an expressive value in comparison with TV board scrap (17 ppm) or DVD player scrap (15 ppm). In Brazil, there is a great potential for e-waste urban mining. In 2016 were gerated about 1.5 million tons of e-waste (Baldé et al., 2017). However, it is worth emphasizing the need to invest in the segregation of this waste in the generating source, as well as efficient reverse logistics routes, to guarantee the scale factor, in addition to investment in control and inspection instruments, aiming to inhibit informality in the segment.

5. CONCLUSIONS

Despite being similar terminologies, the concepts of traditional and urban mining distinguish at several points. While the former results in significant impacts on the environment and human health, the latter aims to mitigate the impacts of waste from different production processes and still enable alternative sources of exploration for secondary raw materials. Also, the potential for value recovery from waste is significant if compared to the values of extraction by conventional mining. Thus, although many emerging countries face some challenges on waste management, such as the scale factor, there are clear advantages of urban mining as a way of boosting the Circular Economy for the coming years, especially in a scenario of increasingly precarious resources and abundant waste on Earth.

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