ARYAVART SHODH VIKAS PATRIKA
RNI TITLED NO. UPBBIL04292
RNI REG. NO. UPBBIL/2014/66218 PP. NO.- 330-336
ISSN NO.-2347-2944
Vol.-10, No.-I, Issues-11 YEAR- June -2019

Investigation of Bio oil Agglomeration Technique for up gradation of fine size lignite coal from Deposits of Matasukh Mines, Nagaur, Rajasthan, India

1. B. S. Parmar 2. A. V. Singh

Department of Chemistry, Jai Narain Vyas University, Jodhpur, (Rajasthan) India

Received- 17.05. 2019, Revised- 21.05.2019, Accepted - 27.05.2019 E-mail: bsparmar1ksr@gmail.com

Abstract: ***Energy is the main requirement of modern society. The per capita consumption of energy is one of the crucial indicators of the prosperity and quality of life in the nation. In this study, the up gradation of lignite coal was investigated by bio oil agglomeration technique. The lignite coal contained 9.62% fix carbon, 38.76% ash, and volatile matter 16.32% and marginally lowers calorific value 1619.84 kcal/kg as AD sample The separation were highly successful as the recovery more than 28% weight recovery, 30.75% Combustible recovery, 13.30% Carbonic recovery and 2.21CRAR. The up gradation took place up to 2093 Kcal/kg as value add lignite coal +473.16 kcal/kg at minimum 2 drop bio oil in 10% slurry. In this research, the citrullus oil gave fruitful and innovative up gradation of fine size +100 meshes of Matasukh mines by using minimum requirement of Renewable fuel as citrullus oil.***

Key Words: Bio oil agglomeration, Zero carbon emissions, Combustible recovery and Carbonic recovery.

1. Introduction- Agglomeration is a fine size coal particle separation technique to up gradation of lignite coal. Here the fine size [1] +100 mesh was used in up gradation of lignite coal. The fine size means there was not carried out separation under the gravitation force. Agglomeration term was derived by Latin meaning as "to form into ball" .The process in which lignite coal particle of fine size having same nature formed a ball like structure by using bio oil was known by oil agglomeration . In this technique the coal particle and bio oil had hydrophobic nature to take place maximum interaction therefore it may be referred to as hydrophobic interaction separation technique. Now day bio oil may play important role to modify to lignite coal by this relevant coal cleaning technique. The agglomerate coal had characteristics nature to up gradation of lignite coal due to fine size of particle, purity of hydrocarbon , higher No. of fix carbon meanwhile the pollutants are controlled by this technique. In bio oil agglomeration process the interaction between bio oil and carbon particle took place as dispersion of bio oil in solution, transport of bio oil on carbon surface, adsorption of bio oil on surface, collision, separation of lignite coal particle. The maximum interaction was carried out in hydrophilic nature and similarly maximum interaction was carried out in hydrophobic nature between agglomerate and coal particle. Lignite coal particle had hydrophobic nature due to organic contents so agglomerate having hydrophobic nature show maximum inter action in agglomeration therefore we used bio oil having hydrophobic nature in oil agglomeration. In this chapter, the Matasukh lignite coal was subjected to up gradation was mixed to proceed into the used bio oil.

Lignite coal particle and used bio oil had hydrophobic nature eventually being hydrophobic nature of used oil had tendency to add on the surface of coal by surface phenomena to construct agglomerate. Thus this technique was overcome route to up gradation of lignite coal. The hydrophilicity and lipophilicity property differences between lignite coal particle and impurities were the basis of deashing process [2] whereas in bridging theory the bio oil molecule formed bridge between coal particles so it was referred to bridging theory. This was second theory to explain the agglomeration was explained by contact angle. The contact angle value was directly affected the wetting of coal particle [3]. According to this wetting was indirect proportional to the contact angle. It means large

Corresponding Author

ISSN NO.-2347-2944
Vol.-10, No.-I, Issues-11 YEAR- June -2019

contact angle had small wetting and small contact angle had large wetting and spreat easily on solid surface. At more than 90 contact angle the wetting ratio increase of coal particle eventually the bio oil molecule combine to coal particles and each particle aggregate by capillary force between in it. The bio oil molecule formed bridge between coal particles. At above 150 contact angle the super hydrophobic nature had been studied in the surface chemistry which directly depended upon the surface roughness and the low surface energy [4]. The lignite coal Surfaces with a water contact angle above 150° was of super hydrophobic surfaces [5] had been attracting aim for self-cleaning phenomena. Because of its small contact area with water, both chemical reaction and bonding formation had been determined by this mechanism. Today the super hydrophobic phenomena were used to self-cleaning ability and chemical sensing application [6] by contact angle hypothesis. This method was used to isolate solid coal particle. It was explained by contact angle phenomena which direct measured wetting of solid surface [7]. The small value of contact angle had maximum water loading [8] and carbon particle and used oil forms agglomerate from adhesion of coal particle by capillary interfacial force [9] thus due to small contact angle oil formed easily agglomerate and up gradation of coal take place. So the lignite coals supply 35% energy of total energy.

2. Experiment-

2.1 Materials: The lignite coal has a large amount of metal and metal oxide ,nonmetal , carbonic compounds, in carbonic component (ash forming compounds).Lignite coal was used of 100 mesh size of Matasukh mines Nagaur Rajasthan having marginal CV with impurity and oxygenated carbonic material. The lignite coal is naturally occurred carbonic complex compound. The lignite coal chemically consists of hydrocarbon chain is of hydrophobic part and heteroatom nitrogen, oxygen, sulphur as functional group are of hydrophilic part. The hydrocarbon part is in favor of oil agglomeration due to maximum interaction whereas the hydrophobic part is negative aspect for oil agglomeration due to minimum interaction.

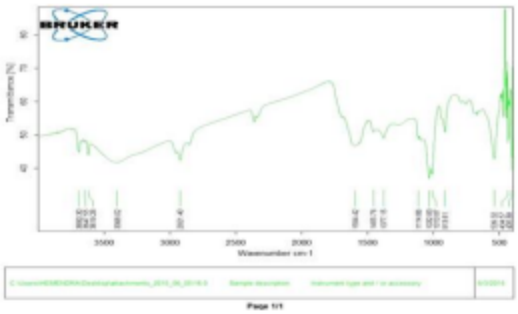

Fig.1. FTIR Analysis of lignite coal S-7

FTIR analysis of sample of Matasukh mines had low % transmittance and FTIR signals bellow 500 cm -1 which showed the presence of inorganic impurity 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 signal with broadness at 3399.02 cm -1 represented the presence of O-H bond with hydrogen bonding by water malecule in lignite coal. The above result show that lignite coal molecules were in fine size and contain the oxygenated functional -OH which reduced hydrophobicity so oil agglomeration took place in mild amount. This was negative aspect for oil agglomeration.

2.2.Agglomerant was used of citrullus Colocynthis seeds oil. This oil was used as agglomerant in lignite coal up gradation in present research work. Citrullus was known by wild gourd and bitter apple .This was a member of the Cucurbitaceae family. It was a non- hardy, herbaceous perennial vine, branched from the base present on sandy dumb. The citrullus basic belonged to tropical Asia and Africa in world. This was widely distributed in Saharo Arabian phytogeographic region [10] in the Africa and the Mediterranean desert region. The Citrullus is also present in Rajasthan as wild herbaceous in desert aria. The seeds of Citrullus were used for human being in drought time mixing with food and its fruits, branches, leaf were used as cattle food [11].There was good medicinal application of Citrullus fruit especially in diabetics [12]. Citrullus

ISSN NO.-2347-2944
Vol.-10, No.-I, Issues-11 YEAR- June -2019

seeds oil was having dense property so it could be used as agglomerant to up gradation of lignite coal. This was natural oil so there was no net change of CO2 during combustion of coal. This was also referred to zero carbon emissions fuel [13].The citrullus oil had carbon contents compounds having hydrophobic nature so the interaction between oil and carbon particle was maximum to take place agglomeration. The lignite coal sample was collected from the Matasukh mines of Nagour of central Rajasthan India. The fine size 100 mesh coal sample was used to up gradation using as 10%slurry in tape water. This fine size of coal particle showed maximum interaction with citrullus oil. The sample contain the marginal CV1619.84kcal/kg having high amount of 38.76% ash and low value 9.62% fix carbon ,16.32% volatile matter in sample. The principal parameters are represented in Table 1 at 35% moisture.

Table 1 At 35% moisture

Physical parameter in basic sample in dry and in water at Sieve Size 100 mesh

S. No.	%Physical parameter	In absence of water	In presence water +100 mesh	In presence water -100 mesh
01	%FC	9.62	9.21	10.11
02	%VM	16.32	17.52	13.99
03	%AS	38.76	38.57	39.99
04	CV kcal/kg	1619.84	1631	1528.52

AS=Ash, VM= Volatile matter, FC=Fix Carbon, CV =Calorific Value

2.2 Oil agglomeration experiment: The oil agglomeration technique is used up gradation if marginal CV sample of Matasukh mines of Nagaur, Rajasthan. Citrullus is local available herbs exist in Rajasthan near lignite coal mines. Process of oil agglomeration is shown in Fig.2 of lignite coal Matasukh mines.

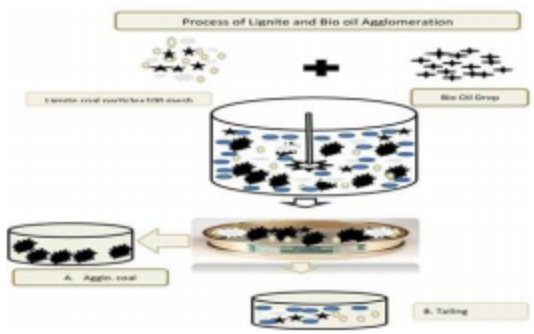

Fig.2 Process of oil agglomeration of lignite coal Matasukh mines.

At first 10 gm. of +100 mesh lignite coal sample was weighted in to dry watch glass and replaced into 250 ml beaker containing 10 ml tape water. Taking, thoroughly sacking 5 minute beaker at sample was properly wetted and later on it was made up 100 ml solution and replaced in to 100 ml stopper measuring cylinder thus the stopper measuring cylinder was slowly tilted four time and was allowed to settle down for 10 minute for blank whereas in oil agglomeration the required doses of agglomerant was added at this moment and kept for 10 minute settle down. Thus 10 % slurry was ready to use by wet sieve analysis as agglomerate lignite coal.

A. %RWThis 10% slurry having agglomerated lignite coal was separated by+100mesh at sieve top represented as w1 gm whereas passing particle was represented by -100mesh as w2 gm. This value is measurement of successful oil agglomeration method in up gradation of fine size lignite coal. It is result of interaction between fine size lignite coal and citrullus oil. The % RW: is

$$\%RW = (W1/W)*100 \quad (1)$$

Here RW=retained weight in percentage, W1=retained weight in gmW2=passing through sieve in gram, W=W1+W2 total weight in gm. The passing percentages is

$$\%PW\% = 100 - \%RW\% \quad (2)$$

Thus the separated w1 and w2 wt. of each mesh was ready to proximate and ultimate analysis of the sample by drying.

Table 2

% RW AD-lignite of Matasukh, Slurry 10%, PH Basic, Settle time 10 minute, Sieve Size 100 mesh with Citrullus for seed oil agglomeration

S.No.	Drop No.	%RWof+100mesh	%PWof-100mesh
1	00	20.7	79.3
2	01	16.2	83.8
3	02	28.0	72.0
4	03	33.0	67.0

ISSN NO.-2347-2944
Vol.-10, No.-I, Issues-11 YEAR- June -2019

+100 mesh= retained in 100 mesh sieve,-100 mesh= passing through 100 mesh sieve.

B. Combustible recovery (%CR)- The lignite had burning part was known by the combustible part and gained weight in gm after treated lignite coal was combustible recovery. Combustible efficiency analysis [14] was used in interpretation of the combustible efficiency washing performance. Thus the separated w1 and w2 each mesh was ready to proximate and ultimate analysis of the sample by drying. The lignite Coal releases thermal energy when it is burned along with carbon which was measured in % CR as:

%CR = (MC (1-AC)/MF (1-AF))*100 (3)

AC=ash content in clean coal in gm, AF=ash content of feed coal in gm, MC=mass of clean coal in gm, MF =mass of feed coal in gm.

Table 3

Combustible recovery AD-lignite of Matasukh, Slurry 10%, PH Basic,Settle time 10 minute, Sieve Size +100 mesh for Citrullus oil.

		+100Mesh			-100Mesh		
S.No.	Oil Drop	MC gm	AC gm	%CR	MC gm	AC gm	%CR
1	water	2.07	0.38.57	20.7	7.93	0.39	79.30
2	01	1.62	0.38.52	16.20	8.38	0.39	83.8
3	02	2.90	0.3290	30.75	7.20	0.3957	70.81
4	03	3.30	0.37.07	34.08	6.70	0.3913	67.00

of coals contain fixed carbon, which provides stored energy at burning in thermal plants. The coal ranking is based on levels of geological metamorphosis, fixed carbon, and calorific value under analysis and operating condition.

C. Carbonic Recovery- Carbonic recovery is negative measurement of the up gradation of coal due to carbon loss as ash. Carbonic recovery is detected as % wt. as :

%C. Recovery=((AT-AF)(100-AA))/((AT-AA)(100-AF)*100 (4)

OR =Carbonic Recovery, AF = Ash Feed in % weight, AA= Ash Agglomerated in % weight, AT= Ash Tailing in % weight.

D. Carbonic Recovery Average Rate (CRAR)- Carbonic contents interact with the used bio oils. This interaction is measured by the hydrophobicity. This phenomenon is detected by the carbonic recovery average rate (CRAR) which is detected as %CR in unites time as :

CRAR= (%Carbonic recovery)/T (5)

CR =Carbonic Recovery, T=Time used agglomeration in sec.

These are also referred to as drive parameters for oil agglomeration.

Table 4

Carbonic Recovery AD-lignite of Matasukh, Slurry 10%, Sieve Size 100 mesh, PH Basic, Settle time 10 minute for Citrullus oil agglomeration.

		+100mesh			-100mesh				
SNo.	Drop	%AC	%AM	%AS	%AC	%AM	%AT	Car.R	CRAR
1	0	9.21	17.52	38.57	10.11	13.99	39.99	86.88	1.44
2	1	14.13	12.35	38.52	8.66	17.30	39.05	54.96	9.16
3	2	15.25	16.25	32.90	10.25	15.18	39.57	13.30	2.21
4	3	4.75	23.18	37.07	5.22	20.65	39.13	18.45	3.07

E. Proximate analysis- The analysis of lignite coal which was carried out by measuring the physical parameter is referred to proximate analysis of lignite and used parameters are termed as the principle parameters.

These parameters are of having fundamental properties of lignite coal. These are moisture, volatile matter, ash & fixed Carbon. In proximate analysis determines moisture, volatile matter, ash & fixed carbon as mass loss in percentage as in experiment.

The high value the volatile matter and fix carbon are in favor of good quality and contains combustible part of lignite coal whereas the high value of moisture and ash are in favor of low quality lignite coal and contains noncombustible part of lignite.

This analysis the physical parameters are used to up gradation of lignite coal. The analysis of lignite coal which was carried out by measuring the physical parameter is referred to proximate analysis of lignite

ISSN NO.-2347-2944
Vol.-10, No.-I, Issues-11 YEAR- June -2019

Table 5

The Proximate analysis AD-lignite of Matasukh, Slurry10%, PH Basic, Settle time 10 minute, Sieve Size 100 mesh, for Citrullus oil.

		+100mesh				-100mesh			
S.N	Drop	%FC	%M	%AS	C.V.	%FC	%M	%AS	C.V.
1	0	9.21	17.52	38.57	1631.00	10.11	13.99	39.99	1528.52
2	1	14.13	12.35	38.52	1775.50	8.65	17.30	39.05	1574.30
3	2	15.25	16.25	32.90	2093.00	10.25	15.18	39.57	1599.05
4	3	4.75	23.18	37.07	1548.50	5.22	20.65	39.13	1460.54

3. Results and Discussion- 3.1. The agglomeration was carried out by the citrullus seeds oil in which % RW of +100 mesh and

%PW of -100 mesh sieved were being represented 28% and 72% respectively and represented in the Table No. 2. In this research it was observed that the retained weight of +100mesh increased successively due to raise up agglomeration phenomena which show that the agglomeration was directly proportional to the amount of citrullus seeds oil agglomerant whereas the passing weight of -100 mesh decreased in successively. The retained weight is shown in the Fig. 3.

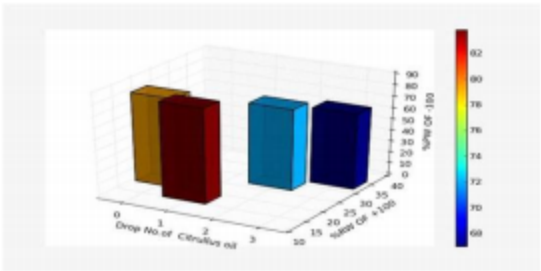

Fig. 3.Representation of % RW and %PW by 2 drop of citrullus oil.

3.2. The removing of ash was in favor of the up gradation of lignite coal. The up gradation was also carried out by the citrullus seeds oil by oil agglomeration. In this research the ash decreased 5.67% for

+100 mesh fine size lignite coal particle at 2 drop citrullus seed oil and Combustible recovery was obtained 30.75% and value added value as +10.15 combustible recovery in agglomerated lignite coal by 2 drop Citrullus seeds oil for +100mesh.The results were given in Table 3 and represented in the Fig.4.

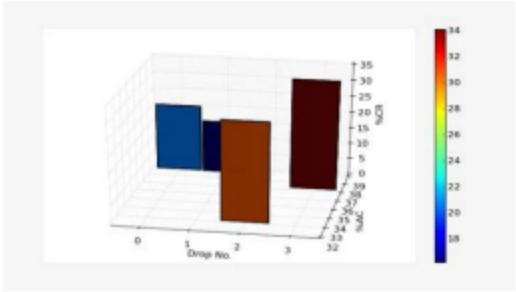

Fig. 4. Representation of % Combustible Recovery by the citrullus oil.

3.3. Carbonic recovery is negative measurement of the up gradation of coal due to carbon loss as ash and. These principle parameters are used for assessing the quality of lignite coal and measured the ratio of combustible and non-combustible constituents in lignite coal. The high value the volatile matter and fix carbon are in favor of good quality and contains combustible part of lignite coal. This oil agglomeration interaction is measured by the hydrophobicity. This phenomenon is detected by the carbonic recovery average rate (CRAR). In present research the carbonic recovery 13.30% and CRAR

2.21 was obtained in citrullus oil agglomeration. Representation of % Carbonic Recovery and CRAR by the 2 drop citrullus oil agglomeration is given in Fig.5.

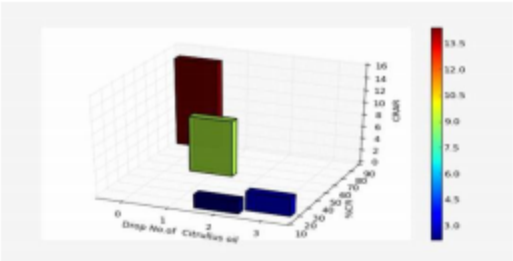

Fig.5. Representation of % Carbonic Recovery and CRAR by the 2 drop citrullus oil agglomeration in favor of up gradation.

3.4. The lignite coal proximate analysis was carried out for100 mesh sieved. The proximate analysis show that non treated lignite coal had marginal CV 1631kcal/kg in water and the principal

ISSN NO.-2347-2944
Vol.-10, No.-I, Issues-11 YEAR- June -2019

parameters %AS 38.57 was maximum and %VM 17.52, %FC 9.21 were minimum which showed poor quality of lignite coal. The treated lignite coal had %VM 16.25,%FC 15.25 show up gradation of lignite coal as value added increase %FC +6.04% whereas the high value of moisture(35%) and %AS38.57 are in favor of low quality lignite coal. The treated lignite coal contains noncombustible part of lignite as %AS 32.90 as value added lignite coal decrease %AS -5.67 in oil agglomeration. Representation of principal parameters are given by Fig. 6 in the citrullus oil. In proximate analysis determines moisture, volatile matter, ash & fixed carbon as mass loss in percentage as in experiment. The proximate analysis is quantitative and physical properties measurement as physical parameters of fine size lignite coal particle in citrullus oil.

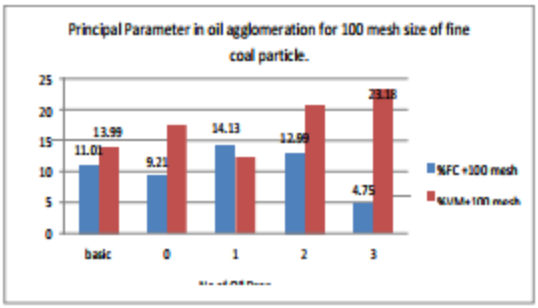

Fig. 6. Representation of principal parameters by the citrullus oil.

3.5. The increasing C.V. is main target in up gradation of fine size lignite coal. At initially dry condition fine size lignite coal contains marginal C.V. 1619.84 Kcal/Kg whereas In the absence of bio oil the up gradation was carried out like wet sieve technique in which+100 mesh got CV 1631.00 kcal/kg for whereas -100mesh 1528.52 kcal/kg in presence of tape water as tailing. The treated fine size coal , in the presence of bio oils the C.V. increased with the No. of drops and at 2 drop of citrullus oil the+100 mesh got maximum CV 2093 kcal/kg and CV increased +473.16 kcal/kg as value added product. The separation technique involved the inherent self-disintegration behavior of the mineral in water followed by bio oil agglomeration. Therefore, there is good need to up gradation of lignite coal for long life by using biotic oils technologically. In this research, the citrullus oil gave fruitful and innovative up gradation of fine size +100 mesh of Matasukh mines by using minimum requirement drop of Renewable fuel as citrullus oil. This method will be useful in near future due to zero carbon emission. The results are shown in Fig. 7 and Table 5 of CV up gradation by No. of drop citrullus oil.

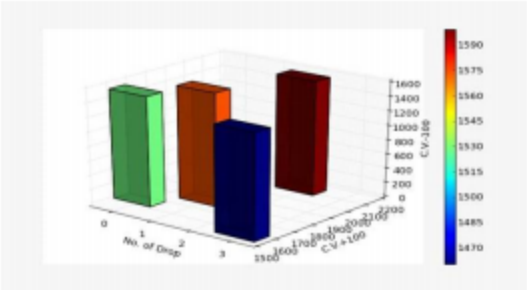

Fig.7.Representation of CV up gradation by No. of drop citrullus oil.

4. Conclusions-

4.1. The fine size +100 mesh lignite coal of Matasukh mines was successful agglomeration by 2 drop citrullus oil having 28% wt. recovery as successful agglomeration method for value added lignite coal.

4.2. The doses of agglomerant was studied which was detected 2 drop maximum requirement for 10%slurry to give combustible recovery 30.75%,cabonic recovery 13.30 and CRAR 2.21.

4.3. The up gradation take place successfully in citrullus oil agglomeration .The optimum CV was obtained 2093kcal/kg with+473.16kcal/kg as value added lignite coal product.

Acknowledgements- The authors are thankful to the University Grants Commission, Bhopal, and the head, Department of Chemistry J.N.V. University Jodhpur for providing the financial support and all necessary facilities during the investigation.

REFERENCES

1. Yakup Cebeci, "Performance of difference oils agglomeration of zonguldak coal"

Indian Journal of chemistry Technology, 2003;10,654-660.

2. Lin Shaobina, Chen Boa,b, Chen Wenronga, Li Wenhuaa, Wu Shenga, " Study on clean coal technology with oil agglomeration in FujianProvince" Procedia Engineering, 2012;45, 986 - 992.
3. V.A. Arkhilov, D,Yu.F.Patrakav and A.S. Vsanina, "Determination of contact angle on the coal surface ,"Journal of mining Science, 2011;5,561-565.
4. Zen Yoshimistu, Akira Nakajima, Toshiya Watanabe and Kazuhito Hashimoto,2002 "effect of surface structure on the hydrophobicity and sliding behavior of water droplets"Langmuir,18,5818-5822.
5. Caiping Meng, "On the Ecological Reconstruction of the Coal Mining Area Based on the Sustainable Development" Journal of sustainable Development, 2010;3-1,187-189.
6. Duong V.Ta, Andrew Dunna, Thomas J.Wasley, Robert W.kay, Jonathan Stringer, Patrick J.Smith,Colm Connaughton, Jonathan D.Shephard, "Nanosecond laser texured super hydrophobic metallic surface and their chemical sensing applications" Applied surface Science, 2015;357,248-254.
7. M.yekeler,A.ozkan , "Relationship between breakage and wetting characteristics of lignite," Indian Journal of engineering and materials Sciences, 2002;9,383-389.
8. Patnaree Buranasrisak and Monpilai H.Narasingha "Effect of particle size distriburion and packing characteristics on the preparation of highly -loaded coal - water slurry"Intenational Journal of chemical engineering and Application , 2012;3-1.
9. Capes C.E. and Germain R. j., Selective oil agglomeration in fine coal beneficiation, " In physical cleaning of coal ,Liu, Y.A. ,Ed. Marcel Dekker inc. New York. (1982);293-351.
10. Karin Ericsson, "Co-firing - A strategy for bioenergy in Poland?" The International Journal, 2007; 32,1838-1847.
11. Igwenyi, I. O, "Phytochemical Analysis and Vitamin Composition of Irvigna Gabonesis and Citrullus Colocynthis"Journal of Pharmacy and Biological Sciences, 2014; 9-3, 37-40.
12. Nabila Benariba, Rabeh Djaziri, Wafaa Bellakhdar, Nacera Belkacem, Marcel Kadiata, Willy J. Malaisse, Abdullah Sener, "Phytochemical screening and free radical scavenging activity of Citrullus colocynthis seeds extracts"Asian Pac J Trop Biomed, 2013; 3-1,35-40.
13. R.Saidur.E.A.Abdelaziz, A.Demirbas.M.S.Hossain,S.Mekhilef, "A review as a fuel for boilers" renewable and sustainable energy review, 2011; 15,2262-2289.
14. Ismail Demir, Ilgin Kursun, " Investigation of radioactive contents of manias soma and Istanbul agacli coals(turkey)" Physicochem.Probl.mine Process, 2012;48-2, 341-353.

*****