

***Completion Report***

*on*

**Utilization of Coal Gangue to Develop Porous Adsorbents for CO<sub>2</sub> Capture**

**Project Code: CU-60**

**Submitted To:**

The Ministry of Coal

Scheme: Project Proposal for S&T Grant of MoC



**Submitted By:**

Dr. Himanshu Sharma & Dr. Raju Kumar Gupta

Department of Chemical Engineering

**Indian Institute of Technology, Kanpur**

Kanpur, UP-208016

and

**Bharat Coking Coal Limited, Dhanbad**

**January 2025**

## Summary

In coal mines, a large quantity of coal reject is produced. Low utilization of abandoned coal reject creates momentous pollutions in the environment. Higher content of silica and alumina makes the coal reject to a valuable feedstock for adsorbent production for CO<sub>2</sub> capture. In this study, adsorbents were synthesized from coal reject for CO<sub>2</sub> capture from a simulated gas mixture (CO<sub>2</sub> and N<sub>2</sub>) using a packed-bed reactor. Various parameters such as coal reject:NaOH ratio, water addition, temperature, and time have been optimized during synthesis of the adsorbent, and the adsorption capacity from TGA experiment is selected as key response of the parameter optimization. Various physico-chemical properties like surface area, pore volume, crystalline structure, chemical composition, etc. of the adsorbent are characterized. Packed-bed experiments show that the CO<sub>2</sub> adsorption capacity increases with the increase of CO<sub>2</sub> concentration up to 12.5 vol%, while a 25.5 % reduction of adsorption capacity is observed as temperature increased from 30 °C to 60 °C. The maximum adsorption capacity of the synthesized material is 1.05 mmol/min at 30 °C and 15 vol % CO<sub>2</sub> concentration during packed-bed tests. Further, multiple adsorption–desorption cyclic analysis show that the adsorbent is quite stable with only a 6.7% difference in adsorption capacity over 10 cycles.