Sustainable solids – liquid separation in mining and mineral industry with solid bowl decanter

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Abstract

Traditionally, a number of different solid-liquid separation techniques have been used in the mining and mineral processing industries. This has mainly been dominated by a number of conventional filter technologies as well as gravity based separation principle. During recent years, modified technologies in solid bowl decanter have proven clear benefits in using decanter centrifuges in, e.g., tailings treatment, even with very fine particles. In the alumina industry, the first tests also showed the benefits of improving sustainability with decanter centrifuges in a number of applications. With reference to several installations in mining and mineral applications as well as to the recent initial test in alumina industry, this paper will discuss how modified deep pond decanter centrifuge proved that the erosive and corrosive environment in which it was mounted (a washer stage) did not create operational problems. This technology will be further tested before final optimisation of the internal design to develop a dedicated full scale decanter centrifuge for alumina industry. The test work will also include other parts in the alumina production process.

Keywords: Tailings; alumina; washer stage; solid bowl decanter centrifuge; recovery.

1. Introduction

For most, if not all Mining & Mineral industries there are several processes where the solid - liquid separation plays an essential role in making the process viable and securing a profitable business for the operation of the plant.

This being in the mining/beneficiation part, the extraction and concentration, or in the purification and metal recovery part of the process. Several steps of solid – liquid separation are located in these process steps, tailings treatment being the largest one, but also several stages are seen in thickening, Crud treatment, etc..

Historically, this separation has taken place in either gravity thickeners followed by disposal e.g. tailing in dam, or by conventional filter technology like plate and frame or belt filter technology. This has been the traditional concept of disposal of tailings slurry to emplacement areas where the solids proportion of the slurry consolidates over time and some of the released water at the dam can be recovered and recycled.

But there is a growing interest in alternative technologies that can deliver improved water recovery, smaller footprint of tailings disposal areas, better rehabilitation opportunities or a combination of these things.

These alternative technologies have been looked at as a single tailings management solution, or as something added to traditional tailings dam disposal. The key considerations in selecting the components of a tailings disposal system would include, among other things:

- Available land area for disposal in either single or multiple disposal locations;
- Topography of selected sites for containment volumes and sensitivity to holding capacity for the life of mine;

- Considerations of storage volume and consolidation time with respect to the normally desirable progressive rehabilitation of tailings disposal sites;
- The opportunity to dispose of fine reject with coarse reject, which may influence the rate of consolidation and thereby present an opportunity for faster rehabilitation;
- Remoteness of the disposal site;
- The impact of future expansion or containment;
- The extent to which water recovery is required (at the plant or dam site) and whether maximizing the water recovery or the ability to dispose of excess water is the primary aim — and whether this aim is required across the life of mine;
- The effect of high recycle water rates on accumulation of dissolved salts and effects of corrosion;
- Capital costs of the entire system;
- Operating costs of the entire system;
- Reliability and stability of the system, particularly the tailings chemistry, particle sizing
- Tailings generation rates;
- Stability of spoil dump that includes co-disposal.

This paper will present how modern solid-bowl decanter centrifuges can be used as an alternative to both traditional tailings dam disposal technique that are in use or that have been used and to other filtration technologies used throughout the Mining & Mineral solids – liquids separation processes.

2. Solid bowl decanter centrifuge

Solids bowl decanter centrifuges were popular in the Mining & Mineral industries in 1980's and competed directly with belt press filters for e.g. tailings dewatering. From the early 1990's the use was reduced because they could not cope with increasing production rates. In the last few years several modified technologies have been implemented to the point where today, tailings treatment plants with Solid bowl decanter centrifuges with capacities above 1 200 dry ton per hour of treatment capacity can be seen.

Centrifuges have developed from tens of liters per hour at hundreds of rpm in the late 19th century to what we have today. 300 m^3/h at up to 8 000 rpm and numerous applications including the separation of cream from milk, purifying beer and wine, cell separation in the biotech industry and several Mining and Mineral applications.

Figure 1. Decanter centrifuge.

For separation applications with comparatively high solids loading, the decanter centrifuge is the most suitable. Decanter centrifuges were originally developed for industrial applications in the late 1940's. Its design is based on a horizontally driven bowl to induce accelerated sedimentation.

8. Conclusions

With reference to the last 5 years of test and full scale references in the Mining and Mineral industries, it has been proven that the solid bowl decanter is “back in the game” again. If modified deep pond technologies is used, clearly addressing the need for high solids transport and not only efficient separation capabilities, and combining it with excessive wear protection against the highly abrasive slurries processed, references show that it is an economically viable solution.
Opportunities to prove this by field testing is critical, as each mining industry, and in many cases each mining site, is different. Alumina is one of these industries where initial tests have been made with very positive first hand observations.

9. References

1. Mundy, Peter Alfa Laval Inc,. Calgary, Canada, Madsen, Bent Alfa Laval Copenhagen, Denmark. The development of centrifugal technology for Tailings treatment, Proceedings of the 9^{th} conference Tailings and Mine waste, Nov. 2009
2. Roberto, Seno Junior, Technology Manager, Alumina Refinery – Companhia Brasileira de Aluminio – Votorantim Metals – Process flow chart and data from test.