

# Removal of Heavy Metals from Dyeing Industry Wastewater by Using Eco-Friendly Absorbents

Saravanan M, Gandhimathi A

**Abstract:** Heavy metals are the very toxic materials for the society. The effluents from textile industries into surface water bodies poses a threat to the aquatic organisms and human health, which is a matter of great concern due to their toxic nature and adverse effect. The small scale dyeing industries generate a large amount of pollution load which in many cases is discharged into environment without any pre-treatment. Dyeing industries releases a harmful heavy metals which is three to four times higher than standard values and most toxic pollutants due to its carcinogenic and teratogenic nature. Several methods have been adopted for the removal of heavy metals from dyeing industry wastewater. These methods include chemical reduction, precipitation, ion exchange, electrolysis etc., but these process contain more expensive so the small scale industries will not used those process for removal of heavy metals. Among the treatment process, absorption technique is very low cost method. In this study heavy metals from dyeing industry wastewater is removed by charcoal from various eco-friendly natural available absorbent materials of orange peels, Cavendish banana peels and lemon are used. The effect of various parameters such as dosage of absorbents for the removal of heavy metals, pH and effect of contact time, are studied. From this study, the removal of lead heavy metal by lemon was found to highly efficient 99.8 % at pH =6, contact time 35 min, absorbent dose 0.8 g/l. Removal of zinc heavy metal by lemon 94.39 % at pH =6, contact time 50 min, absorbent dose 0.6 g/l slightly better than banana 91.69 %, contact time 50 min, absorbent dose 1.6 g/l.

**Keywords:** Absorbents, Heavy metals, Various Peels.

## I. INTRODUCTION

Many of the small scale dyeing industries in Tiruppur, Tamilnadu which releases the toxic wastewater directly to the river, pond the heavy metals are very dangerous to our human being and animals. According to the world health organization (WHO) safety level of industrial wastewater releases guidelines, the maximum recommended limit for heavy metals Zn is 5mg/l and Pb is 0.05mg/l. A natural absorbents play a major roll to remove the heavy metals from dyeing industry wastewater. The main advantages of natural material used removal technology is its effectiveness in reducing the concentration of heavy metals which present in dyeing industry wastewater. As a result of the degree of problems caused by heavy metal pollution, removal of heavy metal from wastewater is important. Recent technology is to have been made to use cheap and available natural available absorbents to remove the heavy metal from dyeing industry wastewater.

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For this research, dry powder from orange, banana, lemon was used as absorbents to remove the Zn and Pb present in dyeing industry wastewater. Parameters such as a pH, magnetic stirrer speed, absorbents dosage and contact time, were investigated. The pore structure in test samples produced from various natural available material was investigated using UV Spectrophotometer.

## II. MATERIALS AND METHODS

### A. Materials

Orange, Cavendish banana, lemon peels is the materials used as an absorbents for the removal of heavy metals. This peels is an economic alternative for the removal of heavy metal ions from dyeing industry wastewater. The main component of peels are cellulose, pectin, hemicelluloses and lignin which contain functional group as possible binding sites for metal ions.



Orange peel



Lemon peel



Cavendish banana peel

### B. Absorbent preparation

Orange, Cavendish banana, Lemon peels are collected from local market in karamadai, Coimbatore were cut into pieces and dried under sunlight for 2 weeks. The dried peels are washed several times with tap water and distilled water respectively, the peels are allowed to dry in a oven at 75°C for 24 hrs. The samples are dried into the normal room temperature and then powdered which passes through 250-500mm sieves. Finally, the powder was washed with distilled water and dried in an oven at 50°C for 8 hrs.



Lemon powder      Orange powder      Banana powder

**C. Dyeing industry wastewater**

The wastewater sample used was collected from the effluent discharge point of dyeing industry in Tirppur, Tamilnadu state. It was carefully bottled in a container and was taken to the laboratory for further analysis.

**D. Analysis**

The heavy metals present in the dyeing industry wastewater sample, were analyzed by using the UV Spectrophotometer. It detected the concentration of Zn<sup>2+</sup> and Pb<sup>2+</sup>. The initial concentration of metal ions present in the wastewater are shown in table 1.

Heavy metals	Initial concentration (mg/l)
Zn <sup>2+</sup>	13.62mg/l
Pb <sup>2+</sup>	0.74mg/l

**Table 1: Initial concentration of metal ions present in dyeing industry wastewater.**

**E. Absorbent study:**

Absorbent experiment was done by measuring 100ml of wastewater sample and poured into a 250ml conical flask. 0.5g of test samples was added to the wastewater. The sample was placed on a jar of rotatory shaker and shook at 120 rpm at a room temperature for a period of 5min after settling the sample again it shook 80rpm of 30min to ensure equilibrium. The suspension was filtered use Whatman filter paper 42. UV Spectrophotometer was used to analyse the concentration of the different metal ions present in the filter paper by the absorbent evaluated by using equation(1):

$$qr = (co - cr)V/w$$

**F. Effect of Contact Time**

The contact time was 30 min to remove the metal ion. 0.5g of the absorbents was added to different conical flask contain 100ml of wastewater, it involved in rotary shaker, and agitated at 120rpm, for each of the different contact time as been selected (20, 60, 80, 120 min). Finally it will be filtered and stored.

**G. Effect of pH:**

Over a pH range of 2-5, the effect of pH on absorbent on metal ions was studied. 100ml wastewater sample was measured into 250ml conical flask and 1g of absorbents was added and agitated for few min. After the pH value was noted by using pH meter.

**H. Effect of Absorbent Dosage:**

Different dosages of the adsorbents 0.5 to 1.6g were added in different conical flasks containing 100ml wastewater sample, it will agitated for few 5 min.

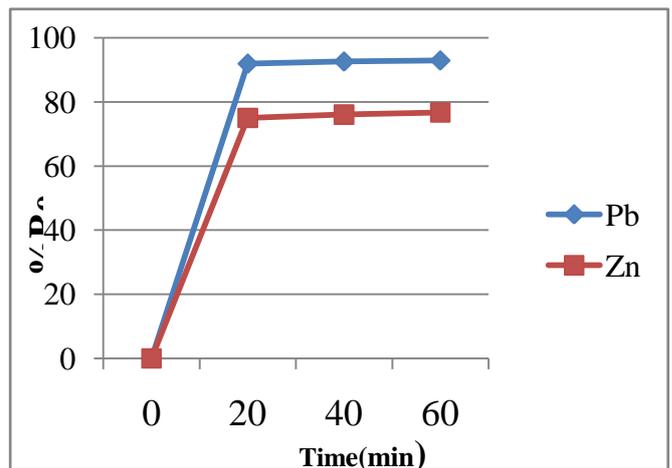
**Abbreviations**

Pb = Lead, Zn = Zinc.

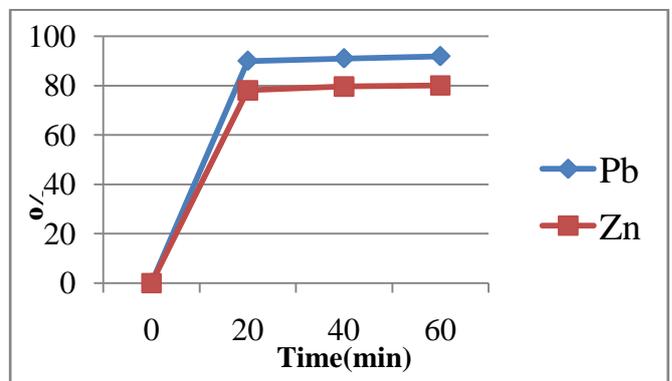
**III. RESULTS AND DISCUSSION**

**A. Effect of Contact Time**

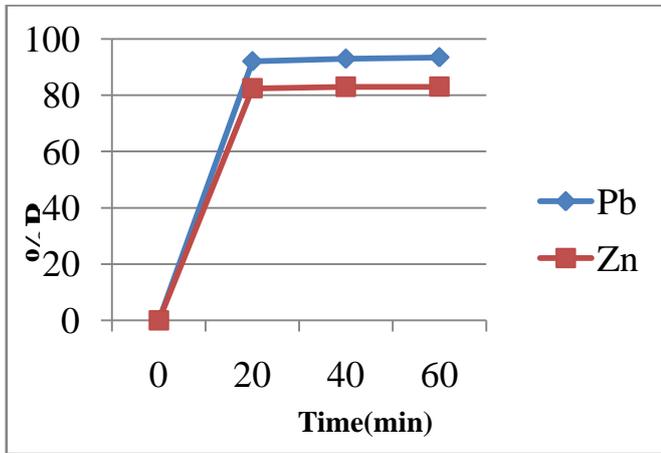
The contact time was 30 min at 34° C to remove the metal ion. From the result, it is evident that the removal of metal ions increased as contact time increases. Lead and Zinc were removed using the absorbents. The percentage of removal is 35 min for Pb, 50min for Zn ;with recording Lemon peel(Pb 92%, Zn 76.7%), For Orange peel (91.76%, Zn 80%) and Cavendish Banana peel (Pb 93%, Zn 83.05%) removal. The figure shows the response of various metal ions at different times.



**Graph 1: Effect of Contact time of heavy metals by Lemon peel powder**



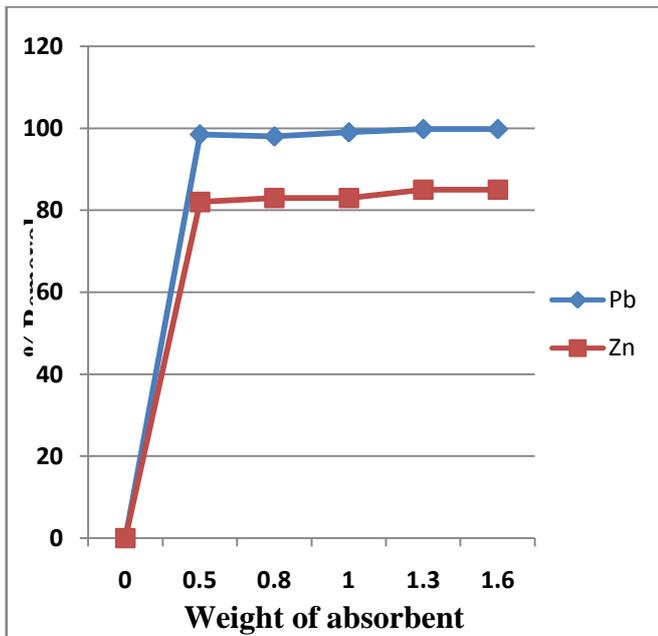
**Graph 2: Effect of Contact time of heavy metals by Orange peel powder**



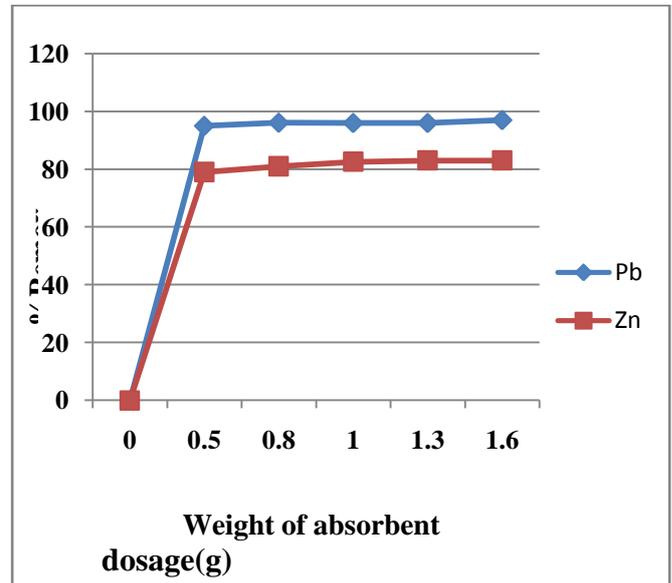
Graph 3: Effect of Contact time of heavy metals by Cavendish Banana peel powder.

### B. Effect of Absorbent Dosage

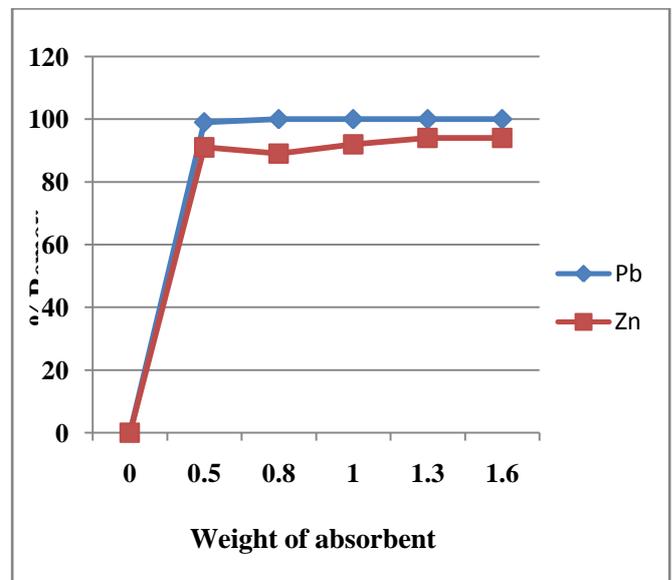
The absorbent dosage was varied from 0.5 to 1.6, under the specific conditions (pH of 2, contact time 30 min, 120rpm and room temperature 34°C). the removal of Pb attained maximum removal even at a absorbent dosage of (Lemon peel of 0.8g with 99.8%, Orange peel of 1.2g with 97%,and Cavendish banana of 1.6g with 99.9%) removal, increase in absorbent dosage, also increased the percentage removal of Zn was (Lemon peel of 0.6g with 84.06%, Orange peel of 1.3g with 80% and Cavendish banana of 1.6g with 83.37%) removal respectively, after increasing the absorbent dosage leads to result of overlapping due to overcrowding of absorbent materials. It was observed that about 1.1 g of absorbent was effective towards the removal of metal ions.



Graph 4: Effect of Absorbent Dosage of heavy metals by Lemon peel powder.



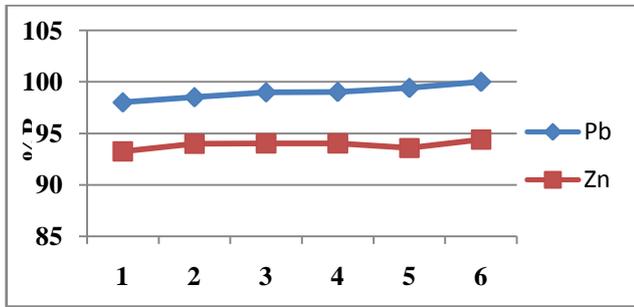
Graph 5: Effect of Absorbent Dosage of heavy metals by Orange peel powder.



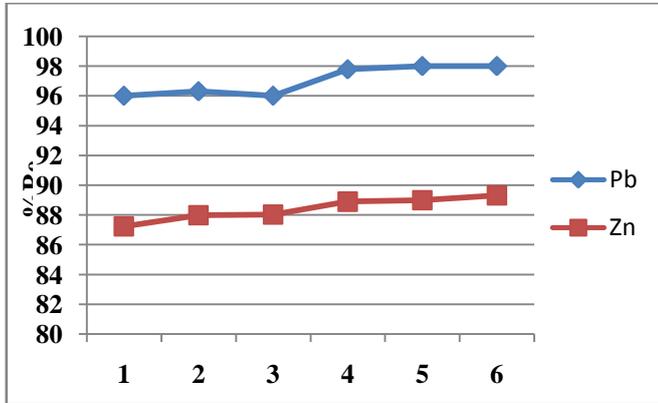
Graph 6: Effect of Absorbent Dosage of heavy metals by Cavendish Banana peel powder.

### C. Effect of pH

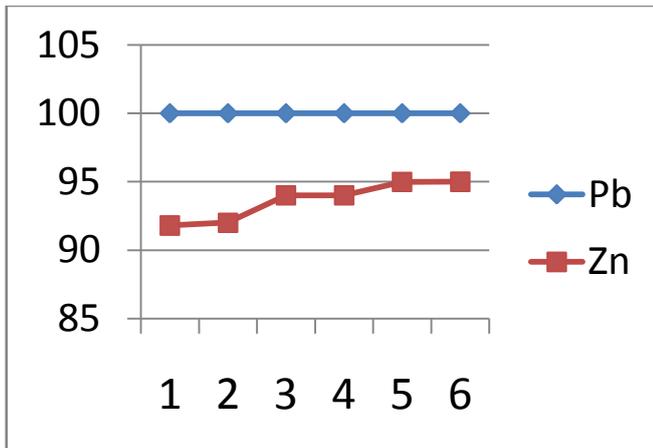
The pH range was studied from a range 2 to 6 under such condition( at optimum contact time of 30 min, 120rpm speed, with 0.5 g of the absorbents) the test samples are used as a absorbent, it was observed that with increase in the wastewater, the removal percentage of metal ions all increased up to pH 6. In Lemon peel the pH 6, maximum removal of Pb, 99% and Zn, 94.39%, For Orange peel (Pb, 98% and Zn 89.32%, Cavendish Banana (Pb 100% and Zn, 91.69%). The highest removal efficiency of metal ions was obtained when the pH value of the absorbent surface is higher and negatively charged.



Graph 7: Effect of pH of heavy metals by Lemon peel powder.



Graph 8: Effect of pH of heavy metals by Orange peel powder.



Graph 9: Effect of pH of heavy metals by Cavendish banana peel powder.

#### IV. CONCLUSION

The experimental data were done by absorbent like Orange, Cavendish banana, Lemon Peels powder towards the removal of lead (Pb), zinc (Zn) ions from wastewater. Finally it was observed that the removal concentration of metal ions depends upon contact time, pH, absorbent amount and concentration of heavy metal. Finally it was found that the absorbent capacity of peel samples for removal of selected heavy metals was 99% for Pb, 87.39% for Zn at 1.6 g dose amount of Lemon and Cavendish banana peels powder.

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