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Fly Ash as An Adsorbent for Treatment of Textile Waste Water

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ABSTRACT

In present study, textile wastewater is analysed for its various characteristics. Fly ash is used as an adsorbent for the treatment textile of waste water for this purpose the batch process under the steady state conditions is used. The influence of adsorbent dose, pH of media is evaluated. A removal efficiency for COD and other parameters such as chloride, Hardness and TDS are studied. A COD removal efficiency of 60-65 % and colour reduction efficiency of 75- 80 % was achieved at 2 h of batch reaction under optimum dose of 3 g/ 100 mL of wastewater. Treatment of wastewater is one of the biggest problems faced by textile manufacturers. The purpose of the present study was to investigate the suitability of using fly ash as low-cost absorbent for treatment of textile effluent

Key words: *Textile effluent, fly ash, COD, waste water*.

1. INTRODUCTION

In order to maintain environmental sustainability, protect public health and ensure the long-term sustainability of water resources, wastewater treatment is essential. Numerous contaminants, including chemicals as well as harmful microbes, can be found in wastewater (Obaideen *et al*., 2022). Untreated wastewater can include harmful substances that damage public health. By removing or reducing these contaminants, the treatment process makes the water suitable for reuse or discharge. As a result, the public's health is protected and the spread of water born illness is reduced (Naik & Stenstrom, 2012). The water bodies and ecosystems are severely harmed by wastewater that has been improperly or completely treated (Sengupta *et al*., 2015). Excess nutrients, such as nitrogen and phosphorus can be introduced into water bodies by it, which can cause eutrophication, oxygen depletion and disturbance of aquatic ecosystems (Mara, 2009). Thus efficient water treatment contributes to reducing these negative impacts and maintaining integrity of natural ecosystems (Jadaa, 2024).

The textile and dye manufacturing industries are among the most problematic categories when it comes to the disposal of extremely toxic effluents because of the presence of toxic chemicals and dyes, which have detrimental impacts on the environment and marine life (Shah *et al*., 2013). According to reports, these industries yearly dump about 100 tons of hazardous colors into wastewater streams (Sun *et al.*, 2010). Chemical process equipment processing and cleaning accounts for the majority of water use in industries. These companies dump their extremely hazardous and complex untreated wastewater into rivers and the ocean (Namasivayam *et al.*, 2007). Textile effluent have a wide variety of colours, alkaline substances, heavy metals, turbidity, pH, temperature and biological and chemical oxygen demand (BOD and COD) and harmful materials (Shah *et al.*, 2013). Release of such effluent pollute the ecosystem and induce allergy illnesses (Gupta & Ali, 2004).

Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of coal fire plants. Coal is a major source of energy worldwide and large fraction (37 %) of it is used in electric power generation in the US. The coal fed power plant produces tons of fly ash, bottom ash and polycyclic aromatic hydrocarbons *(Harkness et al.*, 2015). It is mixture consisting of SiO2, Al2O3 and metal oxides which can be alkaline, alkaline earth and transition metal oxides (Izquierdo *et al.*, 2008).

Fly ash has a significant capacity for adsorption of organic compounds from aqueous solution, the carbon content of fly ash plays a significant role during the adsorption of organic compounds by fly ash. The adsorption capacity increases with the increasing carbon content of fly ash (Banerjee et al., 2014). The fly ash which is produced as a waste is used as an adsorbent for the treatment of textile industry which shows good adsorption capacity. The dye stuff get adsorbed on the fly ash layer

(Malathy & Rajkumar, 2007).

This study aims to use fly ash, an industrial solid waste for the treatment of wastewater 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..

2. MATERIAL AND METHODS

Sampling

Raymond textile industries, which is located at 5 km away from national highway 4, five start M.I.D.C. Kagar, Kolhapur city. Effluent is collected from textile industry and carried out for further analysis. Fly ash is collected from the brick kiln using fly ash from Kolhapur city.

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 capacity to accumulate on the surface.

Adsorption studies

All the experiment were carried out at ambient temperature in batch process. Batch method was used to study the adsorption. Experiments were carried out in the 250 ml of conical flasks. For studying the effect of adsorbent dosage, 100 ml textile effluent and dosage of fly ash varying from 1-3 g was mixed in each flask a retention time of 3 h was maintained after which solution was filtered through the Watman filter paper 42 and tested for parameters such as colour, pH, TDS, Chloride, Hardness and COD. Absorbance of textile wastewater for colour was recorded using UV visible spectrophotometer.

Reduction efficiency

Reduction efficiency of various parameters were calculated using following formula:

Percentage removal= $\frac{Co-Cf}{Cf}\ X\ 100$

Where,

Co=Initial concentration of adsorbate.

Cf=Final concentration of adsorbate.

3. RESULTS AND DISCUSSION

Parameter	Before treatment	After treatment	% Efficiency
Colour	Brownish	colourless	-
TDS (mg/l)	8580	2800	67.4
Hardness (mg/l)	980	300	69.4
Chlorides (mg/l)	2210	1846	16.5
COD (mg/l)	1360	480	64.7
Absorbance	0.98	0.2	79.6

Table 1: Study of adsorption at various doses of fly ash.

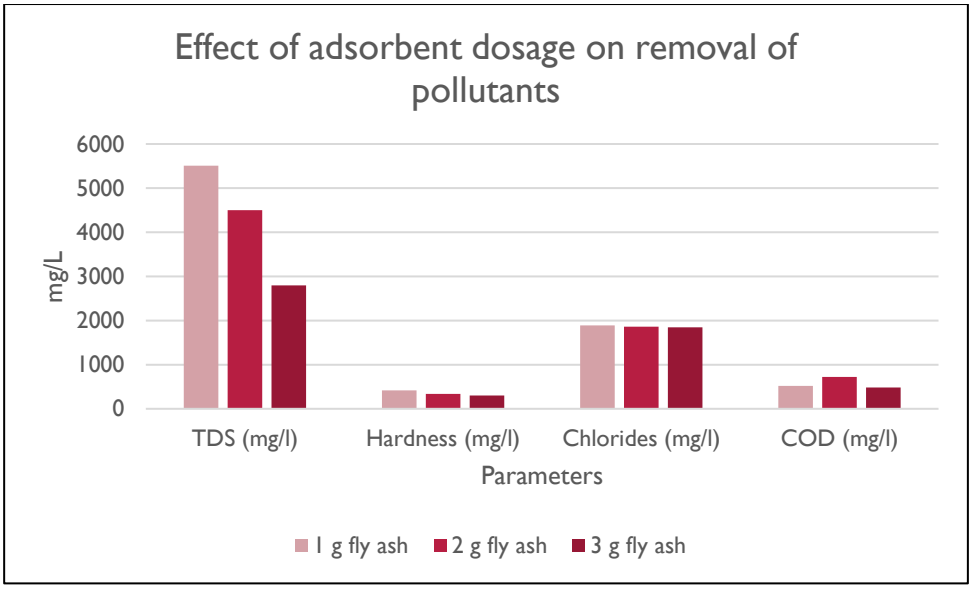

Figure 1: effect of dosage of adsorbent on pollutant removal

The removal of pollutant by treatment of variable dosage of fly ash from 1 g to 3 g per 100 mL of textile wastewater are given in table 1.

Table 2: Comparison of effluent parameter before and after treatment of fly ash at optimum dosage.

Parameter	**1 g fly ash**	**2 g fly ash**	**3 g fly ash**
TDS (mg/L)	5510	4500	2800
Hardness (mg/L)	420	340	300
Chlorides (mg/L)	1888	1862	1846
COD (mg/L)	520	720	480
Absorbance	0.41	0.24	0.2

The parameter of the effluent before and after adsorption through the fly ash and percentage removal of pollutants at optimum dosage of 3 g/100mL of textile wastewater are given in table 2.

The values of the different parameters are found to decrease after treatment through the batch process using fly ash as an adsorbent. The colour was found to get faint at 1 g of adsorbent while it got colourless at 3 g of adsorbent at 2 h of retention time. The total dissolved solids were found to be decreased by 40-46 %. The hardness of the effluent was found to be reduced by more than 65 %. The chloride content of the effluent reduced by around 15-17 %. Colour removal was studied using UV visible spectrophotometer and it has shown efficiency about 75 – 80 %. COD reduction efficiency was achieved 60-65 % after the treatment of fly ash as an adsorbent at an optimum dose of 3 g /100 mL of textile wastewater.

4. CONCLUSION

The investigation has proven that the use of fly ash in treating coloured textile wate is a good method to reduce the pollutant concentration in textile industry wastewater. The removal of colour from batch experiment increases with the increase in the dosage of adsorbent from 1 g – 3 g of fly ash showing that process is highly dependent on the dosage of adsorbent. The absorbance on UV visible spectrophotometer decreases with the dosage of the adsorbent. The treatment method, after meeting all the future improvements in the design can be implemented to put up an end to the prevailing unhealthy environment because of pollution by textile industries

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