

## **ABSTRACT**

Iron ore deposits are finite, non-renewable and irreplaceable natural resources and with fast depletion of high grade iron ore; conservation of iron becomes our prime focus area to increase mine life. India has huge reserve of iron ore. 35 pct of reserve is low-grade iron ore at present. Additionally, Indian iron ore deposits are partly soft and friable in nature. Mechanized mining and subsequent crushing, grinding and beneficiation result in generation of fines accounting for around 70 pct of the total production of the country's iron ore. Simultaneously, Coal is an important raw material of steel sector having an issue like limited sources of coking coal and huge amount of inferior quality of non-coking coal.

Since 2018, India is a second largest producer of steel in world. Iron and steel industry's growth in India has been recorded exceptional in the past and present decade. The industrial development programmed of any country, by and large, is based on its natural resources. Natural resources are depleting due to its high demand. To meet demand of steel industry, beneficiation of low-grade iron ore can be one of solution. Mineralogical studies play important role for designing flow sheet of beneficiation. Beneficiated iron ore are available in fine size only which can be used as agglomerates. Cold bonded composite briquettes / pellets can use iron ore and coal fines. In last two decades, composite agglomerates are getting popular due to its advantages like: fast reduction rate, consistent product quality and pollution control by using fines.

Due to scarcity of good quality iron ore and coking coal, smelting reduction processes are alternative of blast furnace ironmaking/steelmaking. Smelting reduction process has flexibility in quality and grades of raw materials. Such process can be set up at small scale level which not feasible in BF ironmaking.

In present study, an attempt was made to utilize low grade iron ore for ironmaking/steelmaking. Two different types of low-grade iron ore: Odisha (BHQ) and Rajasthan (Goethite) were taken to beneficiate. Ore is upgraded from 53.1 pct to 60.26 pct with iron recovery of 59.75 pct. Rajasthan ore is upgraded by magnetic roasting by coke (high in ash) and charcoal (high in volatile matters). Ore is upgraded from 33 pct to 49 pct with recovery of 90 pct by both carbonaceous materials. Based on combination of ore and carbonaceous materials; four type of composite briquette is prepared from Rajasthan ore

and coke / charcoal. Compressive strength of BA composite briquette is achieved 1170 N/briquette with low shatter index.

Isothermal and non-isothermal studies are carried out for Rajasthan ore with pre-decided variables. BA composite briquette has obtained highest activation energy. SEM and XRD analyses are carried out to identify phases generated or transformed during reduction process.

Smelting reduction studies are employed to extract iron from iron ore. Composite briquette is charged in molten steel bath in induction furnace with different proportion. Iron yield is achieved 90 to 95 pct at research level which signifies positive outcome for utilization of low grade iron ore and coke. Composite briquette can utilize in iron and steel making by additional source of iron and oxygen. Bulk dissolution of composite briquette helps to reduce steel making temperature.