Research Paper

Volume : 4 | Issue : 5 | May 2015 • ISSN No 2277 - 8179

Coal Seam Delineation and Their Proximate Analysis in North and Northeastran Parts of Auronga Coal Field, Jharkhand, India

Geology

KEYWORDS : Quality, Coal, Proximity analysis, Rajbar coal block, Jharkhand, India.

Raju Doddi	Department of Geology, Osmania University, Hyderabad-500 007, Telangana State.
Santhosh Kumar. S	Department of Geology, Osmania University, Hyderabad-500 007, Telangana State.
Muralidhar. M	Department of Geology, Osmania University, Hyderabad-500 007, Telangana State.

ABSTRACT

Coal is one of the primary sources of energy, accounting for about 67% of the total energy consumption in India. India has some of the largest reserves of coal in the world. Indian coal has high ash content and low calorific value. Auranga Coalfield is the easternmost member of the Koel Valley group of coalfields in Latehar District of Jharkhand State, India. Five promising sectors of coal bearing formations had been identified in Auranga Coalfield viz., Jagaldagga, Gowa, Rajbar, Sabanu, and Banhardi sectors. Of the potential sectors identified, Rajbar coal block occupies the largest area which is spread over an area of 17 sq km in the north and north-eastern part of the Auranga coalfield. On the basis of drilling data, the geological formations encountered are Raniganj, Barren Measure, Barakar and Talchir Formations of the lower Gondwana Supergroup and representative lithology in these formations in overall are sandstone, siltstone, coal seams and sandstone with predominant black shale, pebble beds, conglomerate and fireclay.

To establish quality of the coal in terms of grade and chemical nature, a few coal seam samples were collected from Rajbar coal block and proximate analysis for different elements like moisture and ash contents, volatile matter and fixed carbon etc has been carried out. The results show that the coals of this basin are equally rich in ash, volatile matter and fixed carbon. Moisture content and used-heat-value (UHV) are low. In general, the grades of these non- cocking coals in this area have been assigned as D, E and F.

INTRUDUCTION

Coal is the world's most abundant and widely distributed fossil fuel. "Coal quality" is the term used to refer to the properties and characteristics of coal that influence its behavior and use. Among the coal-quality characteristics that will be important for future coal use are the concentrations, distribution, and forms of the many elements contained in the coal that we intend to burn. Knowledge of these quality characteristics in Indian coal deposits may allow us to use this essential energy resource more efficiently and effectively and with less undesirable environmental impact (Anudhyan Mishra, 2009).

The quality of coal needs to be assessed so that it can suitably be used in different industries. The mineral matter content and its type will give an idea about the coal preparation practice that will be required to be adopted for its cleaning and subsequent use. The main objective of the study is to analyze the quality of the coal and find out its suitability for different types of industries. To establish the quality of these coals, seam wise coal samples have been collected and analyzed for different properties in the laboratory by proximate analysis.

Jharkhand is surrounded by West Bengal on the eastern side and, Uttar Pradesh and Chhattisgarh on the western side, Orissa on southern side, and on the north is the state of Bihar. The state of Jharkhand has a total area of about 79,714 sq km, out of which 18,423 square kilometer area is covered by deep forests. Jharkhand is the richest state in the country as far as the availability of mineral resources is concerned (Dutt and Datta 2000; Chandra,1992). The minerals found in abundance in Jharkhand are bauxite, coal, iron ore, pyrite, limestone, copper ore, china clay, fine clay, graphite, soap stone, silica sand and quartz sand(Bose, 1968). This coal field is in the Latehar District of Jharkhand.

The Rajabar block covers an area of 17 sq km and forms integral part of Auronga coal field. The Rajbar block is bounded by latitudes 23^{0}45’18.8” to 23^{0}47’59.0” N and longitudes 84^{0}37’47.4” to 84^{0}40’51.6” E covered in the Survey of India toposheet number 73 A/9.

GEOLOGY OF THE AREA

Ball (1880) and Dunn (1928) differentiated the Gondwana rocks of the Auranga Coal Field into the Talchir, Barakar, Ranging, Panchet and the Mahadeva Formations. Later, Das (1978, 1979) identified the Barren Measures Formation in addition to the above mentioned formations which was subsequently collaborated by the sub-surface data. A conspicuous feature of the Gondwana rocks in the Rajbar sector is the absence of the Karharbari rocks containing superior quality coal which is well developed in Jagaldagga and the adjoining Gowa sector lying in the southern part of the Coal Field (Das, 83).

Greenish to yellowish green, often micaceous and calcareous, fine to medium grained sandstone, siltstone & thin coal band are available in the Raniganj formation. Grey to greyish white fine to coarse-grained cross-bedded and laminated arkosic sandstone, pebble beds, conglomerate and grey to carbonaceous shale, coal seams and fireclay occur within Barakar formation. Granite, granite gneiss with patches of mica-schist and quartz and pegmatite veins are representative rock of Pre Cambrian.

SAMPLING PROCEDURE AND ANALYSIS

For collection of coal samples, core sampling procedure was followed. The entire core sample was transferred into polyethylene bags. Representative splitting could be done later in the laboratory. A properly marked sample tag was placed inside the innermost bag and the outside container was labeled and each container was separately sealed. A total of seven seam samples were collected from a single bore hole.

Determination of moisture, volatile-matter, ash and fixed carbon in coal comprises its proximate analysis (Anudhyan Mishra, 2009).

i) Determination of moisture content: Loss in weight of coal caused by heating of coal sample for one hour at 105˚C is the moisture content of coal. A known amount of finely powdered coal sample is kept in a silica crucible and heated in a muffle furnace at 105-110˚C for one hour. There after the crucible is taken out, cooled in a dessicator and weighed. The percentage of moisture is given by % moisture in coal = {loss in wt. of coal X 100}/ wt. of coal initially taken.

ii) Determination of Volatile Matter: It is the loss in weight of moisture free powdered coal when heated in a crucible fitted with cover in a muffle furnace at 925°C for 7 minutes.

% volatile matter = {loss in wt. of moisture free coal X 100}/ wt. of moisture free coal taken

iii) Determination of Ash content: It is the weight of residue obtained after burning a weighed quantity of coal in an open crucible (i.e. in presence of air) at 750°C in a muffle furnace till a constant weighed is achieved.

% ash in coal = {wt. of residue ash formed X 100} /wt. of coal initially taken

iv) Determination of Fixed Carbon: It is determined indirectly by deducting the sum total of moisture, Volatile matter, and ash percentage from 100.

% fixed carbon in coal = 100-(% moisture+% ash+% volatile matter)

v) Physical properties - Specific gravity: The proportion and nature of both the organic mass and mineral matter influence the specific gravity of coal. For the same type of coals, the higher ash coals have higher specific gravity. The true specific gravity of bituminous coals varies between 1.27 & 1.45.

The following formula is valid for many coals of India.

$$S = k + \frac{A}{100}$$

Where ,

S = Specific gravity

A = Percentage of Ash

k = a constant, value is 1.25

RESULTS AND DISCUSSION

In any thermal power plant determinations of proximate analysis are common practice to assess the quality of coals. Proximate analysis of coal samples taken from coal bearing boreholes has been carried out at 60% RH and 40^0 C to determine the percentage of moisture (M), volatile matter (VM), ash (A) and fixed carbon (FC). As a result, varieties of correlations and have been developed to predict UHV of coals from proximate analysis.

It is well known that quality is grade of coal is evaluated from the parameter, comprising ash, and moisture determined from proximate of boreholes analysis of coal in State Geological laboratory Hazaribagh Jharkhand. Proximate analysis data of seven coal seams is presented in table-1.

Auronga coal field in coal seams has been encountered in the boreholes drilled in this area. Most of the coal seams are inter banded in nature and exhibit split section development pattern both along strike and dip direction. Moreover, coal seams show considerable variation in thickness and lithological characters of interseam parting sediments. Their correlation have been made various criteria such as thickness of the coal seam, associated parting, seam structure, band-by-band data, characteristics of litho-units in the roof and floor of the seam, development of carbonaceous or non-carbonaceous bands within a coal seams. Exploration in this area reveals the occurrence of seven coal seams and these have been numbered from I to VII in ascending order.

Table-1. Proximate analysis for eight coal seam samples from the study area.

S.No.	Depth from (mt)	Depth to (mt)	Seam Thickness (mt)	Seam No.	M (%)	Ash (%)	VM (%)	FC (%)	UHV K.C/K	Specific Gravity Gram/ Cc	Grade
1	80.78	95.22	14.44	VII	4.3	31.8	28.9	32.2	3912	1.60	E
2	110.07	110.84	0.77	VIT	4	35.9	27.1	30.2	3394	1.64	E
3	115.55	120.5	4.95	VIB	3.7	40.2	26.8	26.5	2840	1.68	F
4	168.5	171.77	3.27	V	3.8	39.4	25.6	30.6	2948	1.67	F
5	202.25	203.5	1.25	L6	4.3	32.3	27.5	34.5	3851	1.60	E
6	244.99	246.32	1.33	IV	3.9	37.7	23.8	33.2	3158	1.66	F
7	323.26	325.2	1.94	II	4.2	33.9	27.3	33.9	3649	1.62	E
8	335.53	335.85	0.32	I	4.6	28.2	30.5	35.6	4379	1.56	D

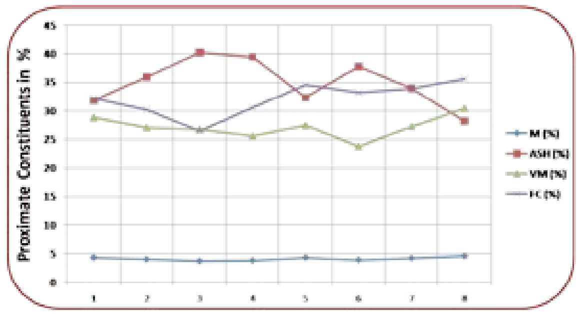

Figure-1. Plot of seven coal seam samples (I to VII) Vs constituents of proximate analysis

To determine the quality of coal, proximate analysis of seven coal seam samples were carried out following the Indian standard procedure. The percentages of moisture (M), volatile matter (VM) and ash content (A) of all the samples have been shown in figure-1.

It may be observed from table-1 and figure-1 that the seam no-I has the highest moisture content i.e. 4.6% and seam no-VIB has the lowest i.e. 3.7%. From this we conclude that sample no-I, VII and L6 will take more time for heating and have lower calorific value. Also sample no.8 will be consumed more for a certain heating purpose than other coals.

It was also found that sample no. 1 and 8 have the highest volatile matter content (30.50% and 33.96%) respectively, where as seam no-IV has the lowest volatile matter content (23.80%). It has been observed in the past that coals with high volatile-matter content ignite easily and are highly reactive in combustion applications. With increase in volatile matter content of coal there is a decrease in the calorific value of coal.

The ash content of the coal seam samples varied to a large extent from 28.2% to 40.20%. All the samples have ash content more than 30% and will create problems during combustion. These may give rise to formation of clinkers in the furnaces hindering the reactions. These samples when burnt will give rise to environmental pollution to a significant extent. It is therefore essential that these coal samples be washed before being utilized by the industries.

The fixed carbon content which has a direct relation with the calorific value varied from 26.50% to 35.6%. It could be observed from table-1 that the fixed carbon content of these coal seam samples is low hence their calorific value will also be low. Used heat value (UHV) of these coals varies between 2840 kcal to 4379 kcal.

CONCLUSION

From the proximate analysis parameters comprising ash content, moisture presence, volatile matter and fixed carbon in coal in the laboratory indicates almost same quality of coal in different seams from I to VII. Coal seams developed in the area are of non–cocking. It could be observed from this study that the coal samples collected for the study contain medium quantity of moisture, medium to high amount of volatile matter and high amount of ash. Used heat value (UHV) of these coals is also low comparing to good rank coal. Thus all these coals could be used in thermal power plants and in other small scale industries for combustion purposes. As the ash content of the coals are high in these coals, proper pollution control arrangements are necessary to implement during burning as these coals are expected to give rise to huge amount of noxious pollutants i.e. produces oxides of carbon, including carbon dioxide, oxides of sulfur, various oxides of nitrogen (NO_x) and other toxic substances.

ACKNOWLEDGEMENT

I express my deep sense of gratitude to Sri. Jai Prakash Singh, Director, Department of Mines and Geology, Jharkhand, for allowing me to publish this data. I am very much thankful to Sri. Amitabh Kumar, Assistant Director, Department of Mines and Geology, Jharkhand for his continuous support in bringing out my research work. I am also thankful to Sri. M.A.Samad, GM Geology, Indu Projects.Ltd, for his help in carrying out the field work.

REFERENCE

• Anudhyan Mishra , 2009 "Assessment of Coal Quality of Some Indian Coals " Thesis, Bachelor of Technology degree in Mining Engineering, National Institute of Technology, Rourkela. | • Ball. V. (1880): On Auranga and Hutar coalfields and the Iron ores of the Palamau and Tore. Mem. Geol. Surv. Ind., Vil.-15, Pt.1 | • Bose, J.1968: Geological investigation by drilling in the Chuperbhita and Mahuagarhi Coalfields, Rajmahal Hills, SanthanParganas district, Bihar. Goel. Surv.Ind. Unpublished progress Rep. From 1964-65. | • Das, S.N. , (1978) : Geology of the central and south-east¬ern parts of the Auranga, C.F., Palamau district., Bihar., Unpublished, Geol. Surv. Ind. Report. | • Das, S.!T., (1979): Geology of the northern and north¬eastern part of Auranga C.F., Palamau district, Bihar., Unpublished, Geol. Surv. Ind. Report. | • Das, M. (1981-85): Final Report on the Regional Exploration of Coal in the Rajbar Sector, Auranga Coalfield, Palamau District, Bihar. | • Dunn, J.A. (1928): The Auranga Coalfield, unpublished. Geol. Surv. India Report. | • Dutt, A.B and Datta, R.K (2000) Indian coal resources spectrum, Proc. Sem on New Challenges for Indian Coal, Coal resources of India. Mem. Geol. Survey of India. Pp 10-13. | • D. Chandra,"Jharia Coalfield",Mineral Resource of India, Geological Society of India, Bangalore, 1992. Harpalani, S. and G. Chen, 1995, Estimation of changes in fracture porosity of coal with gas emission; Fuel, 74, 1491-1498. | • Indian Standard: 1350 Part 1, 1984, Methods of Test for Coal and Coke: Proximate analysis (Second Revision), Bureau of Indian Standards, New Delhi. | • Indian Standard: 436 Part 1/Sec 1, 1964, Methods for Sampling of Coal and Coke, Sampling, Bureau of Indian Standards, New Delhi. | • Indian Standard: 1350 Part II, 1970, Methods of Test for Coal and Coke: Determination of Calorific Value (First Revision), Bureau of Indian Standards, New Delhi. |