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Review article

Tailings management in gold plants

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Abstract

General aspects of tailings management that would be applicable to any mining operation are reviewed with specific emphasis on gold operations. The production of acid from sulphidic tailings is discussed together with selection criteria for impoundment of sulphides and tests to enable prediction of acid mine drainage. The chemistry and precipitation of arsenic associated with gold sulphides ores is also discussed. However management of cyanide from tailings ponds is of particular concern. The various methods of destroying and recycling cyanide are briefly reviewed with a focus on the advantages and disadvantages of AVR (Acidification–Volatilization by aeration and Reneutralization), SART (Sulfidisation, Acidification, Recycle and Thickening) and IX processes. Much of the general information is abstracted from a comprehensive text by the author [Ritcey, G.M., 1989. Tailings Management—Problems and Solutions in the Mining Industry, Elsevier Science, 970 pp.] with an update of practical experiences from the recent literature.

Keywords: Tailings management; Acid mine drainage; Cyanide degradation; Cyanide recovery

Contents

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1. Introduction

The mining and subsequent recovery of metals means that huge quantities of rock are moved, crushed, pulverized, and processed to recover the metal values, and the bulk of this fine material together with mine and process wastes are returned to a mining disposal area. These tailings and waste rock constitute a large proportion of the original ore that was mined. A wide range of particle size fractions is discharged to the tailings. This includes coarse mine waste, fine clays, flotation tailings, chemical precipitates and slimes. Such a range of size fractions mean that the design and construction of tailings impoundment areas should take into consideration the physical, chemical and mineralogical aspects of those tailings. In addition, liquid effluents and residues from the processing of the ore are also impounded.

In gold operations, as well as in all mining operations, there are many similar environmental concerns for both the solid effluents as well as the liquid effluents. The solids may contain sulphides that, upon weathering, form acid and will dissolve constituents from the residues, as well as constitute an acidic discharge. Cyanides and metal–cyano complexes are a concern in the liquid effluents, as well as arsenic.

2. General aspects of tailings management

The tailings management system of a mining operation is comprised of many components which include: tailings treatment in the mill; slurry thickening; slurry transport; tailings impoundment; water recovery and recycle; tailings and effluent treatment; evaporation and restoration of the site (Ritcey, 1988a, 1989). A simplistic environmental tailings model is shown in Fig. 1.

The discharge of tailings and waste rock from a mine/mill operation produces a potential source of contamination to the environment. In addition to trace metal values that could be recovered, in some cases, mine water discharged to the tailings impoundment may contain, acid due to auto-oxidation or bacterial oxidation of sulphides in the mine. Such acid, unless neutralized before disposal, will react with the tailings to solubilize more metals and therefore produce contaminants. Acid mine drainage probably presents the single most important factor in

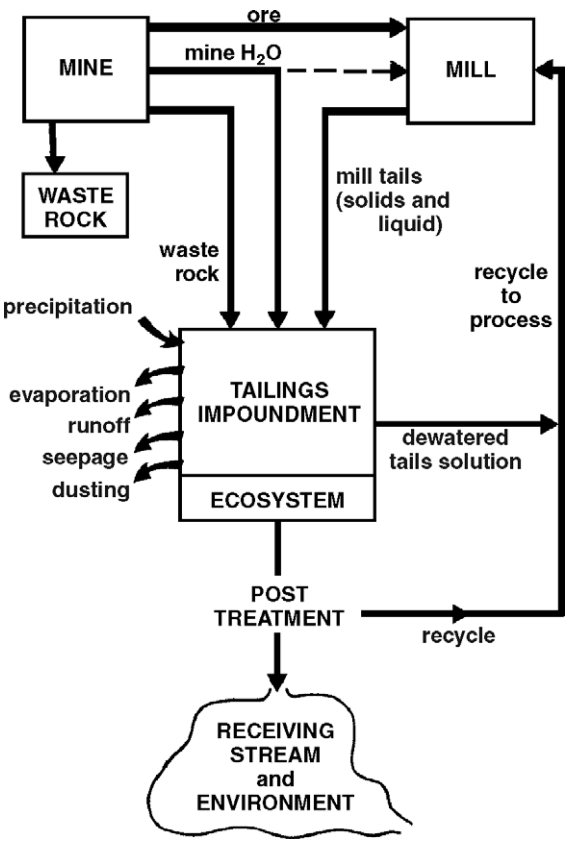

Fig. 1. Mine/mill tailings environmental simplistic system model.