The Road to a New Bauxite – Mine and Refinery Optimisation

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Abstract

The Rusal Aughinish Alumina (AAL) refinery is located on Aughinish Island on the shore of the Shannon Estuary 33 kilometres west of Limerick city in the South West of Ireland. The plant, commenced operation in 1983 and has a current production capability of 1.99 million tons per annum. It sources bauxite predominantly from Guinea, Brazil and Guyana and uses the Bayer process to produce Alumina. Since 2010, Rusal Aughinish has been preparing to move to a new bauxite Dian-Dian located in Guinea from a bauxite reserve owned by Rusal. This was an opportunity and a challenge for the company to deliver optimum production and costs for both the mine and the refinery without impacting adversely on product quality. It is well established that any change to the chemical composition of the bauxite requires careful assessment in a refinery operation. The detailed study carried out over a few years was used to determine the overall project scope for the mine and the refinery. The key objectives of the project have been to optimize bauxite quality and production while managing operational challenges such as equipment erosion in the digestion chain, mud throughput increase and impurities control. A state-of-the-art mining strategy, installation of dryers at the mine and a second bauxite unloader at the refinery capable of handling additional throughput, the implementation of an automated deep cone thickener in the mud circuit and capacity upgrade of the oxalate removal unit have played key parts in the successful transition to the new bauxite. This paper outlines how the transition to the new Dian-Dian (DD) was achieved.

Keywords: Alumina refinery, Dian-Dian bauxite, mine, deep cone thickener, impurities balance.

1. Introduction

Aughinish was commissioned in 1983 with a design capacity of 800 000 tonnes per annum. The refinery design was based on high quality dry CBG (62 %) and dry MRN (38 %) bauxites. Both bauxites had very high extractable alumina, well above 50 %, and a low level of organics, in particular MRN with Total Organic Carbon (TOC) three times lower than CBG. The refinery was designed using the best available technology at the time: a Kaiser digestion design, an Alcan precipitation design and Alcoa calciners were installed. A single chain was built originally and today the refinery is still operating on that single chain, but the production capability has been increased to approximately 1 990 000 tonnes per annum.

These design choices have introduced some operational constraints:

- The precipitation circuit only operates optimally if the circuit is oxalate-free.
- The organic and inorganic impurities removal units have a relatively small removal capacity and require low level of impurities input.
- The mud circuit and its equipment were designed for relatively low mud factor.

The selection of plant design and technology for an alumina refinery is generally based on the physical and chemical composition of bauxite supply. Bauxite handling, method of extraction of the alumina content, mud circuit requirement and control of bauxite impurities are just a few critical aspects that have to be considered in the plant design. For a chosen plant design and technology, production, costs and quality are optimised within constraints specific to the refinery.

Since mid-2018, a new bauxite is being supplied to the Rusal Aughinish refinery. This new bauxite is coming from Rusal's own "Dian-Dian" bauxite reserve. Since March 2019, Dian-Dian accounted for 60 % of the bauxite mix processed in the refinery. This achievement came through a thorough process of integration of the new bauxite for both the mine and refinery. Close collaboration between Rusal Management, the mine project and refinery teams was critical for the success of this transition.

The Dian-Dian project arguably started nearly 3 decades ago when exploration drilling and sampling was carried out in 1991. Feasibility studies were also carried out at various times in 1991, 2007 and more recently in 2013 by the Russian National Aluminium-Magnesium Institute (VAMI) or now called Rusal Engineering Technical Centre [1]. Conceptual studies were carried out by that AAL Research and Development department starting in 2010 to assess impacts on the refinery.

Since Rusal acquired Aughinish in 2007, one of the long-term objectives has been to increase Rusal's own bauxite to be supplied to its refineries. Over a period of 8 years, through close collaboration between various stakeholders (Rusal personnel on the mine project and at Rusal Aughinish) all design details were assessed, engineered and constructed at the mine and the refinery. This effort delivered a custom designed project fulfilling the requirements of all stakeholders at the mine and refinery while optimising the overall capital expenditure and operating costs. Figure 1 illustrates the process followed to deliver the transition to Dian-Dian.

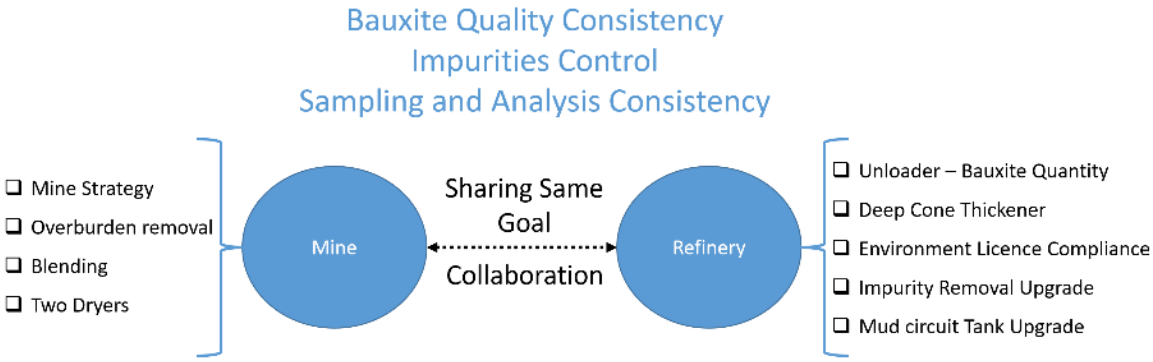

Figure 1. Process used to deliver transition to Dian-Dian Bauxite.

The result was a smooth transition with stable and consistent supply of bauxite quality with minimum disruption to normal operation at the refinery and more importantly, no production loss incurred at the refinery during the transition process.

- Longer turnaround times (3 - 5 years) and reduced maintenance.
- Significant savings on caustic recovery.

Additional advantages to Rusal Aughinish is that it enables upgrade of all other mud circuit tanks without compromising production stability.

7. Conclusions

Since 2010, Rusal Aughinish has been preparing to move to a new bauxite from the Dian-Dian mine located in Guinea from a bauxite reserve owned by Rusal. This was an opportunity and a challenge for the company to deliver optimum production and costs for both the mine and the refinery without impacting adversely on product quality.

The transition to Dian-Dian was successfully achieved by optimising the entire chain of operation from the mine to the refinery. This was delivered by having close collaboration between the mine project team, refinery personnel and Rusal Management.

The mine operation plays a key role in controlling the overall bauxite quality and level of impurities, particularly its organics content. Optimised alumina, silica and TOC content with low variability in bauxite quality was critical to the refinery requirements.

Rusal Aughinish upgraded specific production systems to improve the level of optimisation and a smooth transition was achieved while maintaining production, minimising operational disruption and avoiding any impact on product quality while optimising costs for the mine to refinery operation.

8. References

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