

Considerations for reporting of tailings

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The reporting of tailings has historically posed a conundrum in as far as reporting to the correct level of confidence. Tailings are sometimes over- or underestimated, excluded, or incorrectly reported. Using the correct terminology is important and not just a matter of semantics. Tailings can be defined as a 'mineral' or 'solid material' and as a 'residue stockpile' or 'residue deposit' by current South African mineral reporting codes and law. Tailings need to be included in Public Reports and the company's annual report as either a Resource or a Reserve. According to the 2009 and now the 2016 version of the SAMREC Code, tailings are considered to be a Mineral Resource by default and may be classified as a Reserve after the application of realistically assumed mining, metallurgical, processing, infrastructure, economic, marketing, legal, environmental, social, and governmental Modifying Factors. The following technical aspects need to be understood and considered in order to classify tailings: geochemical and physical characteristics, grain size, homogeneity, level of oxidation, grade(s) or percentage contained, penalty elements, densities (SG) and processable tonnage to be included and non-processable tonnages to be excluded, and volume of the dump. These will determine the 'reasonable prospects for eventual economic extraction' required by the Code. The amount of historical information is also critical, whether or not the tailings were sampled during or prior to deposition and how regularly they were sampled. If no information is available the spacing of the drilling or augering grid, the sampling interval, and number of elements or metals assayed will determine the degree of confidence for classification. Whether or not the tailings are or contain a processable (and by implication saleable) product is also a consideration for inclusion or exclusion. Where historical dumps or current dumps are considered sub-economic, but have potential to be re-worked or reprocessed, the tailings need to be reported. Tailings that are proven unsuitable be utilized further they may be excluded from classification and classified as waste. Material considered as 'waste' becomes subject to the National Environmental Management Waste Act (NEMWA) and has significant cost implication. Legislative considerations, such as the Mineral and Petroleum Resources Development Act (MPRDA), also need to be taken into consideration. It is also crucial to take into account all the minerals, metals, or elements that are contained in the tailing dumps. This can be considered as part of the legal Modifying Factors. If all proven or potential mineral or metals in the tailings have not applied been for, it leaves the potential for external applications to be lodged for the tailings. Therefore, correct and detailed reporting is essential from the start. In terms of the MPRD amendment, all residues produced under the old-order rights and not applied for now vest with the State. Any tailings remaining after closure of a mine will also vest with the State. Historic tailings are considered a heritage site in terms of South African's National Heritage Resources Act.

INTRODUCTION

The reporting of tailings has historically posed a conundrum insofar as reporting to the correct level of confidence. Tailings are sometimes over- or underestimated, excluded, or incorrectly reported. Tailings are generally only touched upon in a cursory manner in mining and environmental legislation.

BACKGROUND

Tailings and tailings facilities are subject to a number of laws and mineral reporting codes. This article focuses on applicable South African legislation and reporting codes. Reference is made to tailings in the Mineral and Petroleum Resources Development Act (MPRDA), the National Environmental Management Waste Act (NEMWA), and the National Heritage Resources Act (NHRA). An Amendment Bill to the MPRDA has also been promulgated, but was still under review at the time of writing this article, after being sent back to the National Assembly by the President of South Africa.

The review of the MPRDA, resulting in the Amendment Bill, was in part due to a court case in which ownership of old-order tailings was disputed. In the case of *De Beers Consolidated Mines Ltd v. Ataquia Mining (Pty) Ltd and Others*, it became apparent that the original Act did not specify historic dumps or tailings. Tailings were therefore considered to be a movable asset of the permit holder that extracted the material.

Tailings are also defined for classification and mineral reporting purposes in the SAMREC (SAMREC, 2009) and SAMVAL (SAMVAL, 2009) codes.

Tailings management in South Africa is regulated by law in the Guideline for the Compilation of a Mandatory Code of Practice on Mine Residue Deposits issued by the Department of Mineral Resources (DME) in 2000. This guideline makes implementation of a code of practice mandatory for each tailings facility with compulsory adherence to the SANS 10286, Code of Practice for Mine Residue Deposits.

DEFINITIONS

In order to understand the semantics behind classification of previously processed or handled material, the definition of the different types of product needs to be clarified.

The MPRDA definition of 'minerals' included substances that occur naturally in or on the Earth and in any residue stockpile or residue deposit. A residue stockpile was defined as *'any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, beneficiation plant waste, ash or other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or production right'*.

The definition of 'residue deposit' is similar. It reads: *'Any residue stockpile remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right.'*

The word 'mine' in the MPRDA, when used as a verb, means any activity for the purposes of winning a 'mineral'. Section 5(4) of the MPRDA states that a person may not mine, *i.e.* win a mineral as defined, without a mining right.

Residue stockpiles or tailings do not occur naturally in or on the Earth. They are created by mining operations. A residue stockpile or deposit therefore falls within the ambit of the MPRDA only if it is created by the holder of a mining right or remains at the termination or expiry of a mining right.

The SAMREC and SAMVAL codes have the same broad definition of a 'mineral' as in the MPRDA, where a 'mineral' is present in tailings. The codes also specify that a '*Mineral Resource covers in-situ mineralization as well as dumps or tailings that have been identified and estimated through exploration or assessment and sampling from which Mineral Reserves may be derived by the application of modifying factors*'.

According to the SAMREC Code, for tailings that are '*... currently sub-economic, but there is a reasonable expectation that it will become economic, then this material may be classified as a Mineral Resource. If technical and economic studies have demonstrated that economic extraction could be reasonably justified under realistically assumed conditions, then the material may be classified as a Mineral Reserve*'. In order to avoid confusion or to make the inclusion or exclusion of tailings from a Resource or Reserve statement easier, tailings may be reported separately with an explanation. Coal and diamond tailings have separate reporting sub-sections in the Code.

As tailings have the potential to be re-processed several times during the life of operations as improved recovery methods are developed, they may need to be reclassified. In the case of a bulk commodity such as chromite or manganese (Figure 1) the entire tailings dump can be reclaimed for sintering. A platinum group element (PGE) or gold tailings dump (Figure 2) can be reprocessed and deposited as a new dump with a lower grade, but still have potential for later reprocessing if recovery methods improve or the material becomes economically viable.



Figure 1. Manganese tailings dump.



Figure 2. Gold tailings dump.

MODIFYING FACTORS

The main technical factors to consider when classifying tailings are the physical properties, which are generally described in terms of geometallurgical characteristics. Other Modifying Factors that can be considered are technical, economic, legal, environmental, social, marketing, governmental, and political factors.

Some operations work on the principle that all tailings have the potential to be reprocessed. Generally, precious metal producers put more effort into recording the properties of the tailings prior to and after deposition. This then provides a body of knowledge that a Competent Person can use in order to classify the tailings.

The following technical factors and geochemical and physical characteristics need to be considered in order to classify the tailings: grain size, homogeneity, level of oxidation, grade(s) or percentage contained, penalty elements, densities or specific gravity (SG), processable tonnage to be included and non-processable tonnages to be excluded, and volume of the dump.

If no or very limited information is available about the tailings dump, the spacing of the drilling or augering grid, sampling interval, and number of elements or metals assayed for will determine the degree of confidence for classification. In the case where the tailings will be reprocessed in bulk, such as chrome or manganese, the grid can be more widely spaced than for tailings where the valuable constituents make up only a small percentage of the tailings, such as the platinum group minerals (PGMs). Auger drilling of a tailings dump is depicted in Figure 3 and recovery of auger material in Figure 4.



Figure 3. Auger drilling of a gold tailings dump.



Figure 4. Recovering auger drilled material.

The grain size and habit of the mineralization, *e.g.* refractory *versus* free grain, in the tailings is also a factor that will determine if reprocessing is viable. If ultrafine milling or a re-design of the plant is required, the cost impact can be weighed up against waiting for the introduction of new processing

techniques during the life of mine. The physical and geochemical nature of the tailings also needs to be considered, such as density settling, and mobility of elements over time. The homogeneity of the tailings will also be influenced if the tailings are derived from more than one orebody or multiple seams with different mineralogical characteristics.

A detailed quality assurance and quality control (QA/QC) programme is integral to the classification considerations. This would cover the entirety of the sampling, assay, and reporting process and should be audited by a third party.

A suggested way of modelling tailings dumps is the inverse distance to a power gridding method. As sampling of tailing dumps is inherently difficult, the results tend to be more indicative than absolute. Smoothing is generally required to minimize the 'bullseye' effect. An example of such a contour map of a hypothetical dump is presented in Figure 5.

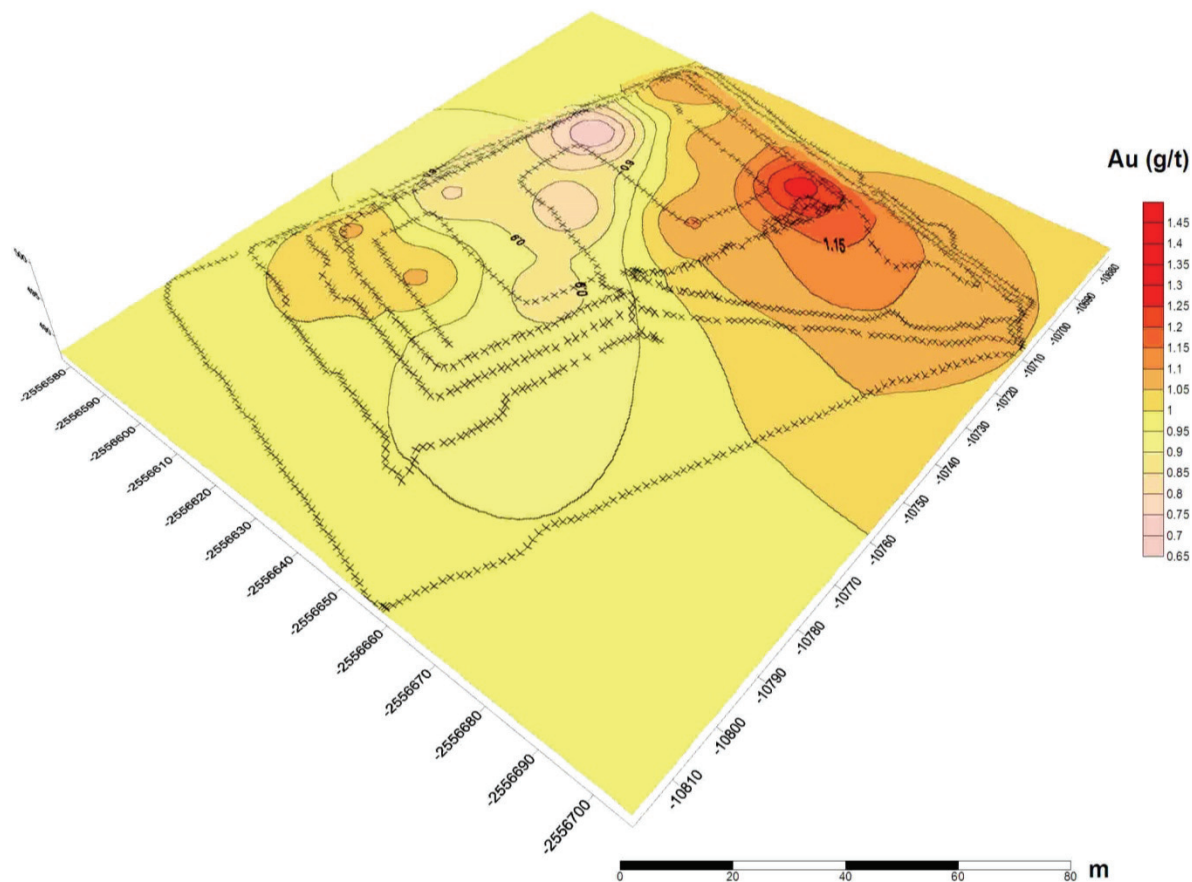


Figure 5. Contour map of a hypothetical dump using the inverse distance to power gridding method.

APPLICATION FOR EXPLORATION AND MINING RIGHTS OVER TAILINGS

When the MPRDA was initially promulgated in 2004 it did not specify tailings, which were therefore legally considered to be a moveable asset of the permit holder that extracted and processed the material. The MPRDA has since been amended, but the amendment remains under review and has not been officially promulgated.

The State holds historical tailings in custody and third parties will be able to apply for prospecting and mining rights for these tailings. The possible consequence of the amendment is that rights to such

tailings will fall under the rights of those parties with prospecting or mining rights to the land physically underlying these tailings.

The MPRD allows the primary holder of a mining right to mine and dispose of associated minerals discovered in the mining process. The MPRD also allows third parties to apply for rights, permits, or permissions over these associated minerals. The only requirement in this regard is that the third party notifies the primary mineral right holder of the application being made.

CLASSIFICATION OF TAILINGS AS WASTE

The SAMREC Code clearly states that: *'Portions of a mineral deposit that do not have reasonable and realistic prospects for eventual economic extraction must not be included in a Mineral Resource'*. These tailings would then not be reported as either a Mineral Resource or a Reserve. The Code goes on to state that: *'a detailed listing of such exclusions and reasons therefore, signed by a relevant Competent Person, should exist'*. The implication is that the tailings would then be classified as 'waste'.

The decision to classify tailings as waste has potential financial impacts. Once the decision has been taken to deposit the tailings as 'waste', the material becomes subject to the relevant environmental legislation. Prior to June 2014, the MPRDA largely regulated mineral waste. Mines did not need a waste licence for their mineral waste – only an approved Environmental Management Plan (EMP) and a water use licence were specified. Mineral waste facilities were designed and operated based on a risk-based approach, which takes into account site-specifics, the nature and the characterization of the waste material, and an environmental specialist consultant's professional judgment.

Mineral waste now falls under the National Environmental Management Waste Act (NEMWA) Amendment Bill, implemented in December 2014. At the same time the 'One Environmental System', which aims to streamline mining, environmental, and water use authorization processes for mining-related operations, was rolled out. The Minister of Mineral Resources is able to issue environmental authorizations and waste management licences in terms of NEMA and NEMWA respectively for mining and related activities. The Minister of Environmental Affairs will be the appeal authority for these authorizations.

The NEMWA Amendment predefines mineral waste as hazardous, and applies the technical requirements of small landfills, for which it was originally intended, to large mine residue deposits. Mines now also need to apply for waste licences for these disposal sites. This poses engineering and cost challenges, including the use of geosynthetic material, which is mostly plastic-based materials and required in landfills, to cover the mineral waste. This would not be viable for dumps that contain material that is prone to spontaneous combustion. Also, the design and type of liner to be used must be of sufficient longevity and integrity so that it will not fail due to the sheer size and weight of the dump. Installation of pollution barrier systems, *i.e.* liners, for certain mineral waste facilities in accordance with the NEMWA Regulations is potentially costly, considering that some of these dumps have been set up for temporary purposes, ranging from ten or twenty years in mining terms, before being reclaimed or used as backfill or for other purposes. Hence, the current dump cannot always be designed as a permanent deposition site. These additional requirements will have an immediate short-term and long-term financial impact on the mining operations, which are not necessarily budgeted for.

OLD-ORDER TAILINGS AND HISTORICAL TAILINGS

The MPRD Amendment Act extended the definition of 'residue deposit' and 'residue stockpile' to include deposits or stockpiles created under old-order mining rights. The effect of the amendment is that ownership of residues held in terms of an unused old-order rights and which have not been converted, now vests in the State.

If, however, the old residues are held in terms of used old-order mining rights which are converted, then the majority opinion is that mining of the residue under the new-order mining rights is permitted. Ownership will then revert to the State after mining ceases.

It was initially unclear whether the provisions contained in the MPRD Amendment Act applied retrospectively effect to stockpiles or deposits created before the MPRD Amendment Act or the MPRDA. In the MPRD Amendment Act, this issue is addressed and it now refers to 'historic mines and dumps created before the implementation of the Act'. Section 42A is the new section, which provides transitional measures dealing with historical residue stockpiles and residue deposits not regulated under the Act. For a period of two years from the date that the MPRD Amendment Bill is promulgated, the rights continue in force and the holder had the right within the two-year period to apply for a reclamation permit. A reclamation permit will be granted if the holder intends conducting mining operations upon the grant of the reclamation permit. Similar provisions to those dealing with the conversion of old-order rights pertain to the conversion of rights in respect of historical residue stockpiles and residue deposits.

Cognisance should also be taken that historic mining site infrastructure older than sixty years is subject to the National Heritage Act. This would include the tailings dumps and associated historic buildings.

CONCLUSION

The Modifying Factors for converting tailings into a Mineral Reserve are influenced by the initial processing method, the manner in which the tailings dump was generated, and the effect of time. The considerations for classification of tailings extend beyond the mineral reporting code requirements and the modifying factors. Legislation ranging from the application to explore and mine tailings to retaining these rights may impact on the considerations. The decision to discard tailings as waste will have a financial impact in terms of the environmental requirements that will have to be met.

The continual advancement of processing methods would suggest that a tailings dump may be re-processed several times during the life of a mine's operations. The physical or geometallurgical characteristics of the tailing are the main considerations when classifying tailings, but classification cannot be considered or done without taking into consideration the legislative and reporting requirements.

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