Experience Driven Design Improvements of Gas Suspension Calciners

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Abstract

FLSmidth has experience with Gas Suspension Calciners (GSC) over the past 40 years from different hydrate sources calcined in both pilot and full scale Gas Suspension Calciners of various design and capacity. This paper outlines the design changes in cyclone dimensions to lower the gas velocity to reduce pressure drop & wear on vortex finder and to minimize the risk of particle breakdown; redesign of riser ducts to reduce the peak velocites to minimize the Particle Break down, Pressure drop & wear; improved refractory design to minimize radiation loss, thereby reduction in thermal energy consumption and other improvements in calciner such as optimized holding vessel, start-up burner relocation etc.

Keywords: Alumina, Calciners, Thermal, Energy, Consumption.

1. Introduction to Gas Suspension Calciner with 4 Direct Heat Recovery Stages

Calcination is the final step of the Bayer process where alumina is produced from aluminum trihydroxide (Hydrate, Gibbsite). After calcination, alumina is sent to a smelter where pure aluminum is produced.

In 1976 FLS had commissioned the first industrial Gas Suspension Calciner (GSC) technology for the pre-calcination raw meal (~70% limestone fines) in a new 4600 tpd Cement clinker production line in Japan. The pre-calciner operating temperature was about 950^{o} C with few seconds of solid retention time.

Since the basic research and development work and prototyping of the gas suspension calcination technology was developed and done for cement raw meal it was relatively straight forward in 1976 for FLS to adopt this calcination furnace/reactor technology for alumina production.

2. Gas Suspension Calcination

The timing of this technology spin-off was very fortunate as FLS had lost its dominating world market position for supply of rotary kilns for production of sandy or floury alumina when the last rotary kiln for alumina was contracted in 1974.

Ten years after FLS started the development with pilot plant testing in 1976, the first GSC unit with a calcining capacity of 1000 TPD and calcination furnace temperature around 1050^{o}C for Smelter Grade Alumina (SGA) was commissioned at Hindalco [1]., India in 1986, replacing three old FLS rotary kilns.

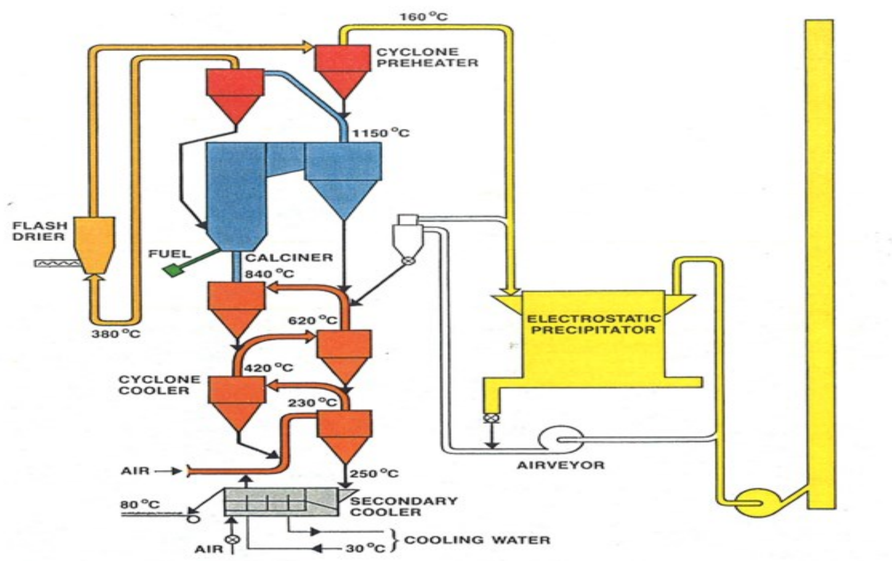

Figure 1: Gas Suspension Calciner Vertical arrangement.

The First GSC technology is a vertical arrangement comprises (Figure 1) of:

- Drying and Pre-heating/Pre-Calcination (PO1, PO2) of Feed material
- Calcination Furnace (P04) and Furnace Cyclone (P03)
- Direct Heat Recovery from alumina by cooling with Air in Four (4) stage Cyclone cooler;
- Indirect alumina cooling with water in a Fluxo Cooler.

In 1986, Eurallumina, Italy, decided to retrofit one of three Ø3.95 x 107 m long rotary kilns producing 900 tpd sandy alumina with an oil fired GSC unit to produce 1550 tpd SGA. The specific energy consumption was reduced to 3100 kJ(LHV) per kg SGA from about 4100 kJ(LHV) per kg sandy alumina. The alpha-phase content was reduced from about 18% in the sandy alumina to 2-5% in SGA for the same SSA and the LOI (300-1000 °C) was reduced from 0.8% to 0.55-0.65 wt %.

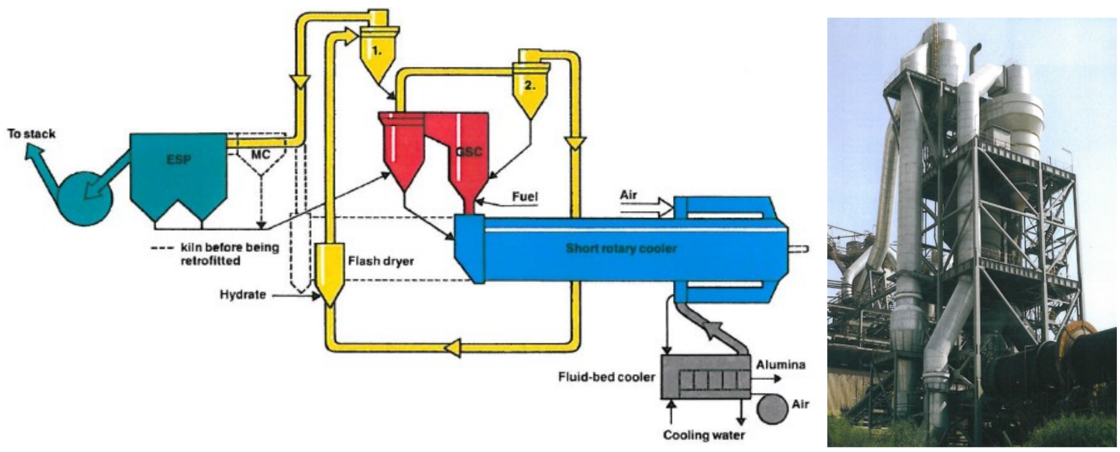

Figure 2a. GSC Retrofit converting rotary kiln to rotary cooler, Eurallumina, Italy.

In the global alumina market rotary kilns were replaced with new stationary calciners, but some were retrofitted to more energy efficient operation and higher production capacities Figure 2a.

4. Conclusions

With the improved design changes of:

- Cyclone design optimization
- Redesign of riser ducts in GSC
- Improved refractory design
- Optimization of holding vessel
- Redesign of distribution box

the specific energy consumption shall be reduced less than 2650 kcal/kg and particle break down of -45 micron less than 4%.

5. References

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