Towards Sustainable Zero Waste in Alba

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Abstract

Spent pot lining (SPL) material is a hazardous waste generated during the process of aluminum smelting. SPL is toxic material that is contaminated with cyanide and fluorides. In many cases, landfilling is the conventional methodology of handling this waste, which is not a sustainable solution.

ALBA has taken the lead to construct and implement the first of its kind technology in the GCC region to process and detoxify the SPL and convert it to a valuable additive material for the cement industry. This paper discusses the project development and the challenges aroused during the project evolution. It will also focus on the process flow and the detoxification methodology as well as the final product and its specification. Finally, the paper will discuss the marketing of the final product and its benefits and impact on cement industry.

Keywords: Aluminium smelting, Spent pot lining (SPL), Solid waste, Clinker, Zero-waste.

1. Introduction

Solid waste generation and management has become a serious issue of concern, especially in aluminum smelters where it represents one of the intractable environmental challenges. Aluminum smelters are in the heart of industries where different types of solid waste are being generated part of which are being hazardous waste. Typical solid waste generated by aluminum smelters are Carbon Dust, Cast Iron Slag, General Waste, Refractory Waste, Construction Waste, Spent pot lining (SPL) and others. SPL represents around 50% of the total solid waste generated in the aluminum smelting process.

SPL material is comprised of carbon and refractories and has been categorized as hazardous waste by many regulators as it exhibits several characteristics that make it toxic. Carbon cathode gets contaminated with fluorides and cyanides during the operation of the reduction cells, and these contaminants have the potential to leach into the ground water if the material disposal is not managed well. Additionally, SPL reacts with water to generate a strong basic solution that is highly corrosive and also emits flammable and explosive gasses in the process such as methane and hydrogen and toxic gasses such as ammonia. Figure 1, SPL removed from the reduction cell.

Figure 1. SPL removed from the reduction cell.

Disposal of SPL has been carried out conventionally through either landfilling direct, or washing in sea water before taking the material to a landfill. It requires the material to be landfilled in specifically engineered landfills that are fully insulated and designed to prevent contamination of soil and ground water. These methods have become unfavorable by many environmental regulators and more sustainable methods are sought that encourages sustainable solutions and the full recovery and conversion of the material to useful end products with zero-waste output and very low environmental footprint.

SPL mainly contains carbon (40-50 %), fluoride at around (10-18 %), aluminium (10-13 %), and cyanide (0.7- 4.5 %). Such material can be useful in certain processes like cement and steel industries that is both economical and environmentally sound [1]. The most valuable constituent in this case is the fluoride which serves to lower the temperature of clinker in the cement industry and improves the formation of complexes inside the clinker [2] so that a higher yield of Portland cement is obtained.

2. Exploring the Optimum Process for ALBA's SPL Treatment

The journey to reach and identify the most suitable SPL treatment process for ALBA has taken almost a decade where a common effort with the GAC smelters was started in 2008. In 2009 ALBA sent a team to evaluate many different processes/approaches by which SPL was being handled. The team concluded that the processes/approaches evaluated then were neither mature nor complete. Nevertheless, ALBA management didn't stop the effort and started again to look into the possibility of collaborating with a small cement plant available in Bahrain. Unfortunately, this collaboration didn't grant the aimed result due to the small size and other limitation with the cement plant. ALBA's efforts continued into 2017 where some potential processes were identified again and an evaluation process started.

2.1 Technology Selection

After shortlisting the potential treatment processes and associated technology suppliers, it was decided to approach three suppliers to evaluate their offerings and to short list a recommended supplier. Based on the thorough analysis, technology benchmarking and due diligence, REGAIN technology was selected. REGAIN technology has been handling Tomago smelters SPL since 2003.

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