Mineralogical Impact on Pelletization Process of Indian Iron Ores

Pallishree Prusti
Roll No.: 19CH91S01

ABSTRACT

To achieve the national target i.e., 300 million tonnes per annum (MTPA) of crude steel making by 2030–2031, India has to depend on low and lean grade iron ore resources. These low and lean grade iron ores are liberated at finer sizes. Pelletization process is the only alternative to utilize the fines of ≤150 μm. In this thesis, the effect of temperature profile in the pellet induration is extensively studied for the pelletization process using Indian iron ores with variable mineralogy. The impact of mineralogy can also be controlled with proper binder or additives dosage. Pellets were prepared from a magnetite concentrate beneficiated from a banded magnetite quartzite (BMQ) ore at variable induration temperatures (800-1250 °C) and their mineralogical conversion was analysed. The concentrates produced using different beneficiation routes have momentous role on the pellet quality. The subsequent effects on pellet characteristics were compared by the pelletization of concentrates generated from a Banded Hematite Quartzite (BHQ) adopting two different routes such as, conventional beneficiation and reduction roasting-magnetic separation. Indian goethitic-hematite ores are inbuilt with high loss on ignition (LOI) due to the associated goethite and kaolinite. LOI needs to be completely removed before entering to the firing zone of pellet induration process. Otherwise, residual LOI in the preheated pellet leads to poor quality due to cracking and breaking. The impact of LOI in drying and preheating zones has been studied with three iron ore samples with variable mineralogy. The preheating temperature and rising time were optimized for the complete removal of LOI. A mathematical correlation has been developed to predict the residual LOI w.r.t. its dependant variables like goethite and kaolinite (wt., %), preheating temperature and rising time. The fitted empirical equation is found with 0.07 RMSE and 0.9679 coefficient of determination (R^2). The preheated pellets were characterized for cold compressive strength (CCS), porosity, Fe %, FeO % and morphology through optical microscope, x-ray micro-CT, SEM-EDS, and XRD. The impact of additives to produce requisite pellet's quality are studied varying the dosage of appropriate fluxing agents (dolomite and limestone) in terms of their physical, mineralogical, chemical, and metallurgical properties. The work carried out here can be real-world application from the prospective of sustainability and conservation of natural resources as well as ecological perception for the current pellet making industries.

Keywords: *Mineralogy; Indian iron ore; Pelletization; Loss on Ignition; Goethite; Kaolinite; Preheating; Fluxing agent.*