

How Additional Vacuum Disc Filter Design Can Support Operations

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Abstract

Vacuum disc filters are running successfully in seed filtration applications in all alumina refineries worldwide. The paper will discuss the latest developments of vacuum disc filters operated in alumina refineries. In addition to the latest process data in fine seed and coarse seed applications, the paper will provide designs and process data of two special applications.

First, the BoVac Disc Filters of BOKELA allow for seed re-slurry in an extension of the discharge chute. This is a very cost efficient and maintenance friendly opportunity especially if the seed filters are installed on top of the precipitation tanks. With a re-slurry in the filter discharge chute extension, the re-slurried seed can be guided not just in the precipitation tank under the filter, but through the connected pipe in any of the neighbour tanks. This increases availability and flexibility of the operation in combination with a minimum of extra equipment and extra cost.

Second, the BoVac Disc Filters of BOKELA have an optional design that allows for cake wash. In alumina refineries this design is used for fine seed wash. The current standard is still to wash the fine seed on drum filters that have two to three times the footprint compared to disc filters. This requires more space, bigger and thus higher CAPEX. Therefore, the ability of using disc filters for fine seed wash applications reduces both CAPEX and OPEX which is in line with reduction of energy consumption and associated reduction of the plant's CO₂ footprint.

Keywords: High Performance Disc Filter, Seed and Cake Wash, Seed Re-slurry, CAPEX Reduction, OPEX Reduction.

1. Introduction

Most alumina is produced using the Bayer Process to process bauxite and convert it into alumina and bauxite residue. This Bayer Process has several filtration steps as the following simplified process flow sheet shows (Figure 1).

Precipitation is a part of the refinery that can cover as much as six filtration steps which are:

- Product deliquoring (optional)
- Coarse seed filtration
- Fine seed filtration
- Fine seed rinse (optional)
- Fine seed wash (optional)
- Calcium oxalate filtration (optional)

The production requirement of a 1 Mt alumina refinery is about 200–400 t/h of fine seed, 1000–2000 t/h of coarse seed and 170–200 t/h of product. And many refineries produce 2–5 Mt alumina per year which results in the requirement of huge filtration areas for the duties mentioned above. The target values of all duties can be reached with vacuum filtration and do not need pressure filtration. This is beneficial to keep the OPEX low.

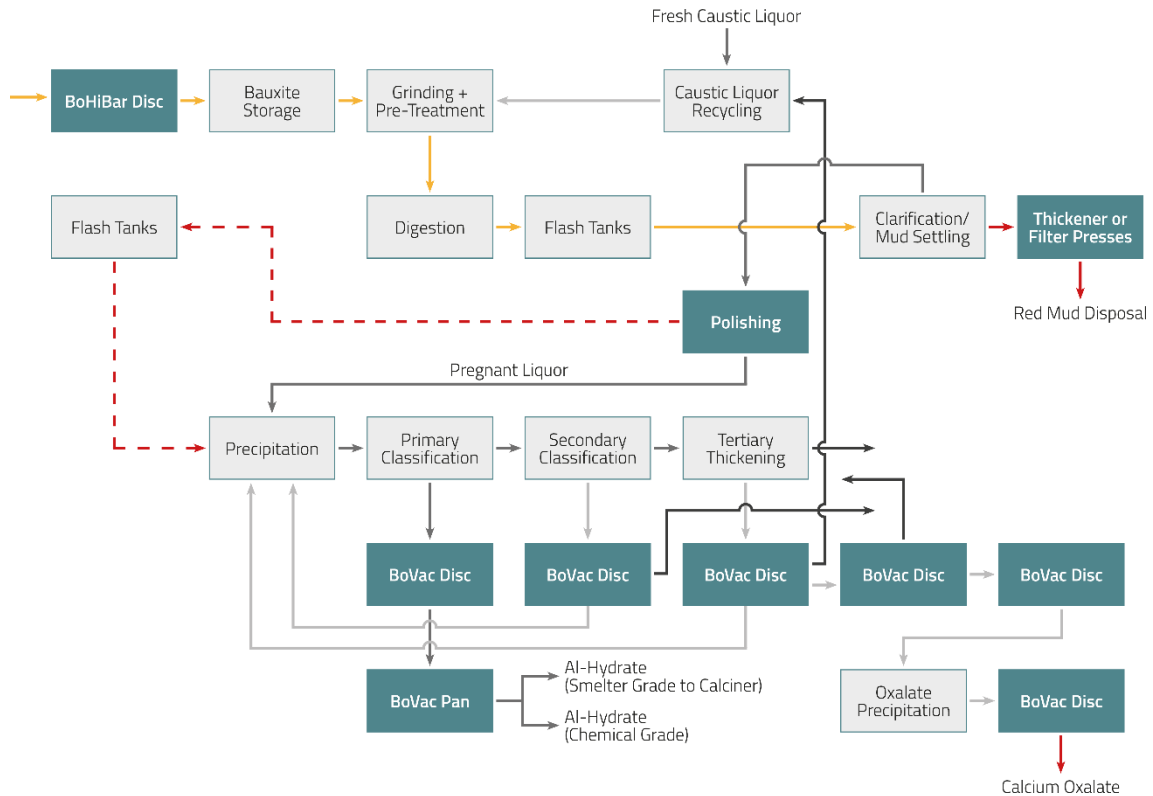


Figure 1. Simplified Bayer Process flow sheet.

From all vacuum filter types, disc filters provide the largest filtration area per unit and the highest filtration area per 1 m² footprint. This keeps the size of the filtration buildings small which results in low capital expenditure (CAPEX) if this filter type is used. Furthermore, there has been a technical development of the vacuum disc filters in the last decades. The standard design with 3.9 m disc diameter and up to 12 discs has been replaced in the 70's–90's with large diameter disc filter pushing the disc diameter to 5.3–6.0 m having a maximum of 3 discs. And finally at the beginning of the new millennium the high-performance disc filters [1] appeared on the market with disc diameters of 5.6–7.5 m and a maximum of 4 discs.

The special design features like:

- Joint single trough design (no agitator required)
- Fast exchangeable filter segments
- Pre-separation control head
- Adaptable form zone angle/vacuum
- Internal piping with low pressure losses
- Automatic operation without slurry overflow
- Online cloth wash while filter is in full production

result in:

- High speed operation (up to 6 rpm)
- Full cake discharge with low discharge pressure
- Adaptability to production requirements
- Integration in automated process control system
- Fast and simple maintenance
- Availability greater than 98 %



Figure 8. Cloth wash on BoVac Disc filters.

Finally, the filter should allow for maximum filtrate removal with minimum cake wash. All this supports the use of disc filters which are taking over as state of the art from drum filters in this duty.

5. Conclusion

Vacuum disc filters are running successfully in seed filtration applications in all alumina refineries worldwide. Especially, the development of the high-performance design at the beginning of this millennium with disc diameters of 5.6–7.5 m and a maximum of 4 discs solidified the leading position of this filter type. The special design features like joint single trough design (no agitator required), fast exchangeable filter segments, pre-separation control head (minimum pressure losses), adaptable form zone angle/vacuum, internal piping with low pressure losses, automatic operation without slurry overflow and online cloth wash while filter is in full production have resulted in high speed operation (up to 6 rpm), full cake discharge with low discharge pressure (25–45 kPa), adaptability to production requirements, integration in automated process control system, fast and simple maintenance and an availability of > 98 %.

Further developments in the last years are the additional chute extensions that allow for the solids re-slurry in these chute extensions. This supports the 30–40 % less CAPEX solution which puts the filters on top of the precipitation tanks. The pipe outlet of the re-slurry chute allows for connection with different precipitation tanks and solves the issue how to manage operation and cleaning of precipitation tanks.

Finally, the option of adding a cake wash system to the high-performance disc filters enable the use of these filters in fine seed wash duties. This is a further opportunity to reduce CAPEX by 30–50 %, if disc filters can be used instead of drum filters or horizontal belt filters which both require bigger filter buildings. Additionally, also OPEX is 20–30 % less with the use of disc filters. If all seed filtration duties are performed with only one filter type, this simplifies maintenance activities and spare part stocks.

6. References

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