

Dry Stacking – Filtration of Bauxite Residue with Filter Presses

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Abstract

This paper is divided into two sections. The first one describes and compares a range of bauxite residue materials from alumina refineries around the world. In particular, the paper compares the physical and chemical characteristics of the materials in slurry form and discusses the results of filtration tests on the different materials. Specifically, we focused our attention on the moisture content and yield stress values of the filter cake to determine the suitability of the cake for dry stacking. The second section details a number of case studies analyzing information coming from some of the largest residues dewatering and dry stacking projects where Diemme Filtration (Aqseptence Group) was involved. Each case study contains tests and operating data from the site as well as various pictures that show the components of the filtration and stacking systems. The main aim of this paper is to demonstrate that the adoption of the dry stacking technology for greenfield sites and retrofitting the technology to existing operations reduces the footprint of the storage area and minimizes the risks associated with residue storage.

Keywords: bauxite, dry stacking, bauxite filtration, filter presses.

1. Introduction

The safe management of mineral tailings is still one of the main challenges of the mining industry. The risks associated with tailings dams have been well demonstrated by recent failures causing significant harm to people and the environment. These incidents are not confined to any particular continent or country and cannot be classified as a third world problem. Tailings dam failures have occurred at sites owned and operated by prestigious mining companies with the highest management standards. There is inherent risk in the technology and that risk varies with the particular conditions of the location. Topography, climate, seismic activity and proximity of residential areas can increase the risk significantly.

The risk of a tailings dam failure (major or minor) should be accounted for in the overall economic evaluation of a mining operation as well as the cost of rehabilitation of the dam at the end of the mine life. Comprehensive and meaningful comparisons between tailings management technologies for a proposed mining operation must take these risks and closure costs into account. When this comparison is conducted correctly, those technologies that may have a higher initial capital cost may also be found to be the most economic over the life of the mine because the risks and closure costs are included in the analysis.

Over the last ten years the alumina industry has gradually embraced pressure filtration and dry stacking of bauxite residue. In fact, the technology has become the preferred method of managing bauxite residue (red mud).

2. Mineral Tailings Management

2.1. Conventional Tailings Dams

Where feasible, dams or ponds have been used as the standard method of dealing with mineral tailings slurry. Many factors influence the successful operation of a tailings dam (Figure 1). Settling of the solid particles in the dam does not always occur uniformly or completely and recovering water for use in the mine is often inefficient.



Figure 1. Tailings dam

Decanting the supernatant is often critical in meeting the design life and total tailings capacity of the dam so when poor supernatant quality prevents this, it is a serious problem. If the design relies on evaporation to concentrate the slurry, this is highly reliant on the prevailing weather. Climate change may have introduced another complication to the selection criteria for an appropriate tailings management system.

As we have witnessed, even in recent years, tailings dam failures have the potential to be very destructive and are a significant risk to a mining operation and its owner. Raising the height of tailings dam walls to extend the operating life of the dam is expensive and usually increases the risk of dam failure and damage to the mine personnel, the environment and any nearby residents.

2.2. Paste Thickening

Paste thickening has been used in mineral tailings management since the development of high-density and paste thickeners. The technology has been used in greenfield situations but it has also been retrofitted to existing operations as a way of extending the life of a conventional tailings dam.

5. Conclusion

Aqseptence Group's experience with bauxite residues and their filterability and suitability for dry stacking has proven that even though pressure filtration is now the preferred method for dewatering these materials, the chemical and physical differences in each bauxite residue mean that careful consideration of the configuration and design of the filter presses is important. To get the best results and the most economic dewatering plant, careful and thorough test work is required.

To summarize, to determine the best and most economic filter configuration for a particular bauxite residue, it is desirable to:

- Complete a thorough chemical analysis of the slurry;
- Accurately measure the particle size distribution of the solid phase of slurry;
- Perform a wide range of filtration tests, and include fixed-volume and variable-volume plate pack assessments;
- Understand the mineralogy of the resulting filter cake to better predict its filterability;
- Choose the filter configuration that best suits the application, with careful consideration to the targets.