Microbial Ash Removal of Coal

B. K. YADAV
Shekhawati Institute of Engineering and Technology

Abstract- In this present study an attempt has been made to carry out the investigation on microbial Ash removal of coal using an acidophilic, sulphur oxidizing bacterium, Thiobacillus ferrooxidans in three different laboratory equipments. For this purpose, high sulphur coal has been obtained from Assam (India) and subjected for proximate and ultimate analysis to ascertain various constituents such as ash percentage, moisture content, volatile matter and C, H, N, S percentage present in the coal. Further coal sample was subjected for bio oxidation was carried out in three different laboratory equipments such as Shake flasks, Bioreactor, and Pachuka tank. The experiments were carried out for a period of 25 days at 300 C with initial pH 2.5 with 2% pulp density. From the studies it was possible to reduce a maximum of 26.55 % Sulphur, 18.65 % Nitrogen and 70.3 % Ash in Shake flask studies. A maximum reduction of 29.65% of Sulphur, 63.81 % of Nitrogen and 56.89 % of Ash was observed in studies carried out using a Bioreactor.Similarly, a reduction of 28.15 % Sulphur, 21.46 % Nitrogen, and 52.01 % Ash was obtained in Pachuka Tank tests.

Indexed Terms- Coal; Thiobacillus ferrooxidans; Desulphurization.

I. INTRODUCTION

Coal is one of the principal contributors of energy resource widely used in thermal power plants, metallurgical industries especially in iron and steel making process in the form of coke. However, the effectiveness and utilization of coal mainly depends on its rank and grade, which is assessed by its maturity, combustible, non-combustible and other deleterious constituent present. Among the various deleterious constituent, high sulphur present in coal decline it uses in the user industries and it limit its application especially in the production of coke. From the literature it may be noted that sulphur present in coal is associated with both inorganic and organic form. The inorganic sulphur is mainly contributed by the presence of sulphide minerals such as pyrite, arsenopyrite, sphalerite, galena etc. and sulphate minerals mainly anhydrite, gypsum and iron sulphate. Studies have also shown that these minerals are not bound and they are randomly distributed throughout the coal seam [1]. However, the organic sulphur is contributed by the presence of mercaptans, thiophenols, thioester, dithioesters, dibenzothiophenes, which possess covalent bonds and embedded within the coal matrix [2].

Presently large amount of coal is used as a fuel in thermal power plant, metallurgical industries in the form of coke. The presence of high sulphur and other impurities decline its utilization in user industries. Utilization of such coal leads environmental hazards, such as formation of acid rain, production of fly ash, releasing of excess CO2 contributing towards the global warming [3].

Therefore, in order to reduce sulphur from the coal, various methods have been employed including physical, chemical and biological processes. Form the literature it may be noted that, physical method is cost effective however; it removes sulphur from coal resulting in loss of energy by removing fine coal particles in case of flotation [4],[5]. Chemical method necessitates high temperature, which alters the economics of desulphurization process. Microbial processes essentially utilize different types of microbial culture, which brings about significant modification such as changes in oxidation and reduction reactions, surface adsorption, formation of chemical metabolite products etc., [6], and [7]. It has low capital and operating cost with compare to other process further there will be no loss of fine coal particles hence no loss of energy [5]. Therefore, from the literature it may be seen that microbial desulphurization of coal has gained more importance in recent years, which may be attribute to flexibility and environmentally benign nature of the process.

II. EXPERIMENTAL

2.1 Materials

The high sulphur coal is obtained from Assam. The sample was collected from the open cast mines from 18 metres seam. Collected coal sample were subjected for crushing and grinding to produce -75 micron size fractions. Further ground samples were subjected for proximate and ultimate analysis. Proximate analysis was carried out according to Indian Standards method (IS: 1350). The ultimate analysis was carried out using CHNS analyser of VerioEL III CHNS

III. RESULTS AND DISCUSSIONS

3.1 Reduction of Ash

Ash is the non-combustible mineral matter, which reduces the heat value of the coal and from the experiments it has been observed that high amount ash was reduced during the desulphurization process. The results of the studies are given in Fig. 1

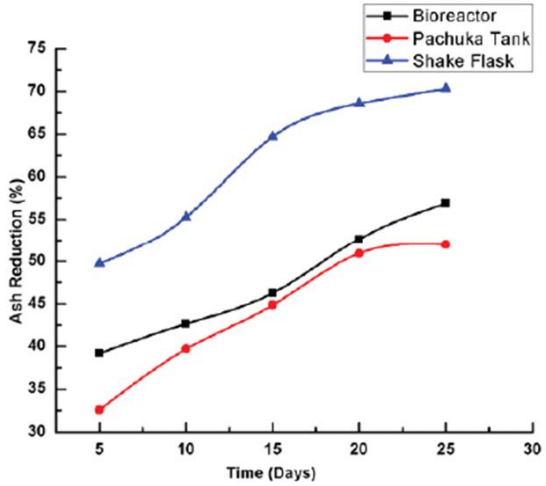

Fig1Reduction of Ash with respect to time

IV. CONCLUSION

A maximum of 70.3 % of ash has been removed in shake flask

V. REFERENCES

[1] Calkins, W.H., 1994, "The chemical forms of sulfur in coal: a review." Fuel, 73(4), pp. 475-484.

[2] Klein, J., Van Afferden, M., Pfeifer, F. and Schacht, S., 1994, "Microbial desulfurization of coal and oil." Fuel Processing Technology, 40(2-3), pp. 297-310.

[3] Nursanto, E., 2008, "Desulphurization of Tondongkura coal of South Sulawesi with Thiobacillus ferrooxidans ATCC 127811 bacteria." Jurnal Teknik Gelagar, 19(2), pp. 85-90.

[4] Kargi, F. and Robinson, J.M., 1982, "Removal of sulfur compounds from coal by thermophilic organism Sulfolobus acidocaldarius." Applied and Environmental Microbiology, 44(3), pp. 878 883.

[5] Garcia, F., Balzquez, M.L., Gonzalez, F., Ballester, A. and Munoz, J.A., 1993, "A comparative study of the biodesulphurization of two Spanish coals with Thiobacillus and Sulfolobus." Biorecovery, 2, pp.179 194.