

Aspects to Consider in Alumina Refining Design

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Abstract

The aggregate demands coming from the internal and external stakeholders of any large scale industrial enterprise evolve over time. Designers of alumina refining plants (both greenfield and brownfield) must also be sensitive to these ever-changing demands.

Based on these perceived demands, three main criteria are then proposed, which intend to be responsive not only to internal business requirements, but also incorporate expectations from external stakeholders, such as regulators, social activists, government and non-government institutions and the public perception.

Firstly, the safety imperative: meaning the complete elimination of all kinds of workplace injuries and work-related illnesses.

Secondly, the environmental protection imperative: the minimization (elimination when practically possible) of emissions to air, water and soil.

Thirdly, the efficiency imperative: the need to minimize the utilization of natural resources and raw materials, and the need to maximize the recycle/re-utilize of all types of wastes.

These three guiding design criteria have an interesting nature. They do not compete among them, meaning that compromises and trade-offs are not necessary. The criteria are mutually supporting and reinforcing. Moreover, they do not exist nor can be sustained in isolation! Designing to eliminate injuries yields a cleaner facility, thus minimizing environmental emissions, and creates higher standards of efficiency. Cleanliness leads to more safety and higher efficiency. High efficiency, the efficient and environmentally desirable use of natural resources and raw materials and the recycle/utilization of by-products, creates a safer and cleaner environment, and in turn ensures the long term economic attractiveness of the business. Typically, more than three quarters of the total production cost of alumina are variable raw material costs, namely bauxite, caustic soda and energy.

Designers should be thorough when setting specific targets to meet the criteria. Using best past performance or industry benchmark data, with little insight on the circumstances the performance was achieved, is certainly not enough. One must initially understand, for each relevant parameter, what are the underlying scientific limits, unhindered by the limits of existing technologies. After this initial understanding, then the limitations and applicability of the best available technologies (BAT's) can be determined.

In 2015/16, a complete revision of a greenfield refinery design, the Companhia de Alumina do Para (CAP) project in Brazil, was performed in accordance to the criteria described above, clearly establishing zero injuries and zero environmental incidents as non-negotiable design goals, along with other traditional financial and non-financial performance parameters. "Simplicity" was the basic design concept adopted in all aspects and steps of study. The CAP refinery project design revision yielded, while meeting the safety and environmental imperatives, a lower capital investment intensity, a lower operational cost and an increase in output/unit, leading to an overall increase in the financial attractiveness of the project.

Keywords: Alumina refining design, safety imperative, environmental protection, efficiency.