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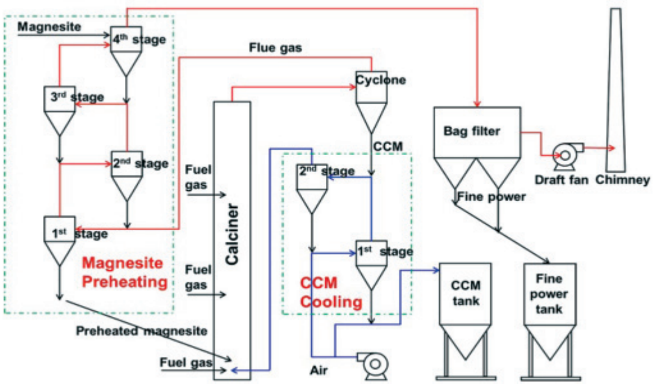
Energy-saving innovation for magnesite transport bed flash calcinations (TBFC) process

Magnesite is a mineral with the chemical formula $MgCO_3$. Iron, manganese, cobalt and nickel may occur as admixtures, but only in small amounts. Magnesite has a chemical composition of $MgCO_3$, and when it is heated it will dissociate into MgO and CO_2. MgO has an extremely high melting temperature, and that makes it a good refractory material in many steelmaking, metallurgical, and ceramic processes. MgO is one of the most commonly used materials for making the bricks used to line kilns, industrial ovens, and blast furnaces. MgO is also used to make fertilizers, magnesium chemicals, and refined into magnesium metal. In the magnesite-based industry, light calcination of magnesite is the first step, which occurs at about 1000°C to obtain the caustic calcined magnesia (CCM, mainly composed of MgO). Here, the term "light" means at relatively low temperatures. CCM is the feedstock for the production of downstream high-value products, such as silicon-steel magnesium oxide, magnesium hydroxide and magnesium cement. In the TBFC magnesite preheating and CCM cooling are respectively 4 and 2 stages, leading to the energy consumption of 4100 kJ/kg-CCM and the energy efficiency of 66.8%, which is almost doubly higher than the 33.9% of the conventional reverberatory furnaces (RF). The TBFC process is mainly composed of a calciner implementing the light calcination of magnesite, a magnesite preheating system and a CCM cooling system. In the preheating system, the fed magnesite is heated by flue gas from the high-temperature calciner. While, in the cooling system, the high-temperature CCM is cooled down by air sent to the calciner. Herein, a schematic of the TBFC process with two-stage cooling and four-stage preheating is given as an example and shown in the Figure. While TBFC is an innovation over RF, in a new development TBFC is attached with a cyclone-type preheater to preheat the fed magnesite where the particles and gas first proceed heat transfer in the heat-exchange pipe and then they are separated in the cyclone.

For TBFC, the preferred process arrangement is proved to be four-stage preheating for magnesite and two-stage cooling for CCM, and the corresponding energy consumption is about 4100 kJ/kg-CCM and energy efficiency is 66.8%.



Featured by staged combustion of fuel gas, TBFC process with 2-stage cooling and 4-stage preheating

Energy efficiency of TBFC is 66.8%, almost doubly higher than 33.9% of traditional RF

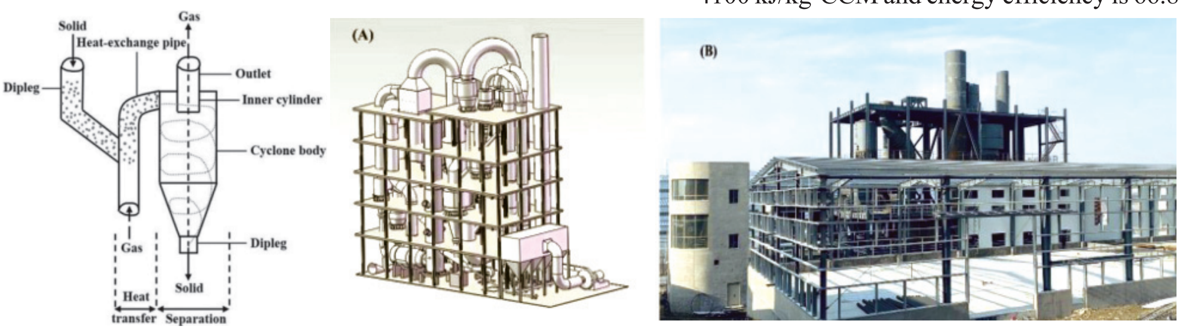


Fig.: A schematic drawing of the cyclone preheater and the TBFC plant under construction

Source and acknowledgement: Ping An, et al. "Energy-saving strategy for a transport bed flash calcination process applied to magnesite" Carbon Resources Conversion, March 2021.