Improvement of Discharged Water Quality by Alteo Gardanne

Laurent Poizat[1], Laurent Guillaumont[2] and Jean-Paul Leredde[3]
1. Project Manager Alteo Technology
2. Bayer Production Director
3. Alteo Technology Director
Alteo Alumina, Gardanne, France
Corresponding author: Laurent.poizat@alteo-alumina.com

Abstract
Alteo Alumina in Gardanne, France, first operated in 1894, is the oldest alumina refinery in the world. It has met many challenges in its lifetime, a notable example being the move to the production of specialty aluminas in the 1990s. The most recent challenge, the need to significantly decrease the plant impact on the environment to follow regulatory evolution and improve community acceptance of the site, has perhaps been the most difficult and complex. The improvements made during the last 6 years have been spectacular. Specifically, in 2015 the "red mud" discharged from the plant had a solid bauxite residue content of 75g/L, pH 12.5, dissolved aluminium 400mg/L, dissolved arsenic 350µg/L, COD 200 mgO_2/L and BOD5 100 mgO_2/L. In 2021, water discharged from the plant has a solid content of less than 0.035g/L, pH 8.5, dissolved aluminium is less than 1 mg/L, dissolved arsenic is 40 µg/L, COD 50 mgO_2/L and BOD5 10 mgO_2/L. The various stages that made these dramatic improvements possible, and why these options were chosen at the time will be reviewed.

Keywords: Alumina production, Environmental performance, Bauxite residue, Waste water, Reduction of environmental impact.

1. Introduction

The environmental impact of alumina refineries, whether actual or perceived, poses a significant threat to the existence of the industry. Specific greenhouse gas emissions, although significantly lower than the downstream smelting of aluminium, will need to be reduced to meet ever tighter regulations as climate change will no doubt be the main driver for new policies. Other improvements need to be made on various emissions like NOx or SOx from steam production or calcination, while dusts from bauxite, alumina or bauxite residue need to be under better control.

The main issue that the industry faces however, is arguably the handling of the large quantities of bauxite residue (red mud) generated by the Bayer process. Several significant spills and incidents have raised awareness in the general public about this waste, and it is generally perceived as "hazardous", although it is most of the time not the case for the solid part. The Ajka accident on the 4th of October 2010 [1], involving 10 fatalities, comes obviously to mind together with more limited and recent events.

Most, if not all, alumina refineries in the world have been under increasing pressure in the last 20 years to better manage their residue discharge stream and stored bauxite residue [2] to decrease hazards for local communities and environments. Significant investments and extra operating costs are necessary to comply with ever more challenging regulations. This weighs on a site's balance sheet at best, and can put refineries out of business at worst. If the reduced discharge concentrations requested cannot be met, operating permits might not be renewed.

As most alumina production sites have been struggling with this for many decades, this paper documents what has been done at Alteo Gardanne, France, to very significantly improve the discharged water quality.

The Gardanne refinery was the first industrially operated Bayer process in the world, beginning operations in 1894. For most of its history it has been part of the Pechiney group, but since 2012 has been operated by Alteo, which has been recently acquired by UMS Group.

Along the way, several modernization stages and production increases have taken place, including a major step that took place in 1966. Since then, and for almost 50 years most of red mud has been discharged through a 55 km pipe to a discharge point 7 km offshore and 320 m deep into the Mediterranean Sea, as per Figure 1.

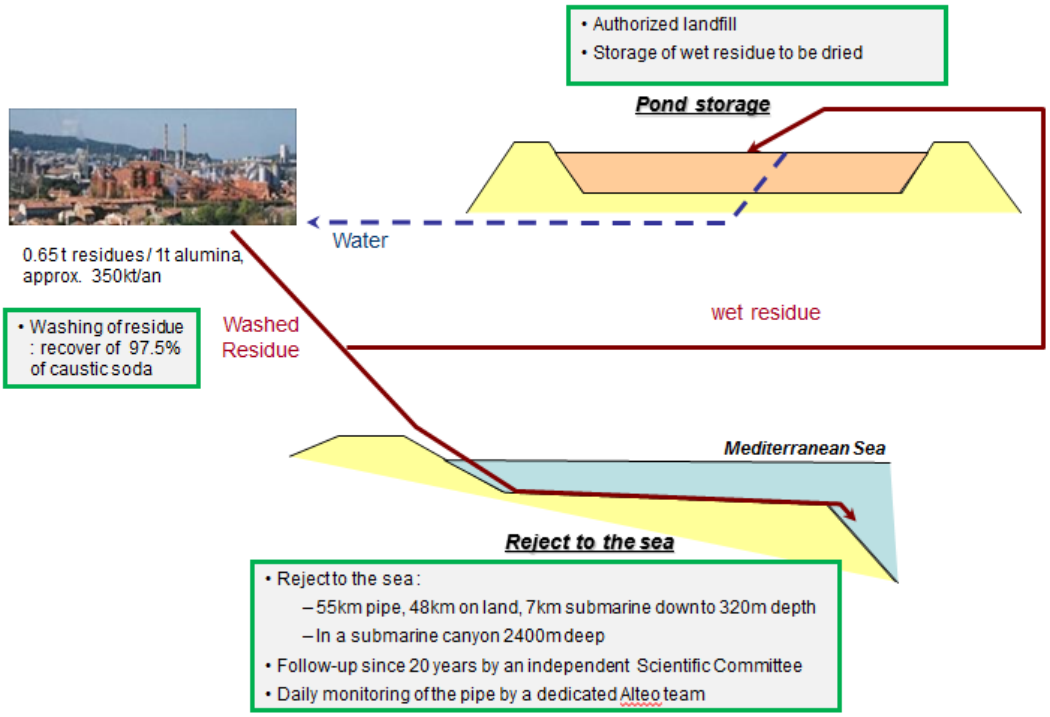

Figure 1. Pre-2008 management of bauxite residue and wastewater.

Since 2015 a major environmental transformation has taken place, with the achieved improvement in water quality summarized in Table 1. The improvement was done through several significant investments, as described in the following sections, including a preparatory stage from 2008 to 2015 with filter pressing a part of the residue flow.

Table 1. Improvement of water quality discharged in a sea trench

	2015	**2021**
pH	12.5	8.5
Suspended solids (mg/l)	75000	35
Dissolved Al (mg/l)	400	1
Dissolved As (mg/l)	0.35	0.04
COD (mg O_2/l)	200	50
BOD5 (mg O_2/l)	100	10

For reasons other than the success of the improvements reported here, Alteo is currently undergoing a transition to stop digesting bauxite and switch to an aluminium hydroxide feedstock, as the best way to continue serving our specialty alumina markets and customers.

8. References

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