

Challenges of mine closure due to asbestos banning

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Abstract

The use of asbestos is a controversial issue that raises significant concern within society. Because of this, asbestos mining has been banned in several countries around the world. In Brazil, where the mineral domestic consumption was prohibited some years ago, there is the potential need for asbestos mines to suddenly close due to a legal determination. Although maintaining the operation of an asbestos mine demands a series of measures to mitigate associated impacts, its closure should also be carried out with special attention due to potential risks, and environmental and socio-economic aspects must be considered.

It is important that the operator has enough time to produce necessary information, as well as to provision the financial resources required to execute closure activities. This period is also beneficial for the community, which seeks a smoother transition from a scenario in which mining represents a significant employment source to one in which it does not exist.

Understanding the risks associated with sudden closure and considering them when making decisions about the project's lifecycle are fundamental steps in the process as they contribute to a post-closure scenario with greater socio-economic sustainability and a lower risk of environmental liabilities.

Keywords: *asbestos mine closure, legal closure challenges, post-mining socio-economic sustainability, environmental liability*

1 Introduction

Mine closure is an essential activity in the mining lifecycle and should be planned at the outset of exploration. In Brazil, however, this hasn't been the case for projects initiated in the last century. Such operations have been progressively adjusting to newly enacted legal requirements and to both national and international good practices.

Small municipalities often exhibit a strong dependency on mining projects. In such contexts, mine closure must not only resolve environmental issues but also require special attention concerning socio-economic aspects, so that the end of mining activities does not signify the end of the municipality.

The situation surrounding asbestos mining is even more complex. Where permitted, the mineral's extraction is exclusively for export, given that domestic use has been legally abolished. Moreover, ongoing discussions at the Supreme Federal Court (in Portuguese, Supremo Tribunal Federal [STF]) could determine the immediate banning of the mineral's extraction. On one hand, the environmental and occupational concerns related to asbestos mining are significant. On the other, there's a deep socio-economic dependence on mineral extraction for both the host municipality and the state's finances, in addition to the potential of substantial environmental liabilities resulting from a sudden closure.

This paper aims to discuss the challenges of asbestos mine closure in Brazil, given the presented context.

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2 Asbestos history in Brazil

Asbestos is a natural mineral fibre originating from eruptive metamorphic rocks, with broad industrial applicability. Mineralogically, asbestos is classified into two main groups: the serpentine group, exclusively represented by the chrysotile variety (white asbestos), and the amphibole group, which includes five varieties: crocidolite (blue asbestos), amosite (brown asbestos), tremolite, anthophyllite, and actinolite.

The main distinction between the two groups, according to World Health Organization (1986), lies in the morphology of their fibres. Chrysotile has curved and flexible fibres, while amphiboles have straight, rigid, and sharp fibres, which penetrate deeper into lung tissue and are more difficult to eliminate from the body. For this reason, amphiboles are commonly considered more dangerous.

The properties of asbestos, such as flexibility, tensile strength, thermal and electrical insulation, as well as durability, boosted its extensive use in various sectors, such as civil construction, naval, railway, and automotive industries.

As stated by Centro de Tecnologia Mineral (2012) in Brazil, asbestos mining activity began in 1937 in the municipality of Bom Jesus da Serra in Bahia State, with the extraction of amphibole-type asbestos, specifically the amosite variety. In the 1940s, exploration was expanded to the municipality of Pontalina in Goiás State. During this period, Brazil still depended on the mineral import, mainly from countries such as Canada, Russia (then the Soviet Union), and South Africa. Self-sufficiency was only achieved in 1967 with the start of chrysotile variety production in the municipality of Minaçu in Goiás State.

Between the 1970s and 1990s, the country stood out as one of the world's largest asbestos producers, with production expanding, on a smaller scale, to other states such as Minas Gerais (where extraction sites were identified in the municipalities of Caldas, Coração de Jesus, Itabira, Iguatama, and Rio Acima), Alagoas and Piauí.

Besides mining, asbestos played a significant role in national industry, especially in the civil construction sector, being widely used in the manufacture of fibre-cement products, such as roof tiles and water tanks.

Although asbestos extraction in Brazil began in the 1930s, the national government only started regulating its exploration and use in 1995 through the prohibition of the extraction and use of amphibole group varieties and the standardisation of chrysotile use. In that same year, the Brazilian Association of Asbestos Exposed Individuals (in Portuguese, Associação Brasileira dos Expostos ao Amianto [ABREA]) was created in the municipality of Osasco, São Paulo State, with the aim of identifying, supporting, and giving visibility to people affected by asbestos exposure.

The lack of detailed documentation concerning the formal and regularised asbestos mines closure in Brazil limits the assessment of the socio-environmental impacts resulting from this activity. Furthermore, the absence of systematised epidemiological data on the health of workers and communities living near extraction areas, coupled with the long latency period of exposure-related diseases, prevents an accurate diagnosis of the potential damage caused by asbestos in the country.

3 Legal aspects

The regulation of asbestos use in Brazil has evolved significantly over recent decades, leading to its national prohibition. Prompted by scientific studies detailing adverse health effects, such as asbestosis and cancer (mesotheliomas), Brazil moved to progressively restrict, and later entirely prohibit, asbestos use.

The main legislations and regulatory frameworks on the subject include:

- Federative Republic of Brazil (1995) regulated the extraction, industrialisation, use, and commercialisation of chrysotile asbestos, allowing its controlled use. For many years, this law was the main legal instrument supporting asbestos-related mining activity in the country.
- Classification of asbestos as hazardous waste in Conselho Nacional de Meio Ambiente (2004), establishing standards for its environmentally responsible disposal.

- Regulations from the National Health Surveillance Agency (in Portuguese, Agência Nacional de Vigilância Sanitária [ANVISA]) and the Ministry of Labor (in Portuguese, *Ministério do Trabalho*, currently incorporated into the Ministry of Labour and Employment (in Portuguese, Ministério do Trabalho e Emprego [MTE]): Over the years, sub-legal regulations have reinforced control and safety measures for asbestos handling, encompassing requirements for environmental monitoring and collective and individual protection measures.

The definitive turning point in the legal framework occurred with Supremo Tribunal Federal (2017a), through direct action of unconstitutionality, in Portuguese Ação Direta de Inconstitucionalidade (ADI) 3.937 and others, which declared the use of chrysotile asbestos unconstitutional. This decision had immediate consequences on the mineral extraction and commercialisation throughout the national territory, establishing a comprehensive prohibition on the production, industrialisation, and commercialisation of asbestos in Brazil.

Consequently, there was a general repercussion, since the STF's decision (Supremo Tribunal Federal 2017b) established that public health and environment state regulations, which were more restrictive than federal ones, are constitutional. This strengthened existing local legislation that had already banned asbestos in their territories, including São Paulo, Rio de Janeiro, and Rio Grande do Sul States.

As a result of the STF's decision, Brazil now has a comprehensive and definitive ban on the entire asbestos production chain. Companies involved in the mineral extraction or use discontinued their activities, disregarding any previous concessions or authorisations.

However, the Governo do Estado de Goiás (2019) approved legislation authorising the sustained extraction and processing of chrysotile, exclusively for export purposes. As a result, the country's largest asbestos mine continues to operate with reduced capacity. It is worth noting, however, that this allowance is still under judgment by the STF which may yet reverse this permission.

4 Implications of the banning on mine closure

As previously indicated, the contemporary closure of chrysotile asbestos mines in Brazil is associated with substantial environmental and socio-economic challenges, which are addressed in the following subsections.

4.1 Environmental aspects

The project's lifecycle represents fundamental information for the mine closure plan. Once the mining period is defined, data supporting the development and refinement of the details addressed in the closure plan is progressively produced during the operation of the project. Sudden closure requires immediate actions from the operator that might be executed precipitously, lacking comprehensive relevant information, incurring a risk of failure in the closure.

Among the environmental liabilities that may result from the sudden closure of an asbestos mine, the following are prominent.

4.1.1 Soil and water contamination

According to Associação Brasileira de Normas Técnicas (2024a, 2024b), asbestos fibres are the constituent that makes asbestos-containing waste hazardous due to their carcinogenic nature. Furthermore, understanding the mineralogical composition of mining byproducts and monitoring their reactivity with the environment are essential to preventing potential contamination of environmental compartments. Comprehensive studies and careful monitoring undertaken throughout the operation period are indispensable for defining efficient strategies to mitigate impacts in the closure horizon.

If closure has to be carried out without all the necessary information being available, the following mechanisms may occur:

- Mobilisation and accumulation of contaminants from exposed rocks: exposure of mineralised rocks to weathering, which, without proper cover and due to their mineralogical composition, can lead to the mobilisation of contaminants into surface and/or groundwater, making water sources harmful. Additionally, the accumulation of contaminants in soils can make them unsuitable for vegetation growth.
- Erosion of exposed surfaces: potential exposure of surfaces (in piles and mining areas) not adequately stabilised physically, chemically, and/or biologically. Such surfaces are susceptible to erosion by various agents, becoming a source of sediments for water bodies, where water quality can be impacted.
- Exposure of substances used in processing and machinery: if sudden closure implies the total or partial abandonment of mining operations, it is possible that substances eventually used in mineral processing, from reagents to lubricants and fuels, will be exposed and their components mobilised into the environment, becoming sources of soil and water contamination. The eventual lack of demobilisation of the industrial plant also implies a similar risk.

4.1.2 *Changes in air quality*

As noted previously, sudden closure can lead to the abandonment of surfaces that have not been adequately stabilised from physical, chemical, or biological perspectives. Under any of these circumstances, exposed surfaces might be sources of contamination, extending beyond soil and water to include the atmosphere. Considering the possibility for airborne asbestos fibre dispersion, the neighbouring population remains vulnerable even subsequent to the mine's operations cessation. This represents the primary concern during both the operation and closure phases of an asbestos mine.

4.1.3 *Exposure of unstable surfaces*

Unstable surfaces may be left behind, both in waste rock and tailings piles, as well as in mining areas (as already indicated) following the sudden closure of mining operations. This condition may pose risks of landslides or collapses which can generate additional impacts on the already degraded environment.

4.1.4 *Contaminated water lake*

The interruption of water pumping from the pit bottom, essential for mining, will inevitably lead to the formation of a lake. Given the characteristics of the materials handled in the mining project, the water in this future lake will contain contaminants, at a minimum, asbestos fibres, leached from piles and mining areas. Sudden closure may result in a lack of control over access to this location if the area is not properly isolated which can pose a risk both to the surrounding environment and to the community, which may use the lake area for leisure activities, for example. Exposure to contaminants may cause health issues in affected individuals.

4.1.5 *Interference in the recovery of vegetated areas*

Mining activities require the suppression of vegetation and, consequently, the destruction of habitats. Throughout the operation, various measures can be adopted by the operator to mitigate such impacts, but it is at the end of the operation, during closure, that it is possible to rehabilitate all impacted surfaces and reconnect habitats, accelerating the process of recovering biological stability in the degraded area.

Even though the ecological succession process can begin naturally, humans, through revegetation techniques, have the capacity to influence the speed of recovery, allowing the environment degraded by mining activity to be reintegrated more quickly into the surrounding environment. Sudden closure can interfere with this recovery process, making the action of this catalysing agent unfeasible.

4.1.6 Environmental liabilities

Due to the period of operation and considering the evolution of regulatory frameworks during this time, the asbestos mine site may already have environmental liabilities, requiring the investigation and potential remediation of contaminated areas. This process demands a cautious approach, adequate time, and sufficient financial resources.

It is also worth noting that even if the operator intends to carry out the mine closure adequately, returning a balanced environment to society, the entire process demands significant financial resources which are crucial for its success. Typically, financial provisions for closure are consolidated during the mine's operation. Therefore, if a sudden closure is mandated, there is a significant risk that the operator will not yet have the resources required for all the closure activities. This could result in environmental liabilities for both the government and society.

4.2 Socio-economic aspects

The sudden closure of a mine that represents a source of employment for a city, regardless of the mineral explored, can lead to a socio-economic crisis with severe impacts on the local population, which will be overcome at a speed proportional to the community's resilience. Among the potential socio-economic impacts, the following stand out.

4.2.1 Mass unemployment

The sudden cessation of mining operations will also imply the extinction of jobs demanded by the mining activity. Initially, a small number of employees will potentially be retained, but as closure activities progress, these positions will also be terminated. This scenario will lead to widespread unemployment in the city, implying the loss of income for part of the economically active population.

4.2.2 Bankruptcy of local businesses

In municipalities with a prominent mining vocation, professionals frequently establish residency exclusively for employment purposes. Consequently, the reduction of direct and indirect jobs will lead to some laid-off employees leaving the city. In addition to these, even long-term residents, particularly the younger and more skilled, will likely depart in search of new opportunities. Those who remain, in turn, may experience a decrease in their purchasing power.

These combined effects will impact the city's economic activities in general, with companies that depend directly or indirectly on the mine's activity (suppliers, commerce, services providers catering to workers) possibly facing financial difficulties or even bankruptcy.

4.2.3 Impacts on the provision of essential services

The presence of a mining project within a Brazilian municipality's territory currently implies the transfer of various taxes to the public administration, which stimulates the local economy. As a portion of these taxes is calculated based on mineral production, the cessation of production directly halts resource transfers. In this scenario, the municipality's capacity to deliver essential services, such as healthcare and education, will be adversely affected.

In addition, even though an urban exodus is expected due to increased unemployment and decreased purchasing power for those who remain, as well as the discontinuation of company-subsidised medical care and educational assistance, the demand for these crucial services from the community will simultaneously increase amidst a reduction in public funding.

The deficit between the demand and supply of essential services will lead to a deterioration in the health and education standards of the local community, affecting the municipality's human development index.

4.2.4 Real estate devaluation

Uncertainties regarding the city's economic future and the exodus of residents in search of professional relocation can lead to the devaluation of local real estate, thereby impacting families' assets.

4.2.5 Difficulty in professional reintegration

Sudden closure interferes with the communities' ability to qualify themselves so that they can recover economically as quickly as possible. As a result, those rendered unemployed by the discontinuation of mining activities may have difficulty finding new employment, even in other areas of activity, especially if the regional economy does not offer alternatives or if the professionals in question do not have the necessary skills.

5 Conclusion

Based on the context and points discussed, it is reinforced that the sudden closure of mining projects should be avoided whenever possible, as it prevents proper planning and exacerbates associated risks. Regarding asbestos mining, given the specific context of legal determination for its total ban, it is prudent that the points raised here be considered when making decisions, avoiding leaving liabilities for society.

During the mine's operation, environmental issues concerning the interaction between the project and its surroundings must be studied and monitored. This ensures that, at closure, planned environmental impact mitigation measures are more likely to be effective and are actually implemented.

In the socio-economic sphere, the strong dependence on a single activity makes the community very vulnerable, making it mandatory to seek diversification of the economy while the mine is still in operation. In this context, programs that aim to prepare professionals for performing activities not associated with mining can play a fundamental role. Communities should be involved in this process so that the developed retraining programs take local vocations into account.

In conclusion, the planning and execution of mine closure demand time. Although it is possible to carry out the closure suddenly, the challenges associated with this context can be significant and the consequences severe. Additionally, it is crucial to consider that an operator facing a sudden closure may lack sufficient financial resources for the necessary activities. Thus, the controlled prolongation of the project's lifecycle, in addition to providing more time for the community to prepare for the cessation of the mine's activities, can be essential for obtaining necessary information and for generating the financial resources for the effective closure.

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