

Project title: Role of Coal Composition and Maturity on the Sorption Behavior of Indian Coals for Gas Storage Estimation

Project No.: GAP/MS/DST/95/2012-13

EXECUTIVE SUMMARY

CSIR-CIMFR being the leading R&D organization in mining and fuel sector in the country is playing a pivotal role in exploration and exploitation of non-conventional gas resources viz., CBM, CMM, shale gas and UCG. India is now moving towards a phase of commercial development of CBM projects. Hence, there is a need to intensify the R&D on activities non-conventional gas resources for development of commercial scale CBM projects. The project entitled 'Role of coal composition and maturity on the sorption behavior of Indian coals for gas storage estimation' was sponsored by Science and Engineering Research Board (SERB), a statutory organization of Department of Science and Technology, New Delhi vide sanction order no. SB/S4/ES-591/2011 dated 13.08.2012 with the objective to investigate the sorption characteristic of Damodar Valley and North Eastern Coals of India.

Methane associated with coals (CBM) is gaining commercial importance as a natural gas resource. Exploitation of this gas will make the future mining safer without significantly adding to the atmospheric GHG emission levels. Unlike conventional oil and gas reservoir, the coal gas retention mechanism is mainly controlled by the sorption property of the coal. The petrography, chemistry and maturation of coal control the surface behavior and porous structure of coal and, in turn, guide the phenomenon of sorption of methane in coal. Study of these parameters is of immense importance for coal gas reservoir characterization. Hence, the present study aims at critical appraisal of Indian coals for their sorption characteristics in the light of petrography, chemistry and maturation of coal.

Extensive field work were carried out during 2013-14, 2014-15 and 2015-16 to collect coal samples from different Gondwana coalfields and North Eastern coalfields of India. About 190 samples including 70 coal samples are collected from different seams of several coalfields of India. 60 coal seam samples were studied for proximate and ultimate analyses of which 31 samples were shortlisted for petrographic study. Nine coal seam samples were screened on the basis of reflectance (R_r 0.47-1.23%), maceral content, carbon content (77.2-92.2%, dmmf basis),

ash content (1.3-24%) for high pressure adsorption study at different grain size, moisture and PT conditions. The analysis was carried out by the National Facility for High Pressure Adsorption Isotherm construction designed and developed under this project to investigate the adsorption characteristics of coal/shale up to a pressure of ~40MPa, replicating a depth of around 4000m. The analysis takes about 30-40 days' time depending on the coal type. Total 30 runs of adsorption experiment were undertaken including three runs for investigation on change in adsorption capacity with temperature.

For the first time the North Eastern coals are characterized for their sorption characteristics to assess their CBM potentiality. Further, a comparative account on adsorption characteristics of various Indian coals was presented. Model fits for adsorption of methane for different Indian coal seams were generated that can be used for development of commercial CBM projects. The adsorption capacity (V_L) of the coals for moisture equilibrated samples of -72BSS mesh size vary from 19.0 to 25.4cc/g. Various correlations were drawn for adsorption capacity with elemental composition, petrographic parameters, surface characteristics and PT conditions.

Sorption isotherm construction for individual coal seams is a vital parameter for CBM reservoir studies as it provides the information about storage capacity of the coal, techno-economic feasibility of the process, and helps in simulating and designing the operational conditions. Hence, there is immense scope of detailed investigation on sorption in coal/shale for CBM/shale gas exploration and exploitation, ECBM-recovery and CO₂ sequestration in unmineable coal seams, and various other industrial processes where the physical adsorption is the dominant phenomenon. The executive training programme on 'Best practices in coalbed methane exploration and production (ETP: CBM E&P 2017)' was organized during 9-13 January 2017 for dissemination of the state of the art knowledge developed through the project. On this occasion the National Facility for High Pressure Adsorption Isotherm Construction was formally inaugurated by Dr. Pradeep K Singh, Director, CSIR-CIMFR in presence of Dr. Debadutta Mohanty, Principal Investigator/Senior Scientist, Nonconventional Gases Division, CSIR-CIMFR and Dr. Ajay K Singh, Senior Scientist, Nonconventional Gases Division, CSIR-CIMFR.
