President's Corner

Legacy tailings and slag dumps: Turning challenges into opportunities

As highlighted in some of my previous articles, the role of mining in the global economy cannot be underestimated. For centuries, the mining industry has contributed to the sustainable economic development of many countries. In fact, Max Plank, the father of quantum physics, is famously quoted to having said that 'mining is not everything, but without mining there is nothing'. This century-old statement is still very relevant today, as all critical minerals and metals need to be mined, processed, and refined before they can be used in consumer goods, engineering equipment, and infrastructure. Unfortunately, the mining, processing, and refining of minerals and metals face its own environmental challenges. In particular, the various unit processes involved in the mining and recovery of valuable components from the run-of-mine ores generate large masses of waste materials, mostly in the form of chemically and mineralogically complex waste rock and tailings. Further downstream processes, such as those involved in the smelting and refining of metals and alloys, produce large volumes of wastes in the form of slags and fly ash. Regardless of the unit process producing them, these waste materials have common and overlapping characteristics in that their production is sometimes inevitable, they are produced in large volumes, and lastly, they tend to be chemically heterogenous and mineralogically complex.

Solid mine and metallurgical wastes (such as waste rock, tailings, slags, and ash) are collectively classified as mine residues. Due to the relatively low intrinsic monetary value, mine residues are normally disposed of in specially designed tailings facilities and slag ponds. Fortunately, the design of modern tailings storage and slag dump facilities is governed by various national legislations, global standards, and international best practices to minimise unintended impact on the environment and communities. Various industry standards and guidelines, such as the South African SANS 10286, provide guidance on the management of mine residue deposits and other forms of solid wastes. More recently, the global mining industry further reiterated its commitment to zero harm by voluntarily adopting the Global International Standards on Tailings Management (GISTM). The GISTM is a global standard that provides a common and standardised definition and best practices in the design, monitoring, and management of tailings facilities. The international standards and best practices require that active sites be continuously monitored throughout the lifecycle of the facility, an attribute that may not be applicable to legacy tailings and slag dump facilities.

For the purpose of this article, I would like to define legacy tailings and slags dumps as accumulated process residues emanating from the historical closure of mining sites and smelters long before the relevant standards and environmental legislation were promulgated and adopted. Both types of process residues have legacy ownership challenges, potentially due to multiple changes in ownership and/or the liquidation of known registered owners. This means that the management of the historical tailings and slag dump facilities then falls outside the active legislative mandates and best practice guidelines. Regardless of the process or commodity producing them, both legacy tailings and slag dump storage facilities have a number of common and overlapping characteristics in that: (a) they are man-made in nature and have potential to cause notable environmental impact from the accumulation of potentially toxic metal elements, (b) they are formed ex-situ and may have undergone physical, chemical, and/or thermal alteration over a period of time, an attribute that makes their long term geochemical behaviour unpredictable,

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(c) they form an emerging and irreversible component of the anthropocene, with the potential to permanently alter the natural environment and ecosystems, and lastly, (d) they both can play significant roles in the circular economy as sustainable sources of minerals through deliberate remining and other reclaiming activities.

The aforementioned attributes create both challenges and opportunities. Firstly, not much data is published in open access literature to highlight the long-term geochemical behaviour and impact of legacy mine residues. Secondly, in the absence of real-time monitoring data, it may be difficult to understand the long-term geochemical impact of these legacy facilities. Because of the legacy and ownerless nature of some of the storage facilities, the affected sites may fail to benefit from improvements in monitoring technologies and best practices. However, legacy tailings and slag dumps can play a significant role in the sustainable supply of critical raw materials. By taking a 'waste-to-resources' approach, legacy mine residues have the capacity to revitalise the economies of affected communities through their reclamation for use in transversal industries.

The production and accumulation of mine residues is inevitable if humanity is to continue enjoying the same level of affluence and economic development. It is a fact that some mining and smelter sites may close as a result of unavoidable factors such economic disruptions, technoeconomic cycles (such as the potential impact of clean energy transition on coal mining), and resource depletion. This means that there is a need for future thinking to mitigate the post closure economic and environmental impact of tailings and slag dumps. This pragmatic approach is not new to the mining industry and academia, and in fact, was discussed in detail during the recently concluded SAIMM Mine Closure Conference 2025. The upcoming SAIMM Tailings Conference 2026 also provides an important platform to further debate some of these pertinent issues. In addition, I also would like to draw attention to a very impactful paper by Prof. Isabelle Demers (available at https://doi.org/10.1017/mcl.2024.4).

Dealing with environmental issues emanating from legacy mine residues is not trivial. Rather, it is a complicated endeavour that requires a multi-disciplinary approach by all stakeholders. In conclusion, I would like to remind all policy makers, geotechnical engineers, geochemists, hydrogeologists, process engineers, pyrometallurgists, biologists, archaeometallurgists, among others, that the call for abstracts for the SAIMM Tailings Conference 2026 closes on the 1st of July 2025. Please register to attend the conference so that we can collectively discuss these issues.
https://www.saimm.co.za/saimm-events/upcoming-events/tailings-2026-conference

E. Matinde
President, SAIMM