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Beneficiation of Fine Size Lignite Coal by Agglomeration Technique, Deposits at Matasukha Mine, Nagaur, Rajasthan

B. S. Parmar

Department of Chemistry, SNDB Govt. College Nohar, Hanumangarh, Rajasthan, India
bsparmar1ksr@gmail.com

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Abstract

Energy is the main requirement of modern society. This scenario lignite remains cheap and dependable source based on technological state of art in the present world scenario. In this study, the possibility of cleaning and dashing of lignite samples by oil agglomeration techniques was investigated. The lignite sample contains 10, 15% fix carbon, 36.99% ash, 17,86% volatile lignite marginally lowers calorific value 1725.30 kcal/kg. The lignite was transformed into a C.V. (+) 2221.23 kcal/kg with value add 495.93 kcal/kg. The separation was more than 27%. The separation technique involved collectors in water followed by oil agglomeration.

Keywords

Bio oil -agglomeration, zero carbon emissions, fine particle

1. Introduction

By using operating parameters oil agglomeration is physiochemical cleaning technique which is used to remove inorganic and organic impurities for beneficiation of low C.V. value of lignite coal. There is agglomeration time, the size of coal particles etc. whereas chemical operating parameters are oil type and dosage, surfactant, solid content. Oil agglomeration was studied for fine size coal particle separation of lignite coal. Fuel oils [1] are being used in beneficiation of Lignite Coal. Here the fine size means separation is not carried out by the gravitation force. The diameter size of coal particles which are responsible for agglomeration is termed as critical. At this condition, the attachment force is equal to the detachment force. The density effects interaction between liquid and coal [2]. The wetting is directly affected by contact angle value [3]. The small contact angle value of oil forms easily agglomeration. According to this hypothesis oil agglomeration is explained by contact angle phenomena which direct measures wetting of solid surface4 so oils which form low contact angle value with coal particles take part easily in agglomeration. At more than 90^{o} contact angle the wetting ratio increase of coal particle. Above 150^{o} contact angle the super hydrophobic nature has been studied in surface chemistry which directly depend upon surface roughness and low surface energy [5]. The super hydrophobic phenomena are used to self-cleaning ability and chemical sensing application [6] surface. Thus, the decrease in contact angles and the hydrophobic nature increase, and maximum wetting take place due to maximum water loading Ash water slurry flow [7] effects beneficiation in coal industries. The carbon particle used oil forms agglomerate from water/oil adhesion [8] of coal particle by capillary interfacial force. Thus, due to small contact angle oil forms easily agglomerate and up gradation of coal take place. The super- hydrophobic surfaces have recently been attracting attention. By the presence of hydrophobic nature of agglomerant agglomeration takes place easily. The hydrophobic nature of agglomerant depend upon the number of carbons in the tail. Increasing the number of carbons in oils hydrophobic nature also increases. The agglomeration also increases by the collision No. due to maximum collision No. producing maximum interaction between the coal particle and oil by the presence of amount of oil [9]. The agglomeration also increases at higher amount of agglomerant. Bio oils are of neutral carbon fuel because there is no net change of CO_2 during combustion. This is also referred to zero carbon emissions fuel. Biodiesel acceptance increases as a substitute of fossil-derived fuel in the world. Biodiesel is produced with ethanol by catalyst. Both Hydrophilicity and Lipophilicity properties were in the deashing process [10]. In the current study types of agglomerant, fine size, were investigated under laboratory conditions and optimum conditions were determined to upgradation of lignite coal sample. The principal physical parameters, calculation of C.V. was calculated for experimental measurement of oil agglomeration. In abbreviations, the Development- Pollution- Governance idea will have been forwarded in environment improvement.

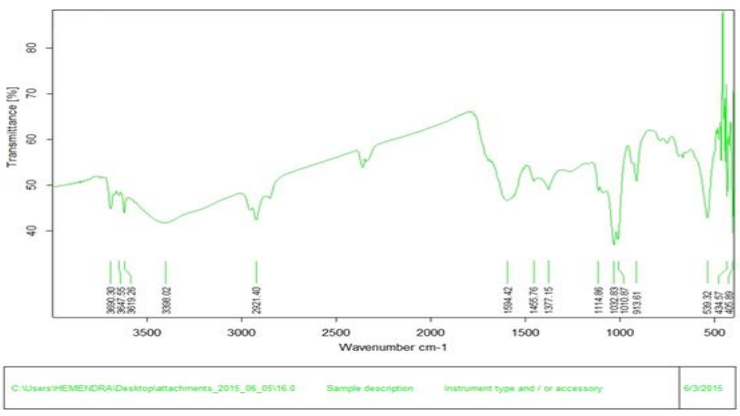

Figure 1. FTIR Analysis of Lignite Coal

There was low % of transmittance in FTIR which showed the high impurities among carbonic substances and there was FTIR signals bellow 500 cm $^{-1}$ which showed the presence of inorganic substances among the organic matter. The presence of FTIR signals between 4000 cm $^{-1}$ to 500 cm $^{-1}$ region showed the carbonic substances with oxygenated functional group. The position of FTIR and with broadness at 3399.02 cm $^{-1}$ represented the presence of O-H bond of hydroxy functional group with hydrogen bonding by water molecules in lignite coal. The FTIR signal at 2921.40 cm^{-1} represented the presence of hydrocarbon identities as saturated C-H hydrocarbon having sp^3hybridization in free condition whereas the small existence in above this region 3000 cm $^{-1)}$ was of Ar-H having sp^2 hybridization and below this region 1600 cm $^{-1}$ to1475 cm $^{-1}$ was of C=C-H having sp^2 hybridization. There were normally few FTIR signal at 2500 cm $^{-1}$ to2000 cm $^{-1}$. The overtone band in FTIR generally was in lower intensity than the fundamental band which showed the presence of asymmetrical geometry of organic molecules in lignite coal having anharmonic frequencies. Overtones are generally not detected in larger organic molecules. The carbonyl and carboxylic oxygenated group were absent in the Lignite coal of Matasukha mines because there was an absence of FTIR band at 1700 cm^{-1} in FTIR spectrum. The FTIR band at 1500 cm^{-1} region showed that there was unsaturated hydrocarbon present in lignite coal with different chemical structure as 1594.42 C=C of alkene,1455.76 C=C of aromatic. The FTIR band at 1000 cm^{-1} region showed that there were saturated hydrocarbon(C-C) and hetero saturated bond(C-O) present in lignite coal with different chemical structure as 1377.15 C-O alcohol,1114.86 C-O ether,1032.83 C-C hydrocarbon.

2. Experiment

2.1. Experiment Tools and Materials

Lignite sample was collected from Matasukha lignite mine Nagaur, Rajasthan and grind to +100 mesh to -100 mesh fractional air-dried base and separated by the 100 No. Sieve manually. Stopper measuring cylinder was used to take place agglomeration. Bio-oil was collected from Bala ji store Jodhpur and used for agglomeration due to high viscosity.

Table 1. For Basic C.V. value. Moisture=35%, Weight of sample =1 gm, P^H=9.1

S. No.	%V.M.	%A	%F.C.	C.V. kcal/kg.
01	17.86	36.99	10.15	1725.30

2.2. Oil agglomeration experiment

At first 10 gm of +100 mesh lignite coal sample was weighed into watch glass and replaced with beaker containing 10 ml. tape water. Taking thoroughly sacking beaker the sample was properly wetted and replaced with 100 ml. stopper -measuring cylinder and made up 100 ml solution by adding tape water. Thus, the stopper -measuring cylinder was slowly tilted four times and allowed to settle down for 10 minutes for blank whereas in oil -agglomeration the required doge of agglomerant was added at this momentum and kept for settle down. Thus the 10 % slurry was ready to be used in wet sieve analysis in agglomeration. Like this the 10% slurry was used as +100 mesh as w_1 gm. whereas the passing particle was -100 mesh as w_2 gm.

2.2.1 The retained weight was calculated as

$$RW=(W_1/W) * 100 \quad (1)$$

Here RW=retained weight, W_1= weight in gm.

W_2=passing weight gm. $W=W_1+W_2$ total weight of used sample in gm.

The passing weight can be calculated as

PW=100-RW. (2)

PW=passing weight, RW=retained weight.

The w_1 and w_2 each weigh is used for proximate analysis of the sample by drying

Table 2. Retained weight, Total weight of sample=10 gm.,size =100 mesh,P^H=9.1

S. No.	Oil	R.W+100mesh gm.	PW-100mesh gm.	%RW	%PW
01	Blank	1.0	9.0	10	90
02	Jatropha	1.5	8.5	15	85
03	Citrulous	1.6	8.4	16	84
04	Pine oil	2.7	7.3	27	73

2.2.2. C.V. value

Oil agglomeration took place by the hydrophobic interaction between the coal particle and oil so oils having hydrophobic nature and dense property are used for optimum agglomeration. Due to dance and organic contents, the oil was used in this chapter which gives mild agglomeration in these given conditions but there is good hope to use Jatropha oil as bio diesel. However low seed production of Jatropha[10] is challenge for technological development for oil agglomeration. The Citrulous is also desert harbors and oil is prepared by the seed part of plant body. The Citrulous oil is more effective than Jatropha oil for oil agglomeration and increase C.V. value more than Jatropha. Like this pine oil was also used for oil agglomeration which gives maximum agglomeration in this chapter. Bio oils with different viscosities were used as bridging liquid to beneficiation of lignite coal in oil agglomeration. The various values are given in Table No.03 and represented in figure 4.

Table 3. No. of bio-oil drop =01.Total weight of sample=10 gm. Time for agglomeration =10 minute.

P^H=9.1. Slurry=10%. Sieve size=100 mesh.

		A	+100 mesh			B	-100 mesh		
S,No.	oil	%F.C.	%V.M.	%A	C.V.	%F.C.	%V.M.	%A	C.V.
1.	0	10.14	17.43	37.13	1727.58	9.62	16.62	38.76	1619.84
2	Jatropha	10.84	17.27	36.89	1752.00	9.75	16.61	39.09	1607.5
3	Citrulous	14.13	12.35	38.52	1775.50	5.83	22.53	36.64	1604.56
4	Pine oil	4.81	36.53	23.66	2221.23	4.90	54.80	40.30	1392.00

3. Result and Discussions

1. In this study the principal parameters moisture, ash volatile, and fix carbon was determined to analysis and beneficiation lignite of Mata Sukha mine for +100 mesh to-100 mesh fine particle. The 1725.30C.V. and high contain 36.99% ash represent the low grade of Lignite Coal. The results are given in Table No.=01and represented in Figure 2.

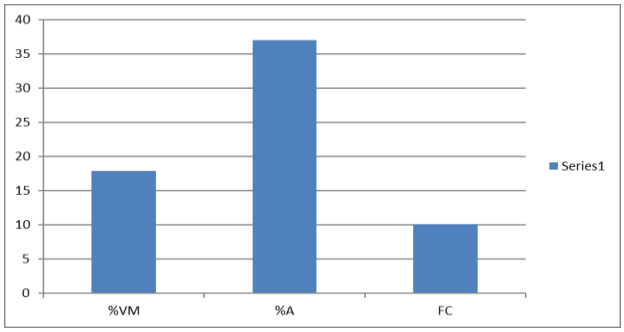

Figure 2. Representation of principal parameter in basic sample >%F.C.

2. The agglomeration was determined by the amount of retained weight because oil agglomeration takes place by the surface attachment between agglomerant and coal particle so size if agglomerated species increase and retained weight also will increase and oil agglomeration also gradually take place. The various weights of agglomeration are listed in Table No.02 and variation represented in figure3.

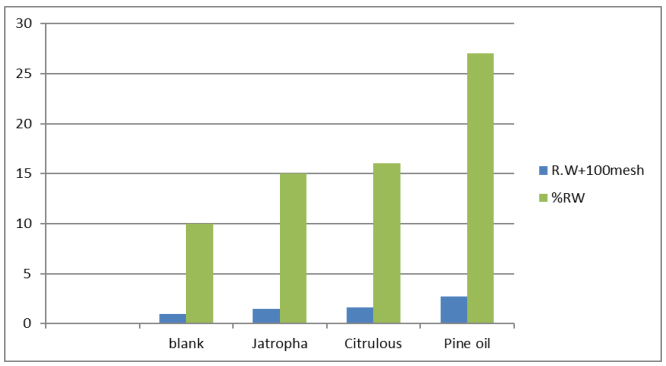

Figure 3. Percentage Representation of Retained Weight by Bio oils

3. In beneficiation was studied by oils in which the bio-oil was used due to zero Co2 emissions to control of air pollution as Jatropha, Citrulous, pine oil. In this research work in oil agglomeration. Jatropha is a desert plant that has a toxic nature. The oil is separated by the seed part of Jatropha plant.

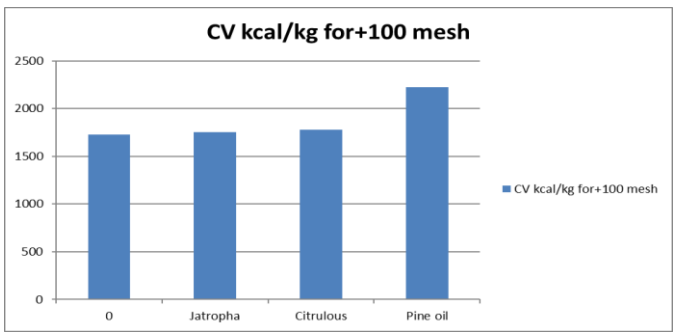

Figure 4. Representation of increase C.V. in+100mesh and C.V. decrease in -100 mesh for bio-oils in agglomeration

4. Conclusions

Lignite is of having oxygenated functional group so agglomeration took place in mild yield meanwhile the bio-oil may be useful as bridging liquid for agglomeration to form value added lignite coal having bellow conclusions.

1. Low C.V. and high ash contents showed that the lignite sample was of low-grade coal.
2. In this study it was found that the increase of 27 %retained weight was in favor of the upgradation of lignite coal.
3. The increased of C.V.+1752 kcal/kg for Jatropha, C.V.+1775.50 kcal/kg, for Citrulous, C.V. +2221. 23 kcal/kg. for pine oil were determined by oil agglomeration which represents the beneficiation of lignite coal as given+100 mesh fine size lignite coal particle.

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