BX07 - Enhanced Desiccation of Bauxite Tailings by Solar Drying

Breno Castilho[1], Américo Borges[2], Leonardo Agripino[3], Victor Bretas[4], Renata Damas[4], Jafson Saldanha[5] and Jefson Saldanha[5]
1. Senior geotechnical consultant
2. Senior statistician
Norsk Hydro Brasil, Belém, Brazil
3. Dam manager
4. Geotechnical engineer
5. Analyst
Hydro Mineração Paragominas, Paragominas, Brazil
Corresponding author: breno.castilho@hydro.com

Abstract

Tailings management has an ever-increasing importance in the bauxite mining and aluminum industry. Dewatering technologies are being adopted and further developed to reduce environmental impacts and operational risks of tailings storage facilities. In this regard, Hydro combines two steps to desiccate bauxite tailings at Paragominas mine: tailings thickening in a gravity settler and solar drying in a large-perimeter low-height dam. The tailings disposal method used in Paragominas consists of disposal and drying cycles, with tailings being disposed into the Plateau system. The Plateau system was designed for continuous rotation between disposal quadrants, each quadrant receiving a 50-centimeter layer of tailings at each cycle, allowing for solar drying of the layers deposited at the other adjacent quadrants. Parameters such as cycle duration and layer width were initially estimated based on monitoring of disposal test areas and the system was expected to deliver a final solids content of 60 %. This paper shows that, by further developing the tailings disposal process, Hydro has been able to achieve solids content of up to 80 %, a dewatering efficiency like that obtained by filter presses, for instance. Also, a large investigation campaign was undertaken to show that drying is highly homogeneous i.e. no significant changes were found in the spatial distribution of tailings. By increasing tailings solids content, Hydro has been able to increase the geotechnical and rheological performance of the tailings, resulting in a safer and better tailings storage facility. Lastly, future uses of tailings as made easier by the decreased moisture of tailings.

Keywords: Bauxite tailings, tailings disposal, dewatering.

1. Introduction

Hydro currently owns and controls one major mining operation in Brazil: the Paragominas bauxite mine. Paragominas is located in the municipality of Paragominas, state of Pará, Northern Brazil. The mine production capacity is approximately 16 Mtpy of run-of-mine, producing about 11.5 Mtpy of bauxite and generating approximately 4.5 Mtpy of tailings. The mine started operations in 2006 and was acquired by Hydro in 2012.

For the disposal of tailings and water recovery, two different tailings systems have been implemented in Paragominas – the Valley System and the Plateau System. Both systems were designed for the final and permanent disposal of desiccated tailings in dams. Figure 1 shows the two tailings disposal systems in Paragominas.

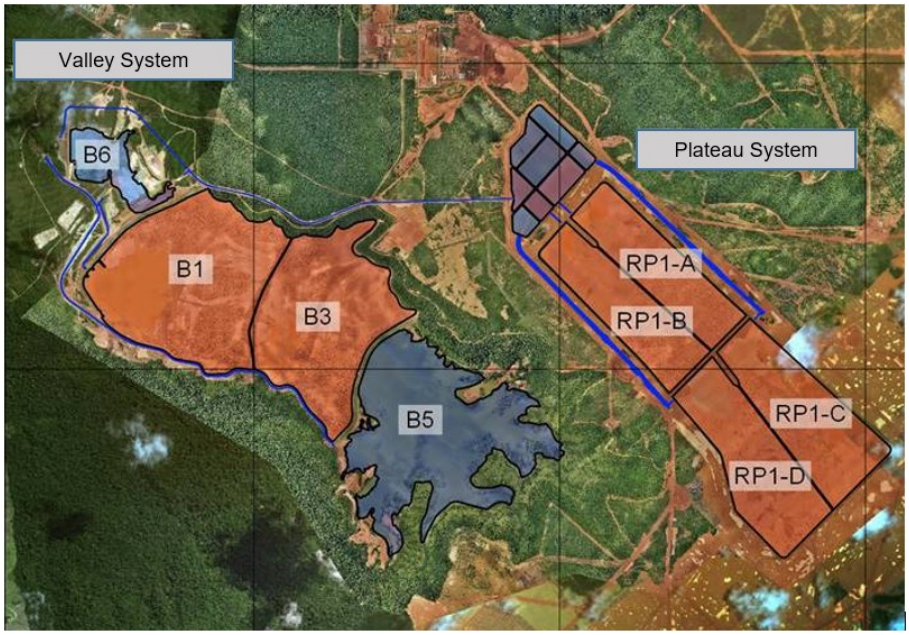

Figure 1. Valley and Plateau tailings systems in Paragominas.

The Valley System was built when the mine first started its operations and consists of three dams: B5 dam, located upstream of the valley, is intended for the protection of springs; B1 dam has the purpose of receiving bauxite tailings and B6 dam, located further downstream, is a sediment containment facility and is also important for the plant water balance. As the Valley System – the legacy system that was in place when Hydro took over Paragominas operations – approached the end of its useful life, the Plateau System was built.

2. The Plateau System

In operation since the end of 2017, the Plateau System was built in a mined-out area. It consists of RP1 dam, a large-perimeter low-height dam, divided in four quadrants for the disposal of tailings (RP1-A, RP1-B, RP1-C and RP1- D), as well as eight effluent clarification basins. RP1 dam total storage capacity is 10.7 Mm³ of tailings. Figure 2 shows a photo of the Plateau System.

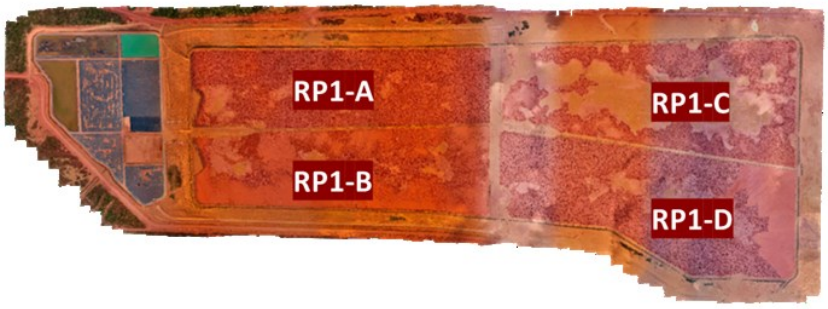

Figure 2. Plateau system.

RP1 dam was designed so that the geometry of the quadrants, the positioning of their decant systems and the spacing between spigots allow for the adequate drying of the tailings. RP1 total area is approximately 300 ha and it contains 142 spigots spaced between 75 to 100 meters from one another.

7. References

1. A.N. Abu-Hejleh and D. Znidarcic, Desiccation theory for soft cohesive soils. *Journal of Geotechnical Engineering* ASCE, 1995, 121 (6): 493–502.
2. R. Rodriguez et al, Experimental and numerical analysis of desiccation of a mining waste, *Canadian Geotechnical Journal*, 2007, 44 (6), 644-658.
3. S. Khandelwal, Effect of desiccation cracks on earth embankments. Texas A&M University, 2011.
4. A.L. Benvindo, et al, Tratamento de Minérios. 3ª Edição. CETEM – Centro de Tecnologia Mineral, Rio de Janeiro – Brasil, 2002.
5. A.P. Chaves, *Teoria e Prática no Tratamento de Minérios*, 2004, v.2, p. 50-116, ed. Signus / Mineral.
6. E. Gareth, E. Swarbrick and Robert Fell, Prediction of the improvement of tailings properties by desiccation *Proc, Ninth Pan American Conference on Soil Mechanics and Foundation Engineering*, 1991.
7. Harold Hotelling, Canonical correlation analysis (cca). *Journal of Educational Psychology*, 1935, 10.