Case Study – Installation and Startup of a System for Red Mud Filtration with Filter Presses

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Abstract

This paper will be describing the case study of the Rio Tinto Red Mud Dewatering project in Canada at the Vaudreuil site in Quebec. The first part is focusing on the output coming from different filtration trials with bench unit and larger scale pilot unit which generated the necessary parameters and information for the sizing of the industrial units. The following part is related to the technical description of the dewatering area (with N. 4 filter press trains) including the arrangement of the equipment and the specific climate conditions faced during the construction and installation. The final part is related to the activities of start-up and commissioning which presented numerous challenges in terms of ramp up and steady achievement of the planned performances. We intend to share some of the main lessons learned as a contribution to the industry in view of future installations.

The adoption of the dry stacking technology to these existing operations enabled the refinery to continue the operation and eventually expand the capacity and in parallel reducing the footprint of the storage area and minimizing the associated risks.

Keywords: Bauxite, Dry stacking, Bauxite Filtration, Filter presses.

1. Introduction

1.1 Tailings Management by Dry Stack Disposal

Tailings management is currently one of the most critical parts of the mining process, due to a series of factors like increasing of waste produced, stricter environmental regulations and water recovery needs [1, 2].

Dry stacking (i.e. disposal of a dewatered waste that, due to the low residual moisture, behaves like a solid instead of a liquid slurry) is now one of the most popular and promising strategies in this field, used by an increasing number of sites all around the world and involving many different mining sectors [2]. Red mud (i.e. tailings from Bayer process) disposal presents a series of additional issues if compared to other standard tailings, like:

- Very fine particle size distribution of solid phase, with possible presence of clayey phases, resulting in more difficult dewatering process;
- Higher hazard due to the alkaline liquid phase.

Red mud dewatering can be carried out with different type of filters, like rotary vacuum drums, vacuum disc filters, hyperbaric filters and filter presses. Generally speaking, any technology presents benefits and drawbacks and defining the best one can be tricky if required targets and materials features (processed slurry and final dewatered residue) are not properly defined [3].

Nevertheless, it can be undoubtedly state that, for a series of factors discussed in para 1.2., filter press represents one of the most popular filtration techniques for this kind of application.

Figure 1. Red mud dry stack facility in Western Australia (Diemme Filtration installation)

1.2 Red mud Dewatering by Pressure Filtration

The use of filter press of red mud dewatering is now a well-established and reliable technology; many installations are working all around the world with an increasing outlook. Many advantages are listed below:

- High dewatering performances: the cake residual moisture can be lowered down to very low values (typically 25 – 35% w/w range, depending on the material and the process conditions), fulfilling the geotechnical requirements for the dry stack design and overcoming the results obtained with other techniques;
- High throughput: high-capacity filter presses, with filtration areas up to 2900 m^2, are designed by Diemme filtration (Figure 1) to be able to process extremely high duties [4];
- Flexibility: every filter press can be tailored to a specific process, based on material characteristics.

Filter press technology can be tuned to optimize cost-benefit ratio and match desired targets. To get this, material characterization and process testing are crucial, equipment sizing and design cannot disregard this step. Generally speaking, red muds present similar characteristics, like very fine solid particles, same main constituents, similar range of solid concentration due to the presence of CCD train washers. Should be considered, nevertheless, that different bauxite ores can lead to a variability that, even if small, is reflected on filtration parameters.

Some important points that can be defined during the characterization and testing are the following:

- Pump selection and feeding system design based on slurry rheology;
- Optimal cloth selection, on the basis of filtrate quality, cake release, mechanical abrasiveness;
- Filter throughput optimization by selecting the appropriate filter configuration, like chamber thickness and plate shifting system;
- Process design to fulfill the required dewatering goal: use of membrane or recessed plates and cake blowing stage;
- Use of cake de-liquoring when extra soda recovery is requested and evaluation of his impact on the overall filter throughput.

A brief summary of the main results obtained during the testing campaign carried out on Rio Tinto Vaudreuil red mud are discussed in the following section.

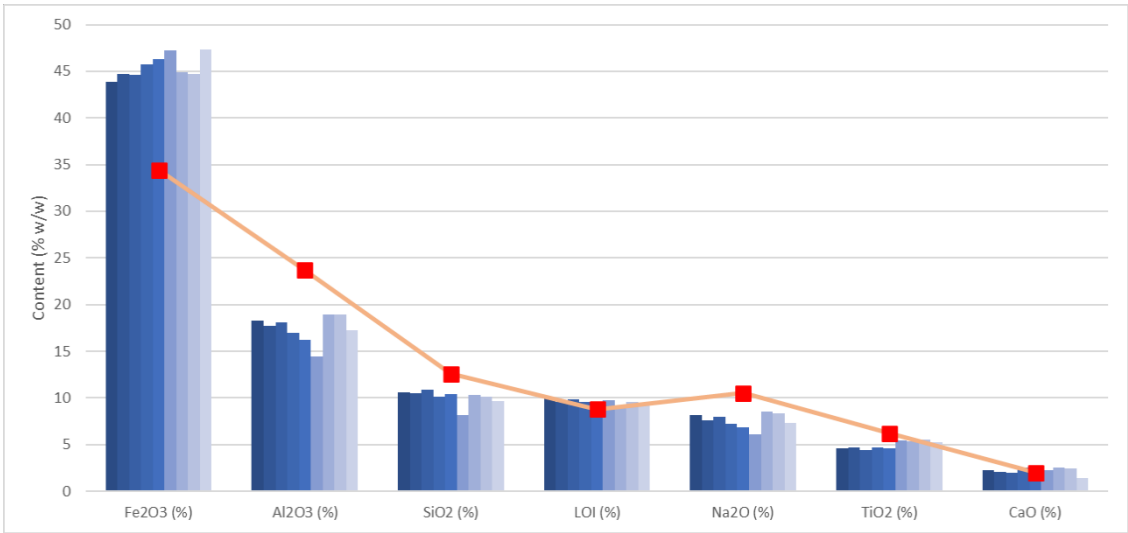

Figure 9. Comparison of main components content between slurries sampled during commissioning (blue stacked bars) and average values from testing phase (red dots).

- Some improvements on the distribution rings at the feeding of the plates in order to reduce the abrasion in the areas of the feeding ports.
- Some modifications by adding some reinforcements of the filter cloths extending the average life and reducing the plant stoppages, operational costs.
- Some increases on the size of the compressed air receivers in order to reach a higher flexibility on the membrane squeezing.
- Root cause analysis for some premature plate failures. This was the consequence of differential pressures inside of the filtration chambers due the presence of coarse solid particles in the slurry. This coarse fraction is likely composed of scales, typically present in bauxite residue slurries, and can be present in significant amounts. The high viscosity of the slurry, even at lower solid densities, makes the identification of coarse material quite tricky.

As of today, the installation is achieving the targeted performances. Despite the challenges encountered during the execution, it was possible to overcome these especially thanks to a very cooperative and transparent approach between the involved parties who approached the issues with the right attitude and steps like:

- Onsite support for 12 months for both mechanical and process issues
- Weekly meeting with expert for design review
- Extra pilot filtration work to evaluate potential drifts in filtration properties
- Addition of a screen prior to the buffer tank to protect the filter components (in particular the plates) from the potential damages of the coarser particles.

4. References

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