Nature Environment and Pollution Technology © Technoscience Publications	Vol. 6	No.4	pp. 649-652	2007

TREATMENT OF TEXTILE EFFLUENT USING FLY ASH AS ADSORBENT – A CASE STUDY FOR TIRUPUR REGION

R. Malathy and N. Rajkumar
Department of Civil Engineering, Kongu Engineering College, Perundurai, Erode-638 052, Tamilnadu, India

ABSTRACT

This paper aims to provide a solution to the prevailing environmental problems due to wastewater from textile industries and dumping of fly ash by the thermal power plants in India. This work is an attempt to find out a solution through low cost treatment methodology. In this study, fly ash, which is produced as waste from the thermal power plant, was used as an adsorbent for the wastewater from textile processing industries particularly in Tirupur region of Tamilnadu. This is an attempt to make use of fly ash as a material to reduce the pollutant concentration in the textile industries wastewater. Column technique has been adopted in this study for adsorption. The fly ash used in this experimental study was collected from the Mettur Thermal Power Plant. The fly ash was used as an adsorbent by packing it in PVC column in different layers with alternative layers of sand in between them. The dyeing effluent was allowed to flow through it from the top with suitable arrangements. The dye stuffs were found to get adsorbed on the fly ash layer. The fly ash was separated and dried later.

INTRODUCTION

Water is essential to all forms of life. Tirupur and Erode in Tamilnadu are well known textile centres in India particularly for textile processing. The main water resources for these industries are Noyyal, Bhavani and Cauvery rivers. Most of the textile industries situated in these regions are small and medium, which are unorganized in nature in view of effluent treatment facilities. Most of the coloured effluents are discharged into the river particularly into river Noyyal, without any proper treatment. So it is necessary to find low cost and affordable treatment for the coloured textile wastewaters. This study aims to use fly ash, an industrial solid waste, for the treatment of wastewater (Chien-Jung Lin et al. 2001) from textile processing industries. Hence, this experimental investigation will definitely be helpful for the society in reducing pollution due to effluent from textile industry and due to fly ash.

MATERIALS AND METHODS

Textile Industries: Tirupur and Erode in Tamilnadu are well known centres for textile industries. Among these, Tirupur dominates most in polluting the environment. There are around 600 dyeing and bleaching industries in operation in the town. These industries release a large quantity of wastewater which in turn is treated in the same industries or in common effluent treatment plants. Some of the small scale industries discharge the wastewater even without treating it. This results in pollution of the natural streams in the nearby areas. Even though there are lot of methods to treat the textile industry effluents, small scale industries are not implementing them due to cost problems. So it was thought to introduce a new and cost effective treatment technique to reduce the pollution (Chiu-Yue Lin and Dong-Hao Yang 2000) due to textile industries.

Fly ash: Fly ash used in this study was finely divided fuel dust obtained from the combustion of pulverized coal in Mettur thermal power station. It is generally finer than cement and consists of mostly of spherical glassy compounds of complex composition. It can also be used to treat the textile effluent. This is of the major advantage because one waste material i.e., the fly ash is used to treat another waste (dyeing effluent). Fly ash particles consist of silica, alumina, oxides of iron, calcium and magnesium, and toxic heavy metals like lead, arsenic, cobalt and copper. Fly ash can be used to remove dyes from wastewater and it can also be used to adsorb the heavy metals from wastewater**.**

Sand: Naturally available river sand was used in the study. Sand was used in alternate layers with fly ash in the adsorption column. Thin sand layer is used in the column through which the effluent is subjected to adsorption.

PVC Column: PVC pipe of internal diameter of 20 cm was used as column in this experimental study. The material is inert, nonreactive and nonporous.

Experimental Investigation

In this experiment, adsorption technique has been used. Adsorption is the surface phenomenon in which the material will be adsorbed to the adsorbent. Adsorption may be either physical or chemical. It can be explained as if a solid surface is in contact with a solution, solute molecules from the latter have the tendency to accumulate on the surface as surface layer. A methodology adopted in the present study has been arrived that best suits (Albanis et al. 1998, 2000) the industrial requirements and has been shown in Figs. 1 and 2.

Packed Column: The PVC column of 20 cm diameter and 60 cm height was used in the study. The column was packed with adsorbent materials in plain manner or in alternate layers of adsorbent and inert sand. In order to check the effectiveness of adsorption, the column of short size was taken. In case of applying to the large industries, the column of large size can be used.

The experimentation was done by using single layered and multiple layered fly ash columns. In the single layered fly ash column, the bottom of the column was filled with sand for 50 mm thickness and above it fly ash layer of 120 mm and sand layer of 30 mm at the top were provided. Whereas in the multiple layered fly ash column, the sand layer of 20 mm thickness was provided at the bottom

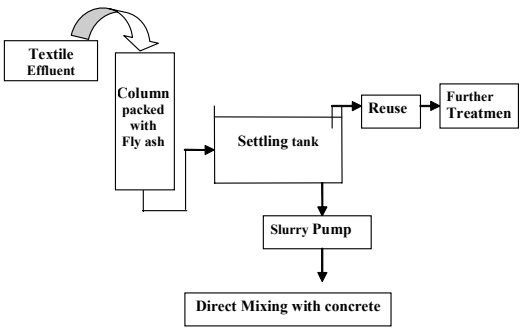

Fig 1: Methodology of fly ash treatment for textile industry effluent.

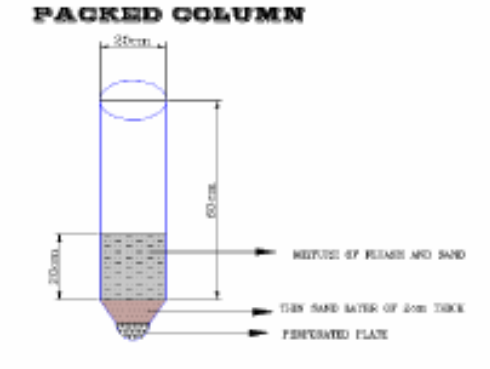

Fig.2: Packed column layout

Table 1: Comparison of effluent parameters before and after fly ash treatment.

Properties	Before Treatment	After Treatment	
		Single Layer	Multiple Layers
Colour	Dark Green	Colourless	Colourless
pH	9	8.32	8.09
TDS (mg/L)	9380	5650	5230
Hardness (mg/L)	3140	1520	1440
Chlorides (mg/L)	4670	4210	4130
COD (mg/L)	980	313	232

Table 2: Percent reduction of pollutants after treatment in single and multiple layers.

Properties	% Reduction After Treatment	
	In single layer	In multiple layer
Colour	-	-
pH	7.6	10.1
TDS	39.8	44.2
Hardness	51.6	54.1
Chlorides	9.9	11.6
COD	68.1	76.3

Table 3: Fly ash properties before and after treatment.

Composition	% by weight	
	Before treatment	After treatment
SiO_2	55 - 60	62.4
Al_2O_3	25 - 29	21.2
Fe_2O_3	4.5 - 4.8	3.4
CaO	0.5 - 1.2	4.8
MgO	0.3 - 0.5	1.0
Loss on ignition	2 - 4	4.8

above which 40 mm thick fly ash layer was provided. Similarly, another three layers of sand and fly ash were provided for the same dimensions. The removal of dyes by adsorption in column composed of fly ash and sand mixtures reach saturated conditions when the adsorbent mixture stops adsorbing the solute dyes.

RESULTS AND DISCUSSION

The parameters of the effluent before and after adsorption through the fly ash column are given in Table 1, and the percent removal of pollutants in Table 2. The fly ash properties before and after treatment are given in Table 3. The values of the different parameters are found to decrease after treatment through the single and multiple layered fly ash columns.

The total dissolved solids were found to be decreased by 40-45% when the textile industry effluent was allowed to pass through the adsorption columns. The hardness of the adsorbed effluent was found to be reduce by more than 50%. The chloride content of the effluent reduced by around 9-11.5%. The chemical oxygen demand got reduced by 68-77% after the effluent was allowed to pass through the adsorption column containing alternate layers of fly ash and sand.

From these results it is evident that the treatment process by, both single and multiple layered fly ash columns is effective, but multiple layered columns are better.

CONCLUSION

The study has proved that the use of fly ash in treating coloured textile waste is a good method to reduce the pollutant concentration in textile industry effluent. The removal of dyes from column experiments decreases with the increase of the solution concentration showing that the process to be highly dependent on the concentration of the solution. The treatment procedure, after meeting all the future improvements in its design, should be implemented to put up an end to the prevailing unhealthy environment because of pollution by textile units.

REFERENCES

Albanis, T.A., Danis, T.G and Kourgia, M. 1998. Adsorption-desorption studies of selected chlorophenols and metal release in soil mixtures with fly ash and soil. Environmental Technology, 19: 25-34.

Albanis, T.A., Hela, D.G., Sakellarides, T.M and Danis, T.G. 2000. Removal of dyes from aqueous solutions by adsorption on mixtures of fly ash and soil in batch and column techniques. Global Nest, The International Journal, 2: 237-244.

Chien-Jung Lin, Juu-En Chang, and Ming-Chun Lu 2001. Application of fly ashes in removal of metal ions from wastewater. Department of Environmental Engineering, National Cheng Kung University, Department of Environmental Engineering and Health, Chia-Nan College of Pharmacy and Science, Taiwan.

Chiu-Yue Lin and Dong-Hao Yang, 2000. Removal of pollutants from wastewater by coal bottom ash. Graduate Institute of Civil and Hydraulic Engineering, Feng Chia University, Taichung, Taiwan