ANJANEE KUMAR
B. K. TEWARY
M. BANERJEE
and
M. AHMAD

A simplified approach for removal of suspended coal fines from black water discharge of mining and its allied industries

Suspended fine particulate matters generated from different mining activities such as washing and crushing of coal affect large volume of natural water. The present paper highlights a simple method to improve the settlement rate of dispersed coal fine particles by incorporating them into a coarser particulate matrix. The process mentioned herein consists of three steps viz. activation of coal fine in aqueous medium, tether of activated particles to the anchor particles and pass them into straight flow stream. The activation of coal fines suspended in the effluent water may be an amine group of polymer which can link to a particle surface of metal oxide to complete the interaction for sedimentation of coal fines. The coagulated coal fine is further separated by gravitation and filtration process.

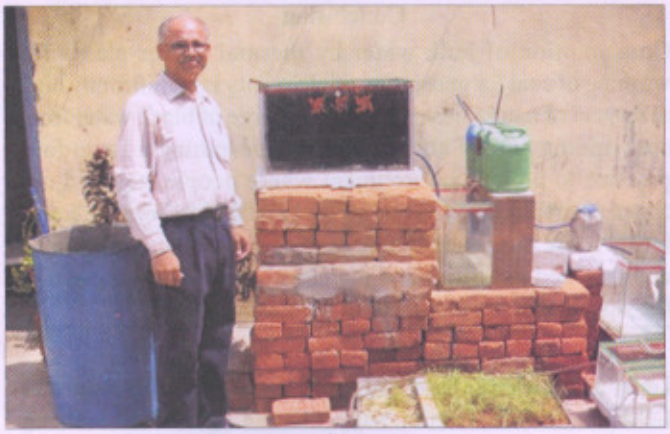
Introduction

Transforming of coal to energy is cheaper than other methods. However, coal is a highly polluting agency. The washing of coal is necessary to get better raw material for thermal power plants. Suspended particulate matter of coal fine from washeries, coke oven and coal-based industries influence the surrounding water qualities at their discharge point. Waste water from coal washeries have been identified as a major source of water pollution for adjacent river such as Damoder river of Jharkhand [1, 2]. Black water is nothing but it is wastage of valuable coal fine from washery. Generally, the discharged suspended particulate matter is difficult to remove from effluent. It is being retained in the series of tanks or in lagoon, which takes long time to settle the suspended coal fines. It is found that during crushing, washing and beneficiation of coal, the effluent from washeries carries lot of coal fines with high calorific value and low-ash content. The separation of fine particles and recycle of the same water will be beneficial from the economical point of view. Particle size of the coal and inorganic constituents suspended in the waste water finer than 325 meshes or about 44 microns [3]. The relation of suspended solid depends on the physico-chemical properties of coal and the enclosing rock. Usually coal particles predominate over rock particles; however, the ratio is not constant and varies with changes in mining condition [4]. The incomplete removal of suspended particle from black water and releasing into the adjoining river create a great hazard to potable water of surrounding areas. Mining and its allied industrial activities in and around mining area lead to acute shortage of potable water [5]. Many of the washeries intake large volume of water from the adjacent river and discharge back their black water in the same river; this degree of pollution load is increasing day by day in the source of running water.

Messrs. Anjanee Kumar, B. K. Tewary, M. Banerjee and M. Ahmad, Scientists, CIMFR, Barwa Road, Dhanbad and Mr. M. Banerjee, Professor, Deptt of Chemistry, Ranchi University

Methodology

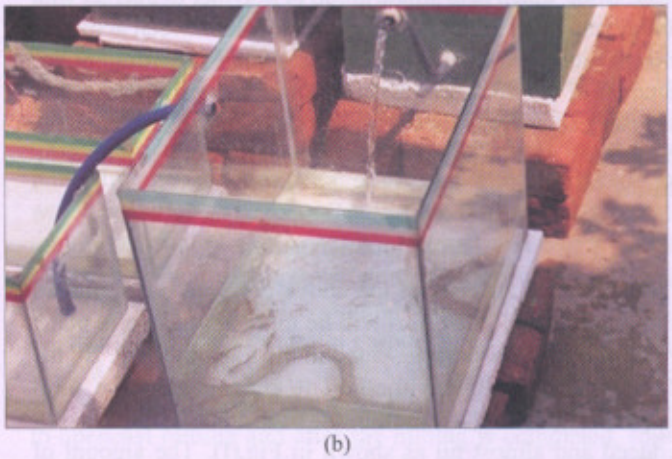
The objective of the present approach is to make an effort for equilibrium between optimum productivity to fulfil our desire of energy and generation of minimum pollution in the social life to serve the natural identity of atmosphere [6]. Suspended particulate matter in the effluent of coalmining and its allied industries need due attention for its removal. An effective approach is established in the laboratory scale to clear up mine-discharge water containing coal suspended particulate matter. In this methodology, the settling rate of fine dispersed materials of coal washery effluent discharge is enhanced and removed by coagulating it into a coarser matrix. The fine particulate matter first activated by organic polymer having at least one amine group followed by tether with anchor particles and finally sedimentation of fine particles–anchor particulate complexes. The separation of coal fines from effluent water is also achieved by forth flotation process. From literature survey it was found that hydrocarbons used to agglomerate coal particles from heavy fuel oils, waste lube oils to form water emulsion by intense agitation. Finer the coal more is the hydrocarbons required to achieve desirable level of clarified water. The treated coal fines are separated in the upper surface of the waste water. In the simulative laboratory experiment the waste water of coal washery is clarified in a two-step process in which coal particles are first agglomerated and separated from the waste water. Thereafter,



(a)

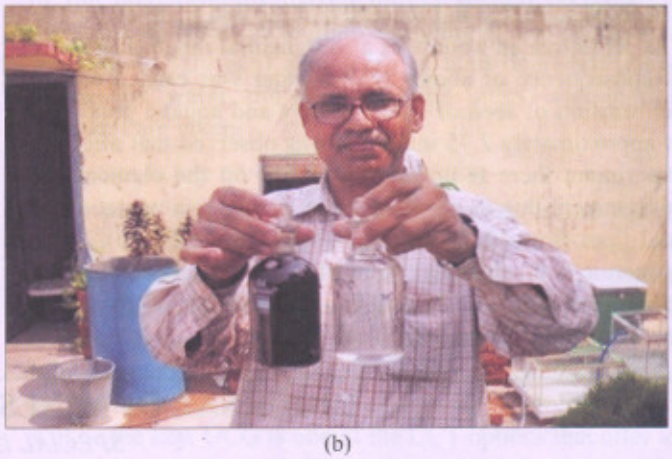
(b)

(a)



(b)

(a)



(b)

Figs.(a) to (f) highlight the sedimentation of suspended coal fines from mine black water

the other constituents contained in the waste water are separated by suitable stream. It involves passing the black water through a reservoir or tanks to recover the large particles of coal fines. Further it is passed to a thickener where a fine sludge fraction is removed. The consolidation carried out to combine the fine particles dispersed in water by the use of high molecular weight polymers followed by linking together of dispersed particles by use of multivalent metal salts. The linking of this coagulate coal fine with inorganic metal oxide will increase the mass of size of consolidated fine particles. The agglomerated mass is settled below the surface of the tank. The mechanism of the separation of suspended particulate matter from black water is indicated below:

Activation of fine particles ⟶ Tether of fine particles ⟶ Anchor of fine particles

Activation of fine particles is the interaction of an activating material such as a polymer, with suspended

particles of coal fines in aqueous solution. During activation, the fine particles become coated by the activating polymer, these coated fine particles adopt some of the surface properties of the applied polymer. This altered surface character of coal fine particles is helpful for consolidation and sedimentation. The activation step may be performed by using flocculants or hydrolysis of polymeric compounds anionic polymers such as polyacrylamide, polyacrylic acid, sulfonated polystyrene, cationic polymers such as olydiallyl dimethylammonium chloride branched or linear polyethylenemine, polyvinyl amine, and non-ionic polymers such as polyethylene oxide, polypropylene oxide, polyhydroxyethylacrylate, polyhydroxyethylmethacrylate. Non-ionic polymers are suitable for hydrogen bonding with metal oxide which help amine group of polymer to interact with coal fines. In the tether process, interaction between activated fine particle and anchor particle attached to sediment for removal of the coal fine particles from the effluent. Anchor particles make it easy for the separation of coal fine. Generally, the density of anchor particles is heavier than the flowing stream.

Result and discussion

The laboratory analysis of the above pre- and post-polluted water reflects that the effort will be more applicable to black water of coal fines as represented in the Figs.(a) to (f). By the straight-flow treatment method it appears that the total suspended particulate matter of fine coal is remarkably reduced and almost nil as shown in Fig.(f). The amount of dissolved solid was not increased at the end point of Fig.(f). The pH of treated water was also in neutral range. The study of consequence of above treated water was carried out on germination of seed of wheat, paddy and aquatic pond fish of approximately 2.75 inches. It was observed that after the experiment there is no adverse effect on the elements of environment due to chemical used during sedimentation of coal fines from black water as shown in the Fig.(d). From economic and ecological point of view the second stage of experiment is further needed for investigation on reuse and recovery of coal fines from black violent flow.

Conclusion

Consumption of bulk water by thermal power plants for washing of coal for generation of electricity is significantly high in respect of natural reserve. The discharge of black water from coal mining and its allied industries becoming a hazardous practice to pollute environment where people stay and use adjacent stream. The above experimentation can be an effective tool to make flowing river free from coal fines adjacent to mine and its allied industries and thereby able to protect nature for the sustainable development of next generation.

Acknowledgement

I duly acknowledge Dr. P. Pal Roy, Director-Level-Scientist of CIMFR for his able support and guidance during experimentation. Thanks are due to Prof. Lilawati, Department of Chemistry, P.K. Roy College, Messrs. Pradipta Kumar Behura, Nagarjuna Construction Ltd; Nadia, W. B. and Durga Prasad, Ex-BCCL Officer, Dhanbad for help and cooperation. The support extended by Messrs. Bashudev Mukherjee and Nurul Hindwi of CIMFR, Dhanbad is also thankfully acknowledged.

References

1. Bhattacharya, Prof. B. B. (2010): "9th Professor S. K. Bose Memorial Lecture", Indian School of Mines, Dhanbad, Jharkhand, 27th December.
2. Singh, G. and Gupta, R. K. (2007): "Water pollution from coal washeries and its impact on Damodar River", *The Indian Mining & Engineering Journal*, December.
3. Stokes, Kristoffer K: "System and method for removing finely dispersed particulate matter from a fluid stream", US Patent no 3856668.
4. Gorshkov, V. A. (1983): "Main method and technique of mine water treatment in the USSR", *International Journal of Mine Water*, 4, pp 27-34.
5. Singh, G. (1990): "Status of Water Quality in a Coal Mining Environment – A Case Study in The Jharia Coalfield, Jharkhand", *Journal of Industrial Pollution Control*; 6 (2),pp 69-76.
6. His Holiness Acharya Mahapragya, Ahimsa Yatra, Rajasthan, 2007.