Development of a Probabilistic Model for Water Management on a Bauxite Mining Site

Pâmela Costa [1], Victor Silva[2], Lavinia Cordeiro[3], Otilio Pires[4], Allan Reis[5], Breno Castilho[6], Maria Emanuele Silva[7]
1. Process Control Supervisor
2. Process Engineer
3. Operations Analyst
4. Operations Analyst
5. Process and Laboratory Manager
6. Geotechnical Consultant
7. Dam Operation Supervisor
Mineração Paragominas, Paragominas, Brazil
Corresponding author: pamela.costa@hydro.com

Abstract

Water is a key resource for the mining industry all over the world. At Mineração Paragominas, water is used for dust control at mining area, bauxite washing in the beneficiation plant and product transport through the 244 km pipeline that links the mine to the refinery. There are currently four main water sources on the plant: a fresh water catchment at Parariquara river, two reservoirs to store water recovered from tailings, rainfall contribution on tailings dams and a reservoir to contain water from springs upstream the tailings dam. It is a complex system, strongly dependent on environmental influences like rainfall and evaporation during wet and dry season periods, alongside with operational conditions and impact of production level and solids content on tailings disposed at the dams. This paper describes the approach adopted in terms of water management at Mineração Paragominas, including the development of a probabilistic model, using Monte Carlo simulation, to integrate and simulate the main water inputs, outputs and storage levels. The scenarios obtained with the model were used to guide actions that improved the company's robustness in terms of water availability on short and medium terms.

Keywords: water management, Monte Carlo simulation, bauxite mining.

1. Introduction

Hydro's bauxite mine is situated approximately 70 kilometers from the municipality of Paragominas in northeastern Pará, on Miltonia Plateau 3. Mineração Paragominas began operating in March 2007 and today it mines about 16.4 million metric tons of ore per year, producing 11.4 million metric tons of bauxite annually, in a process aligned with the best environmental and operational safety practices.

At Mineração Paragominas (MPSA), operations are divided into three main stages:

- Bauxite mining;
- Mineral processing;
- Slurry transportation through pipeline.

The bauxite slurry is pumped from Mineração Paragominas to Alunorte refinery, where it will be dewatered and then transformed into Alumina through the bayer process. The productive chain is represented in Figure 1.

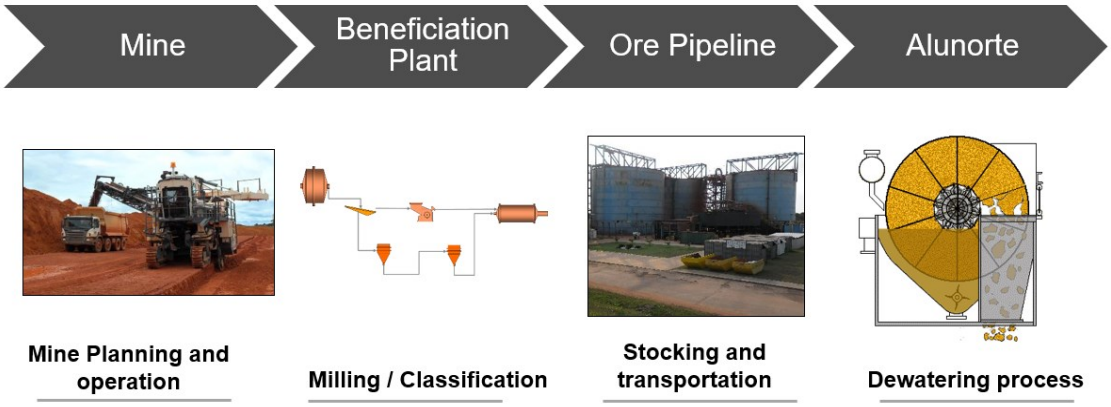

Figure 1. Productive chain.

During this whole process, water is an essential resource to allow production. At the mine area, it is used to control dust. At the beneficiation plant, it is used mostly in comminution and classification process. On the pipeline operations, it is used to transport the bauxite.

The water that goes on the product to Alunorte does not return to Mineração Paragominas, requiring then constant input of fresh water to compensate the losses and allow continuous operations. Besides that, there is also water leaving the system on tailings, as represented in Figure 2.

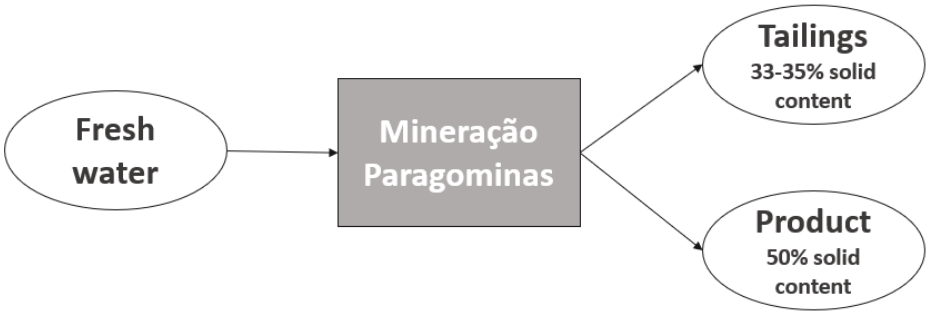

Figure 2. Water diagram.

As plant production increases, it requires a higher amount of water to run operations. However, the supply of this resource is limited and if not used wisely, it may not be enough. MPSA possesses a grant limiting the amount of water allowed to catch per day from Parariquara river, and to be able to capture this the first condition is to respect the remaining flow (ecological flow), which is the minimum flow that must pass after the collection point.

At full production, the plants can produce about 11,5Mt of bauxite a year and to do that, nowadays, it requires more water than just the quantity established on the grant. Therefore, demanding extra water sources to complement the amount catched from Parariquara. This extra water may come from three reservoirs, called B5, B6 and BCs (Figure 3).

4. Conclusion

Water is a key resource to Mineração Paragominas business. The bauxite exploited from the mine site needs water to be processed and transported to the refinery. As production level tends to increase at the plant, a higher water consumption is expected to attend all the process needs. However, water is a finite resource and there is a limit of Parariquara river catchment that needs to be respected by MPSA. Also, water availability is highly dependent on rainfall and evaporation rates, being these variables directly associated with the risks of water shortage.

Although it is impossible to predict for sure the nature behavior, it is possible to obtain good indications on how weather will behave based on historical data. Taking that into account, a simulation model has been developed internally at MPSA. This model is capable of generating different probability scenarios when assessing the risks of water shortage at the plant, which provided valuable information for the water balance work team to decide the best strategy to minimize the identified risks.