recovering caustic and alumina from red mud with IsaMills™

A Long Term Problem

The production of alumina from bauxite has changed very little since the discovery of the Bayer process, in the late 1800's. The process involves bauxite minerals being digested by washing with a hot solution of sodium hydroxide, converting the alumina to aluminium hydroxide which in turn dissolves in the solution:

$$Al(OH)3 + NaOH(aq) \leftrightarrow Na^{+}Al(OH)4^{-}(aq)$$

The impurities associated with the alumina, mainly silica, iron oxides and titanium oxides, do not dissolve, and are able to be separated from the solution through filtering and washing stages, while the aluminium hydroxide solution is further processed to become alumina. The undissolved solids, called red mud, are separated from the hydroxide solution and are pumped to tailings dams or holding pans. Approximately 70 million tonnes of red mud are generated each year.

However, during the process some of the caustic and alumina is lost to tailings and cannot be separated from the red mud. A lot of the alumina and caustic is lost through the formation of insoluble silicate compounds which cannot be dissolved with simple washing techniques. Depending on the ore type and the reactivity of the silicates in the ore, up to 40% of the red mud consists of caustic and alumina silicates – a considerable waste of reagent and revenue. Not only is this a waste of valuable materials, but it also poses a risk of the caustic eventually leaching out of the red mud over time.

While there has been ways to limit the caustic and alumina lost to the red mud, involving hydrometallurgical and pyrometallurgical processing routes to convert the silicates into soluble compounds, the processing techniques generally are expensive using large amounts of reagents and/or elevated temperatures with varying degrees of caustic and alumina recoveries. Some techniques have used ball mills to mechanically activate the surface of the silicates to enable them to be more amenable to leaching, but the low power intensities of ball mills require long residence times to achieve this, making them ineffective.

A New Approach

The adoption of IsaMilling technology for fine grinding of base metals in the early 90's allowed new deposits to be processed that were recognised as being uneconomic to treat. Ultrafine grinding down to 7um could not be considered with ball milling, but with the high intensity stirring action of the IsaMill™ coupled with high energy efficiency, enabled the deposits of McArthur River and George Fisher to be developed.

In a similar fashion, the IsaMill™ offers a chance to economically recover the caustic and alumina locked in the red mud tailings. With high power intensities not achievable with ball mills, the IsaMill™ can be used to mechanically activate the insoluble silicates through the attrition grinding action of the mill, permitting leaching to occur and enabling the caustic and alumina to be recovered, without the need for high temperature or specialised reagents. Also the small residence time of the mill combined with the sharp particle size distribution achieved by the mills' internal particle separator, allows for small circuits to be designed for the treatment of red mud.

Full scale IsaMills™ can be accurately scaled from lab scale units, up to the largest of the IsaMill™ range, the 3MW M10,000 IsaMill™. In addition, pilot scale IsaMills™ can be easily installed in a plant, and various streams in the circuit can be treated individually through the IsaMill™ to determine the optimum stream that should be treated to maximise caustic and alumina recovery.

For enquires about IsaMills™ or IsaMill™ testwork in your operation please contact:

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