Utilization of Decanter Centrifuge for Dewatering of Bauxite Tailings

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Abstract

One of the biggest challenges faced by the mineral industry is the need to do a proper tailings disposal, mainly associated to its moisture content. A lower moisture can be also a leverage to a rational usage of water resources, safe and efficient environment management. In Brazil, dewatering methods have been studied by the mineral industry, specially after the recent local tailings dam accidents. Different methods are avaliable worldwide, and decanter centrifuges are already an option for dewatering tailings on different operations, such as oil sands in Canada, gold ore in Peru, nickel in New Caledonia and also it is being tested for iron ore in Brazil. Regarding bauxite mines, it is estimated that tons of tailings are disposed every year, mainly in settling ponds or tailings dams. Since typical bauxite concentration consists basically in washing the ore and remove particles bellow 37 μm from the product, the bauxite tailings consist of ultra-fine kaolinite, what makes the dewatering operation even more challenging. In this scenario, the purpose of the current work is to analyze the bauxite tailings dewatering by decanter centrifuge, based on bench scale laboratory tests and semi-industrial pilot tests carried out with the tailings from bauxite processing fed by ore from Rondon do Pará, in Pará, Brazil.

Keywords: Decanter centrifuge, Dewatering, Bauxite, Tailings.

1. Introduction

In the mining industry, the scale of tailings production is large, and its storage and handling can be an environmental problem if not managed properly. As a result, tailings are disposed to wet every year in tailings dams or disposal ponds, which can present a high degree of risk and high implementation cost.

Dewatering methods has been studied, as well as new disposal options. There are several technologies available to accelerate the dewatering of tailings through the use of mechanical equipment that favor the solid-liquid separation and allow to reach a humidity such as to allow the disposal of practically dry tailings, further supporting the reuse of water and, thus, eliminating inconveniences and risks of disposal in dams.

Centrifuges, specifically like the decanter type, are versatile equipment and traditionally used in industries such as food, pharmaceuticals, petrochemicals, sanitation, among others. In mining, they are generally used when sedimentation by gravity is too slow or when you want to reduce the amount of water in the thickened phase.

2. Bauxite

Bauxite is a heterogeneous material whose occurrence in nature is characterized by a compound of one or more hydrated aluminum oxide minerals, silica, iron oxides, aluminum silicates, among others. About 90% of the bauxite produced in the world is used to manufacture alumina, the raw

material for aluminum metal. It is estimated that more than 90% of the refined alumina produced is destined to the production of aluminum metal. Other uses for bauxite include making abrasives, refractories, cement and bearing agents. [1]

According to data from the U.S. Geological Survey, 2020, the world bauxite reserves are 30 billion tons while the resources are estimated at between 55 and 75 billion tons. Its distribution is 32% in Africa, 23% in Oceania, 21% in South America and the Caribbean, 18% in Asia and 6% in others. In 2019, world bauxite production was estimated at 370 million tons. Brazil has a reserve of 2.6 billion tons and its production in 2019 was 29.0 million tons.

2.1 Bauxite Beneficiation

Typically, bauxite beneficiation has the following steps [2]:

- Comminution for handling and exposure of clay minerals;
- Disaggregation of clay minerals with water;
- Separation of clay minerals from the fraction of interest;
- Dewatering the fraction of interest;
- Dewatering of clay minerals and
- Disposition of clay minerals.

It is estimated that 25% of world bauxite production is made up of washed bauxite, with outstanding operations being: MRN (Rio do Norte Mining), Weipa (Rio Tinto), Paragominas (Hydro), Juruti (Alcoa) and Miraí (CBA). [2]

2.2 Bauxite Tailings

The fraction of bauxite that is not used in processing is rich in kaolinite and typically takes the form of a pulp diluted in water with a low concentration of solids. The disposal of this tailings in dams has always been a common practice in the mineral industry. However, the current scenario encourages mining ventures to seek alternatives to the use of dams. In this context, the investigation of dewatering alternatives and subsequent disposal of the bauxite tailings are in the center of most of discussions on bauxite processing.

Some of the practices for dewatering bauxite tailings are [2]:

- Natural dewatering: tailings are thrown into dikes and are allowed to settle naturally, while the clarified water returns to the process;
- Thickening dewatering: tailings are flocculated and thickened before being released, immediately recovering part of the water. The thickened pulp is allowed to settle in dikes and the clarified water returns to the process;
- Mechanical dewatering with thickener and centrifuges: in this option, before being fed to the centrifuges, the tailings are thickened, increasing the underflow concentration of solids, and the clarified overflow from the thickener returns to the process;

Even without the addition of polymer, the solids recovery in the equipment during pilot testing was around 90%, and with the addition of polymer, it reached close to 100% solids recovery.

5. Conclusions

For the Rondon bauxite tailings, the pilot test pointed out that it is possible to obtain a 68-70% solids in the cake obtained by dewatering the tailings with a centrifuge, validating the predictions obtained in the laboratory test.

The moisture reached during the test is enough to handle the bauxite tailings and dispose it back is the open strips, validating the disposal strategy of the Rondon Project.

6. References

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