Enhancing Hydrate Properties to Cater New Age Hydrate Applications

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Abstract

Aluminum Tri Hydrate (ATH) is commercially produced by conventional Bayer process. Apart from the main usage in the manufacturing of Calcined Alumina it is also used in multiple applications and acts as a versatile material. While surface area and particle size distribution are the two major quality control parameters for ATH in different applications, whiteness and brightness have also become critical now a days to cater the stringent requirements of different industrial applications like solid surface, artificial marbles, and cable industries. Whiteness is important as it is effectively contributing to the surface opacity, smoothness, and inking. Belagavi Alumina Refinery of Hindalco Industries Limited is the largest producers of chemical grade (specialty) hydrate and alumina in India. Mainly the ATH goes for specific applications like Flame Retardant Filler in Cables, Solid surface, and other polymeric applications, higher the whiteness and brightness, higher is the demand. The major contributing factors for the final whiteness/brightness of ATH are the different organic compounds/ impurities which are part of the process liquor. Hence one of the solutions for increasing whiteness/brightness is to arrest these colours bearing organic impurities and removing them from the liquor. To respond the needs of the customers, Belagavi Refinery and its R&D team worked in collaboration with Nalco (Ecolab) technical team on developing a solution. M/s Nalco (Ecolab) has developed a program which has got the ability to selectively remove coloured organics from Bayer liquor and thereby improving the final colour properties of ATH. This product was tested at R&D centre and found satisfactory. The lab test procedure was developed indigenously after multiple iterations. Based on these encouraging laboratory results a plant trial is under progress at this Refinery with required checks and controls. The expected outcome is improvement of whiteness of ATH from the current level by ~ 10 %. The same will also be reflected in the reduction in the absorbance of the liquor to the tune of 50 % at controlled dosages appx 15–20 ppm. This paper outlines the pioneer work done to develop a process to evaluate the outcomes in the whiteness and brightness in ATH.

Keywords: Brightness, Whiteness, Brightness aid, Alumina trihydrate (ATH).

1. Introduction

Belagavi refinery has been processing bauxites from indigenous as well as imported sources. Owing to inherent characteristics resulting in variations, it poses a challenge to maintain steady process to achieve the product quality meeting the stringent specification. One such parameter is hydrate brightness, which is mainly dependent on the impurities in liquor. The Brightness and whiteness index in ATH is vital in the application of solid surface, artificial marbles, and cable industries. The Brightness and whiteness index were measured by Datacolor 500. ColorMate provides high speed reflectance measurement of powder samples in the range of 400 to 700 nm. Reflectance values at 460 nm is the brightness index and the average reflectance is whiteness index. In the cable application, cables are marked with specific colours to meet the safety and legal requirements. Whiteness index are a compromise between colorimetry and brightness measurement. Colorimetry is a cumbersome but complete three-dimensional description of whiteness, whereas brightness is simple to understand and convey but relates only to the blue portion of the visible spectrum. Whiteness indexes have the advantage of being single number quantities that are based on the entire visible spectrum. Belagavi has been exploring options by process modifications and engineering controls. All these mitigation measures have been yielding marginal success. This is mainly because Belagavi Refinery has not undergone any expansion and has been continuously running since last fifty years with old technology.

Recently Belagavi plant has been working closely with M/s Ecolab towards reducing the organics in liquor by studying various options like the usage of additives such as humate removal aid, additives like MOJO DVS4C013 etc. to improve brightness and whiteness.

2. Laboratory Trial

Belagavi refinery has been processing bauxites from indigenous as well as imported sources. These bauxites have varying quality and hence it becomes a challenge to maintain the product quality and efficiency numbers by suitably blending them. One such parameter is hydrate brightness, which is mainly dependent on the impurities in liquor. Belagavi has been working closely with HICA in reducing the organics in liquor by studying various options for improving brightness including the use of chemicals such as humate removal aid etc. One such chemical, MOJO DVS4C0131 supplied by Ecolab Water was received at HIC-A and used for trial to improve the hydrate brightness. Plant blow-off slurry was treated with MOJO chemical and filtered. Treated pregnant liquor was used for hydrate precipitation, trial was repeated for 3 cycles and results were compared.

Fine and coarse seed: Fresh fine and coarse seed were collected from plant, washed to remove soda, dried and used for test work.

MOJO DVS4C013: MOJO DVS4C013 chemical from Ecolab Water received was used as per the procedure 1 given by Nalco Waters.

Hydrate samples collected from each cycle were tested for colour properties, the brightness index (BI %) and Whiteness Index (WI %) as obtained from the trial is shown in Figure 1.

Above trend of brightness and whiteness is showing an increasing trend. Significant enhancement was observed in brightness and whiteness by 5 % and 10 % respectively after 27 days from the start of the trial. This additive dosing is being continued and the impact is under critical observation.

4. Challenges

Major challenges for any Alumina Refinery are to maintain the oxalate concentration in liquor below the critical Oxalate level (COC) while maintaining a higher productivity precipitation circuit. Belagavi Refinery operates through both agglomeration and growth mechanism and thus maintaining the overall temperature profile of the circuit, it controls impurity precipitation. It also runs a dedicated oxalate removal unit to keep the oxalate concentration in liquor below COC.

However, there is an adverse impact of MOJO DVS4C013 in Bayer liquor where this chemical tends to bring down COC suddenly due to its chemical reaction. Hence the doses must be optimized based on the Refinery conditions. So, in this case, the doses of this chemicals were also maintained at an optimized level to avoid any oxalate precipitation related issues. To achieve this, oxalate COC level was monitored on weekly basis and based on delta of COC vs actual oxalate value, dosage was optimized.

5. Conclusion

Coloured organics are common contaminant within the Bayer process which generally is produced from organic matter present in bauxite. These coloured organics reduce the whiteness and Brightness index in product Hydrate. Consequently, most plants spend considerable time and resources to manage and control the formation and removal of organics in liquor. As Belagavi refinery produces chemical grade of ATH the colour property is vital parameter. Critical control for any alumina refinery specific process control logic and process control measures has been established here through continuous measurement of the liquor oxalate level and COC through which the final doses which can be achieved and sustained was fully optimized in the plant. The same technology can be applied in the other refinery also to control the organic impurities to achieve better colour property in terms of brightness and whiteness in product hydrate.

Control of organic liquor loading results in higher liquor stability. The interference of organics with precipitation kinetics and yield are well known. Such contaminants also deactivate seed crystals often causing disturbances in product quality. With the above program, the physical properties of hydrate can be enhanced.

6. References

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