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Studies on the cleaning potentialities of non-coking coal by washability study

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Abstract

Coking coal is the primary prerequisite source for the production of iron and steel through blast furnace route. Efforts have been made to correct the imbalance between need and availability of coking coal. This can be done by blending coking coal with either non-coking coal or semi-coking coal. To search for the above possibility systematic investigation of coals is required. Before going for any beneficiation studies for upgrading the coal (to reduce the ash level), washability study of the sample is required. The washability study of coals is performed through sink-float test in laboratory. Sink-float tests are widely used for coal analysis, to predict the theoretical yield and ash contents of clean coal obtainable in an ideal gravity concentrator at different specific gravities. It is a common practice to plot a series of 'washability curves', from the sink-float data of a coal sample in order to generate many useful information relating to its amenability for producing clean coal of desired quality. In this article a systematic investigation of washability study of non-coking coal from eastern region is studied through laboratory sink float test. From the washability study it has been found that 17% to 20% ash level can be achieved with a yield of ~30 to 33%%. Based on the data a suitable beneficiation scheme can be suggested.

Keywords: Coal, Ash, Washability, sink, float

1. Introduction

The limited reserves of natural gas and petroleum have made the coal as the v source of fuel in the energy sector in India. As the growth of steel industries, power plants is increasing day-by-day, the importance of coal as primary resource increases. It has been found that today coal holds about 70% of world's fossil fuel resources. Its demand has increased due to its low cost and easy availability compared to other fuels (Franco and Diaz, 2009). Coking coal account for only 15% of the country's overall proven coal reserves. The Indian steel industry has been facing acute shortage of coal for the last several years. To save steel industry facing acute dependence on imported coking coal, domestic availability of coking coal in right quality and quantity has become imperative. To meet the increasing demand of coking coal concerted effort have to be made to correct the imbalance between need and availability by increasing the production of coal of desired quality through better management of available resources of inferior grade. Indian coal has been observed to be of low quality on account of its high ash content. Keeping the above difficulties in the mind it is always entails to find the scope of using high-ash non-coking coal. The beneficiated coal will have the immense potential for being used as a blended mix for metallurgical applications (Reddy and Biswal, 2006; Haldar, 2010; Sahu et al. 2011; Gouri Charan et al. 2011; Vidyadhar et al. 2013). To search for such possibility systematic investigation of coals is required. This washability data is the basis for nearly all coal preparation plant.

The present study demonstrates the washability study of a non-coking coal so that it can be used economically. This washability data is the basis for nearly all coal preparation plant. In this study a non-coking sample from eastern region has been investigated.

2. Experimental

2.1 Material

About one ton of non-coking coal sample was collected from eastern region of India. The whole sample was homogenized and a representative sample of 100kg was withdrawn from the bulk sample. Out of the 100kg sample, requisite amount of sample were taken through coning and quartering method for different studies. In this investigation the whole was crushed to 5mm size. and screened to obtain different size fractions. The size fractions used in present study were (a) -5+3 mm, (b) -3+1 mm, (c) -1+0.5 mm, and (d) -0.5 mm.

2.2 Method

2.2.1 Size Analysis

The crushed 5 mm sample was screened at different sizes. i.e. 3mm,1mm, 0.5 mm. The size distribution of the above coal sample was shown in Table 1. The different size fractions, such as -5+3 mm, -3+1 mm, -1+0.5 mm and -0.5 mm fraction are subjected for ash analysis and the result is tabulated in Table 1.

Table 1: Size wise ash analysis of raw coal crushed to 5 mm

Size (mm)	Wt%	% Ash
-5+3	30.6	46.80
-3+1	42.3	46.32
-1+0.5	13.0	43.94
-0.5	14.1	44.15
Total	100.0	45.85

2.2.2 Sink-Float test

Each size fractions were subjected to sink -float test at different specific gravities such as 1.4, 1.5, 1.6, 1.7 and 1.8. Liquids of different specific gravity such as CCl_4 (specific gravity 1.60), benzene (0.88) and bromoform (2.90) were mixed at different proportion to prepare the liquid of specific gravity from 1.4 to 1.8. The sample is first placed in the lowest specific gravity liquid and two products i.e. float and sink are obtained. The fraction lighter than the liquid floats and fraction heavier than liquid sinks. The portion which floats on a particular specific gravity are known as float fraction and the portion which sinks are known as sink fraction. Then the sinks are placed in next higher specific gravity liquid and the float and sink fractions are separated. In this way, the float and sink fractions of different specific gravities are dried and weighed, taking care that no coal particles are lost. The sink-float data of different size fractions are tabulated in Table-2, 3, 4 and 5. From the sink-float cumulative data the washability curve was drawn which was shown in figure 1.

Table 2: Sink-float result of -5+3 mm fraction

Specific gravity	Wt%	Ash%
1.4 Float	2.5	5.05
1.5 Float	5.4	12.23
1.6 Float	7.6	20.67
1.7 Float	12.0	29.19
1.8 float	20.8	38.16
1.8 Sink	51.7	63.62
Head (Calculated)	100.0	46.65

Table 3: Sink-float result of -3+1mm fraction

Specific gravity	Wt%	Ash%
1.4 Float	3.9	5.70
1.5 Float	7.6	10.17
1.6 Float	7.8	19.54
1.7 Float	8.5	27.62
1.8 float	15.5	36.94
1.8 Sink	56.7	62.41
Head (Calculated)	100.00	45.99

Table 4: Sink-float result of -1+0.5mm fraction

Specific gravity	Wt%	Ash%
1.4 Float	3.6	3.73
1.5 Float	12.9	7.99
1.6 Float	9.5	17.79
1.7 Float	7.7	25.83
1.8 float	11.7	34.52
1.8 Sink	54.6	62.58
Head (Calculated)	100.0	43.08

Table 5: Sink-float result of -0.5mm fraction

Specific gravity	Wt%	Ash%
1.4 Float	0.8	3.61
1.5 Float	11.8	6.57
1.6 Float	11.1	14.95
1.7 Float	9.0	20.35
1.8 float	9.0	31.85
1.8 Sink	58.3	61.18
Head (Calculated)	100.0	42.81

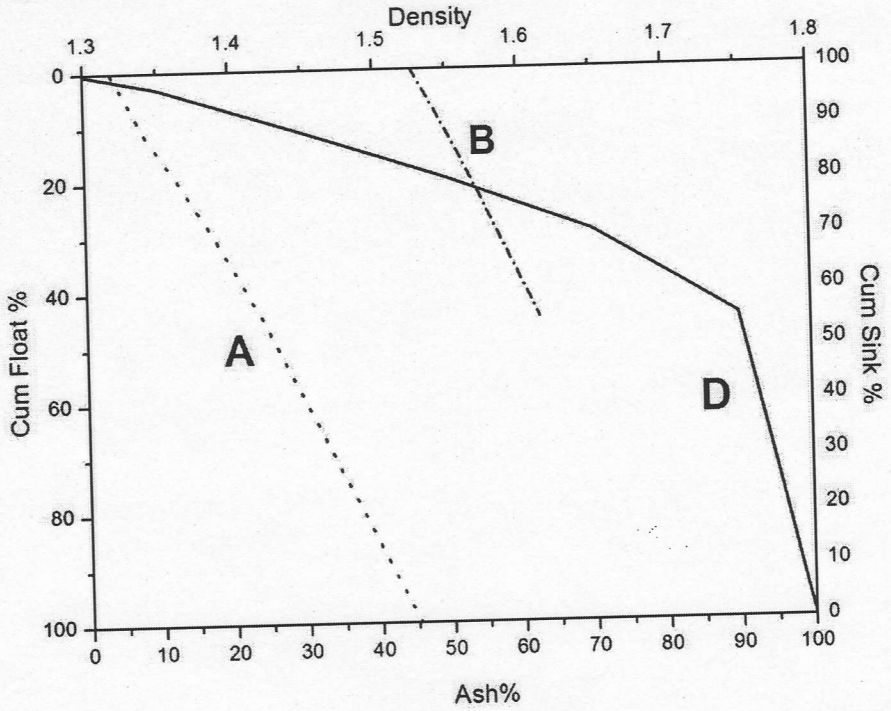

Fig. 1. Washability curve of -5 mm coal: A- Float-Ash curve; B- Sink-Ash curve; D- Density curve

Result and Discussion

This eastern region of non-coking coal is having ash of about 46%. Having 46% ash, the coal can't be rejected. So to know its amenability towards the use in the field of thermal as well as metallurgical purpose (if possible) washability characteristic study was investigated. Sink-float data of all size fractions show that 1.8 sink fraction is having more than 60% ash which is about 50 wt% that can be directly rejected. Out of the rest 50 wt%, some material having ash around 17-20% may be used for metallurgical purpose depending upon the caking characteristics. Rest of the material can be used for thermal purpose. From the washability curve as shown in figure 1, it has been found that 17% to 20% ash level can be achieved with a yield of ~30 to 33%.

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