Process Solutions to Improve Sintering Kiln Performance

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Abstract

Kamensk-Uralsky Alumina Refinery uses thermal causticization to compensate for the caustic soda losses. The thermal causticization process implies sintering of soda ash and Middle Timan Bauxites (STBR) in a rotary kiln producing sodium aluminate to feed to the Bayer process. The high recirculation load of fine dust from the external gas treatment system to the cold end of the kiln leads to significant dust losses including alumina and soda. The paper proposes a solution to reduce the circulating dust load by binding dust from the external gas treatment system in the forms of briquettes. During the studies, physical and chemical parameters of sintering dust were determined and laboratory tests on dust briquetting were carried out with/without the use of binding agents. An effective dust briquetting process was developed. At the laboratory scale the tests on briquette baking with subsequent sinter leaching were performed.

Keywords: Sintering, Bauxites, Briquetting.

1. Introduction

Production of alumina from low-grade bauxites requires an additional process area, i.e. sintering of alumina-containing mixtures. The sintering area is one of the most energy consuming areas in alumina production [1].

It should be noted that to be competitive in the global market, the alumina and aluminium industries must reduce power consumption and cash cost of the products. Therefore, reducing fuel consumption is an important line of research of alumina production processes.

Process solutions, which promote the enhancement of the sintering process and are associated with changing the process flow diagram, mixture preparation processes [2], generation of the optimal phase composition of nepheline sinter [3] are well under development and require significant capital investments. The sintering process for bauxite mixtures requires that the process dust captured in the external gas treatment system is returned to the cold end of the kiln [4]. This results in the circulation of a high dust load in the “sintering kiln – external gas treatment” circuit. The process dust, which is directed to the cold end of the kiln, is heated by the kiln exhaust gases, then it gets into the external gas treatment system, cools down and is supplied to the cold end of the kiln again, thus consuming the heat required for mixture heat treatment.

The authors determined the properties of the gas-and-dust flows at the outlet from the kiln, thus demonstrating that depending on the kiln performance and specifics of the kiln shell shape, dust circulation amounts to 17 % - 45 % of kiln capacity.

The assessment of the sintering heat balance [1] shows that approximately 30 % of the heat is lost with off-gases and circulating dust.

There are various solutions to reduce the unwanted circulating dust load in the kilns [5, 6]. One solution is to granulate dust from the gas treatment system with drum, disk or other type of granulators with further supply of granules to the kiln. Thus, cement industry uses granulation of the dust from the clinker furnaces [7, 8] with further returning the dust granules to the process.

Raw granules need to shall be roasted to improve the strength properties of the granules [9]. Unroasted granules lack the mechanical strength required to transfer them to the cold end of the kiln. Moreover, to ensure the required mechanical properties of the granules, the binding agent should be added in most cases. However, owing to the properties of the dust in the external gas treatment system, the binding agent, which is added to the process, cause blockages of the granulator leading to the disruption of the production process.

An alternative to the granulating would be briquetting of the circulating dust.

This pelletizing method proves to have at least two advantages as compared with granulation, i.e. briquettes have an identical regular shape and demonstrate better transportation properties; additionally, they do not need to be roasted [10, 11].

So far, briquetting the dust from the sintering kiln gas treatment systems of alumina production has received almost no attention. One more objective of this research is to evaluate the prospects of using the briquettes as a raw material for sintering kilns of alumina refineries.

Thus, this paper presents the results of laboratory tests to develop the briquetting technology as well as to evaluate the properties of the sintered material obtained from the briquettes.

2. Laboratory Research of Briquetting Process

2.1 Properties of the Materials

The bauxite mixture sintering area is arranged so that the dust from the kiln is supplied to the stage-wise dry scrubbing around the "dust chamber – cyclones – electrostatic precipitator" circuit [12]. All dust captured at different gas treatment stages is directed to the screw feed of the dust collector. Thus, this circulating dust consists of coarse particles from the dust chamber, finer fraction from the cyclones and fine dust captured from the electrostatic precipitator.

For laboratory testing two different samples of circulating dust were used, i.e. circulating dust from the cyclones and electrostatic precipitator (Sample 1) and total circulating dust from sintering kilns comprising the dust from the dust chamber (Sample 2). Prior to the laboratory tests dust samples were analyzed to determine chemical properties by X Ray Fluorescence (XRF) and particle size distribution (PSD) by sieving. Table 1 presents the PDS of the dust samples.

Laboratory tests show that the process for briquetting the circulating dust from the sintering kilns can be introduced on an industrial scale to improve the performance of the sintering kilns and external gas treatment system. and thereby maximise fuel efficiency and reduce alumina and soda losses.

5. References

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