

# Treatment of Industrial Waste Water using Low Cost Adsorbents

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**ABSTRACT** : Now a days the water flowing over a stream is highly polluted due to the commercialization of the Metropolitan Cities and Business Importance cities. This is mainly due to the wastes coming from the industries is directly diverted to the nearby stream which cause the major pollution to the water streams. This paper deals with the removal of the hazardous materials from the industrial waste water coming out from a textile industry with the help of the Low cost adsorbents. The low cost adsorbents not only remove the hardness, Suspended solids but also removes the some kind of heavy metals present in the waste water. Different kinds of low cost adsorbents and their efficiency of removal also compared in this study.

**KEYWORDS:** Low cost adsorbents, Industrial waste water treatment, Textile Industries

## I. INTRODUCTION

The southern part of India is developed very well in wealth as well as in population. Duo to this growth the industrialization in urban areas also grown up to great heights. Among which textile industries present in all the districts in the southern part of Tamil Nadu. As per the statistics reported by the different kinds of Social Media every district has at least 10 textile industry in the southern part of Tamil Nadu. A Textile industry requires a lot of fresh water for the manufacturing of clothes, Dying of colours in clothes. Due to this the water scarcity already has been raised in the southern districts such as Virudhunagar and Tuticorin. The Textile Industries not only use the fresh water for dying but also discharges the waste water coming from the outlet is directly discharged in to the natural stream. This wastes coming out from the textile industry has very high amount of Suspended solids which majorly affects the Aquatic life habitats. A recent survey has reported the aquatic life that has created in a natural stream has been reduced 56% in the past 12 years. The waste water coming from the industries not only has high content in Suspended Solids but also high in hardness, Biological oxygen demand and Toxic substances. This toxic substances creates different kinds of diseases for the peoples those who present near the water habitat. The Toxic substances also destroy the habitats present in the aquatic region. This can be reduced with the help of natural low cost adsorbents. The usage of cotton salk and apricot seed are found to be very effective in removal of Astrazone Black from aqueous solution and the results were reported by Sibel Kahraman, et al. [1]. The usage of Peanut husk will be effective in removal of the Nickel from the Industrial waste water coming out from the textile industries reported by Katerina et al. [2]. Granules prepared from dry activated sludge was found to be effective in treatment of industrial waste water created due to the dyes by adsorption process reported by A.Djafer et al [3]. The main Objective of this paper is to remove hardness, Suspended solids, Turbidity and pH values and compare the efficiency of the three different adsorbents and to remove the toxic substances created due to the contamination of heavy metals coming from the dyes with the help of low cost adsorbents and to compare the results of various low cost adsorbents.

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## II. EXPERIMENTAL STUDY

The Initial study has been carried out with the help of coagulation jar test. From the flocs formed values the intensity of the adsorbents has been selected. Three kinds of natural adsorbents has been used in this study. Water Hyacinth, Egg shell powder and Orange peel powder has been used in this study as adsorbents. The waste water is collected in the stream near to the spinning mill present in the Rajapalayam Town in Virudhunagar District and another stream in which a major industry located in Kovilpatti in Tuticorin District.

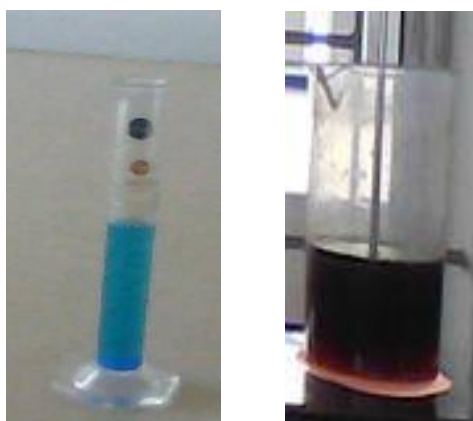


Figure 1 Intensity of dye color in natural stream

From figure 1 the intensity of the dye colour present in the waste water collected in the stream near to the Industry located in Rajapalayam and the Industrial waste water collected near kovilpatti as shown in second figure in Figure 1. For the collected waste water initial characteristics such as suspended solids, Hardness, Turbidity and Heavy metals has been identified and reported in Table 1.

Table 1 Parameters of Collected Samples

Parameters	Values	
	<u>Rajapalayam</u>	<u>Kovilpatti</u>
Colour of the sample	Light Blue	Red
Suspended Solids	8700 mg/l	11500 mg/l
Hardness	850 mg/l	1020 mg/l
Turbidity	1253 NTU	1763NTU
pH	8.6	8.9

From the collected samples the results shows that the samples that are not directly used for irrigation purposes so that the treatment method has been followed by using three natural adsorbents.

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## III. PREPERATION OF ADSORBENTS

Water Hyacinth is seeds are collected and the samples are poured into the fresh water. The growth period of water hyacinth has been noted as 10 days. After 10 days the water hyacinth is placed in the waste water collected from the industries and left the samples for different duration and the results have been noted and compared. Egg shell Powder is collected from the hostels and the canteen placed in National Engineering College. The egg shells have been collected as afresh and that shell shell has been completely washed in tap water and then distilled water. The presence of moisture will affect the adsorption process so that shell has been exposed to sun for a period of 24 hours. After 24 hours the egg shell has been placed in oven exposed to a temperature of 1000C for a period of 2 hours and then the egg shell has been crushed and that has been sieved with the help of 150 micron sieve maintaining homogenous particle size for efficient adsorption.

Orange peel is collected from the fruit shops in and around kovilpatti. The peel was thoroughly washed using tap water and then distilled water. The presence of moisture will affect the adsorbent process so that the orange peel has been exposed to sun for a period of 24 hours then the removal of moisture content from the peel and then the peel is exposed at a temperature of 1000C for a period of 2 hours then they have been crushed as particles then sieved in 150 micron sieve maintaining homogenous particle size for efficient adsorption.



**Figure 2 Orange peel powder**



**Figure 3 Egg shell powder**

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## IV. RESULTS AND DISCUSSION

Egg shell powder and orange peel powder has been added 5 ppm and then they have been mixed at a speed of 100 rpm and allowed to settle down the removal of suspended solids as described in Figure 4.

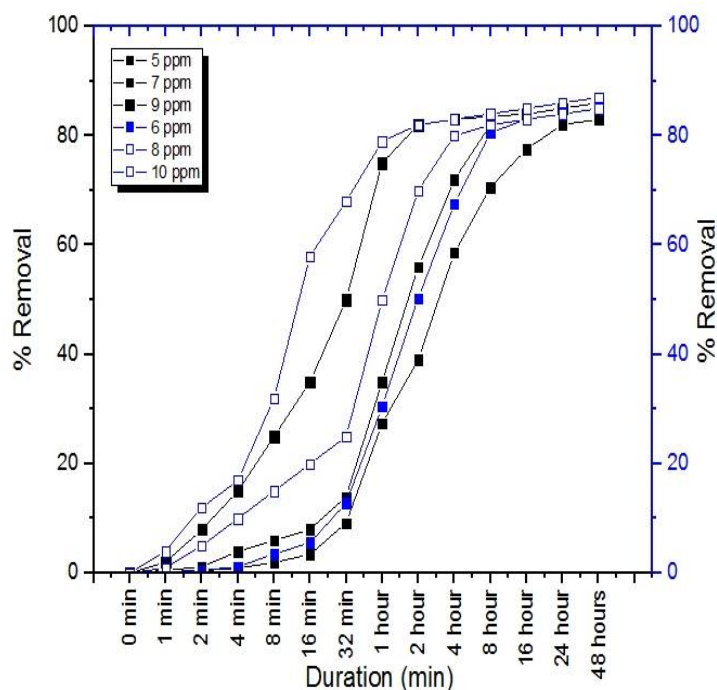


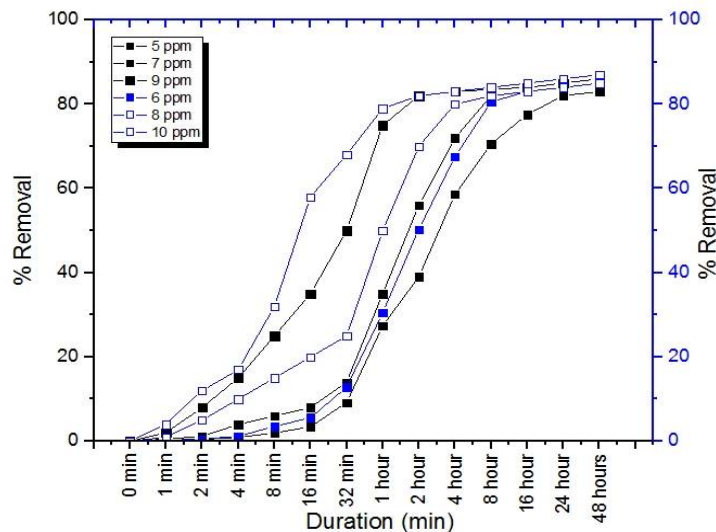
Figure 4 Removal of Suspended Solids with respect to time

From Figure 4 it is concluded that the time increases the removal percentage also increases after a period of 24 hours the removal percentage does not change much. So that the optimum percentage of removal for 5 ppm is found to be at 24 hours is noted to be 92.6% in the case of Egg shell powder and 82.6% in the case of orange peel powder. This reduction in suspended solids is mainly due to the adsorption of the particles in the surface of the egg shell powder and orange peel powder. The small suspended particles are adsorbed on the surface of the egg shell and orange peel powder and forms higher size particles which can easily remove with the help of the filter paper. The orange peel powder is not efficient compared with egg shell powder, This is mainly due to the adsorption capacity of the orange peel powder is comparatively low due to the specific gravity of the orange peel is comparatively low compared with the egg shell powder. Then the removal percentage has been calculated by varying the concentration of the egg shell powder from 5 ppm, to 10 ppm and the test has been repeated on the same time duration this has been repeated same for the orange peel powder. The results has been illustrated in figure 5.

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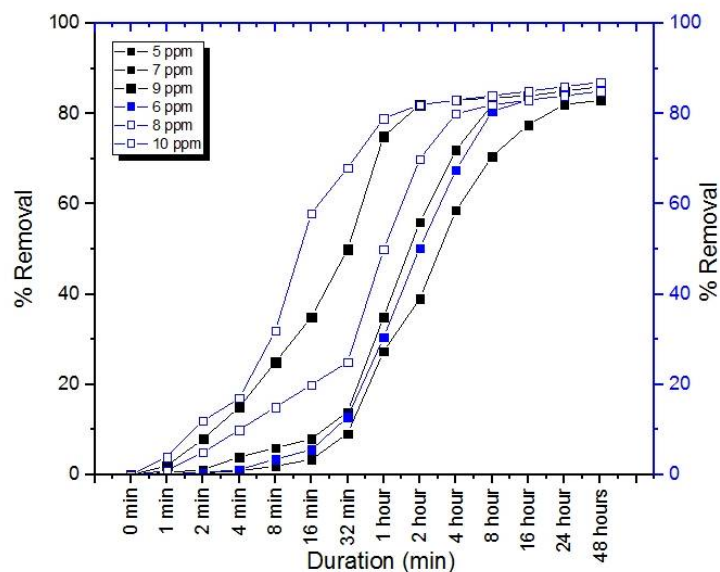
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**Figure 5 Removal Percentage with Concentration for egg shell powder**

From the results concluded from the figure 5, when the concentration of the egg shell powder increased the removal percentage at the earlier time but no significant increase in the later time. This is mainly due to when the concentration of the adsorbent increases the adsorption is high in initial time when time keeps on increasing all the suspended solids are that has already been adsorbed on the surface of the material. So that it is recommended that for better results in shorter duration 10 ppm is necessary if the results in longer period 5 ppm is sufficient. The same is repeated for the orange peel powder and the observed results are almost similar to that of the egg shell powder and the results are shown in figure 6.



**Figure 6 Removal percentage with concentration for orange peel powder**

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From the results obtained from figure 6 it is concluded that the removal percentage variation is almost same as that of egg shell powder but the efficient removal percentage is lie in between 83-86%. But in the case of egg shell powder the efficient removal percentage is 92-96%. This variation is mainly due to the density of the density of the orange peel powder is low compared with egg shell powder.

The same amount of water has been exposed to water hyacinth to grow on that water then the removal percentage has been noted.



Figure 6 Water Hyacinth on waste water

From the results obtained from figure 6 it is concluded that the removal percentage of egg shell powder is 83-86%. But in the case of egg shell powder the efficient removal percentage is 92-96%. This variation is mainly due to the density of the orange peel powder is low compared with egg shell powder. The same amount of water has been exposed to water hyacinth to grow on that water then the removal percentage has been noted.

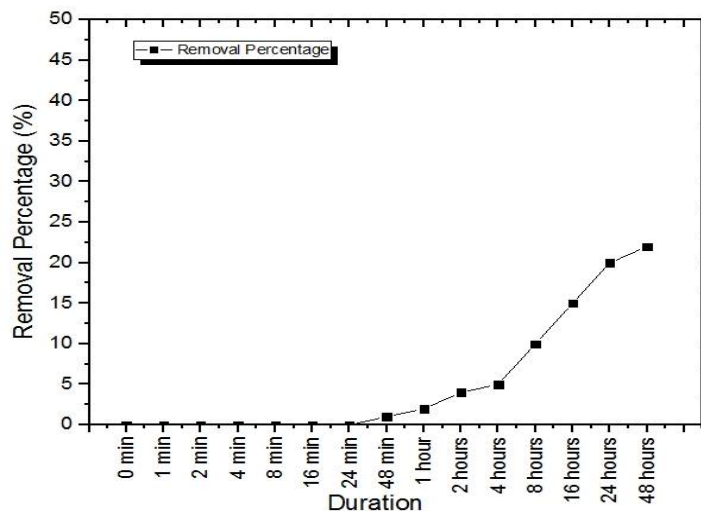


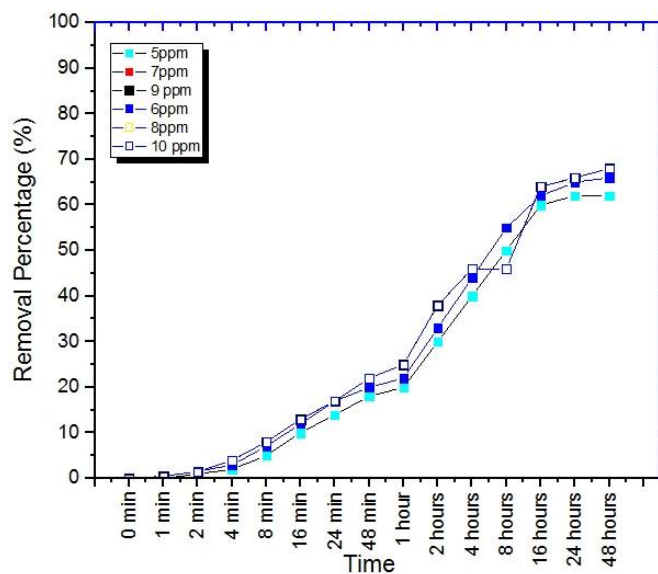
Figure 7 Removal percentage for water hyacinth

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From Figure 7 it is concluded that water hyacinth does not have efficient removal on suspended solids. This is mainly due to the adsorption is not happening on the surface of the water hyacinth. However after 24 hours the effective removal of suspended solids by water hyacinth is 22%. From this results it is clearly observed that egg shell powder has high removal of suspended solids due to the adsorption capacity of the powder. The removal percentage of hardness under different time interval has been described in figure 7.



**Figure 8 Removal Percentage of Hardness for Egg shell powder**

From Figure 8 it is concluded that removal percentage of hardness is in the range of 66% when 8ppm of egg shell powder has been added further increase in the intensity of the eggshell powder does not influence on the removal of hardness. The cause for the hardness in the waste water is due to the presence of carbonate of calcium and magnesium. When egg shell powder is added into the waste water and mixing is started the compounds which are the main ingredients to cause hardness has been reacted with the egg shell powder and has been converted into some other simple chemical compounds. This way the hardness has been removed from the samples. When 8 ppm is added to the waste samples the major reactive compounds which will react with the egg shell powder has been converted into some other compounds. Further increase in dosage does not have influence due to all the reactive compounds has been converted into simple chemical compounds. The removal of hardness for the orange peel powder is shown in figure 9.

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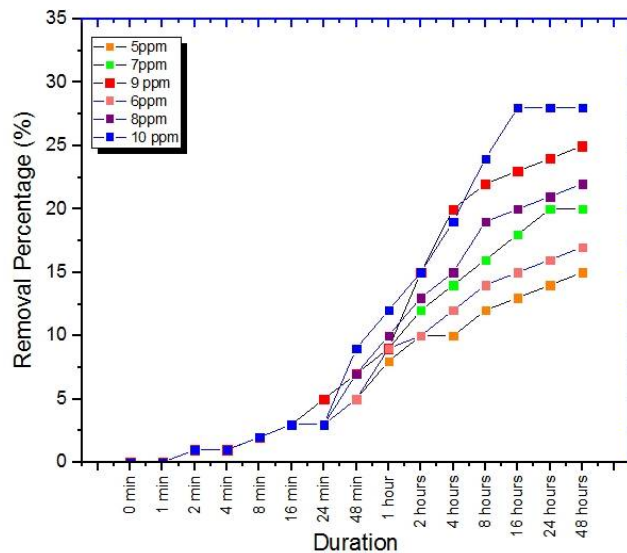


Figure 9 Removal of hardness for orange peel powder

From figure 9 it is concluded that the maximum removal percentage in the case of water hyacinth is in the range of 26 to 28%. This indicates the orange peel powder is not efficient in reacting with the compounds which are the major cause for creating hardness in waste water. In the same way the water hyacinth also not efficient in reacting with the compounds which are major cause for the hardness values. So that water hyacinth is not considered for turbidity removal and pH removal. The turbidity removal for the egg shell powder and orange peel powder is compared and explained in figure 10.

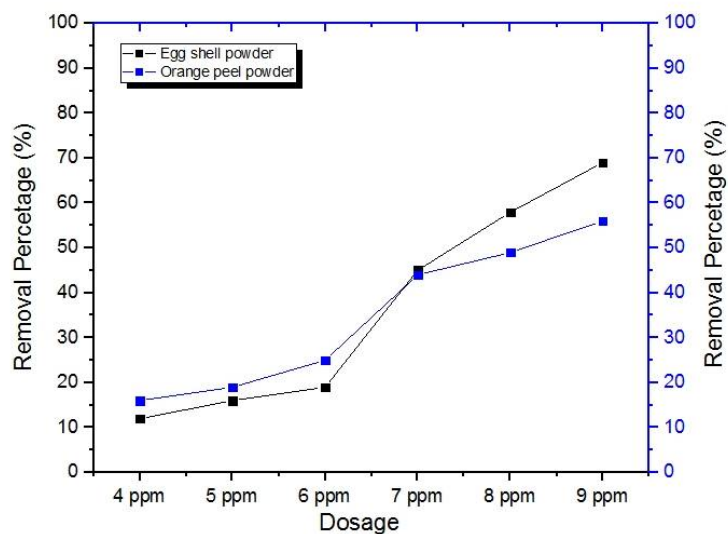


Figure 10 Removal of Turbidity

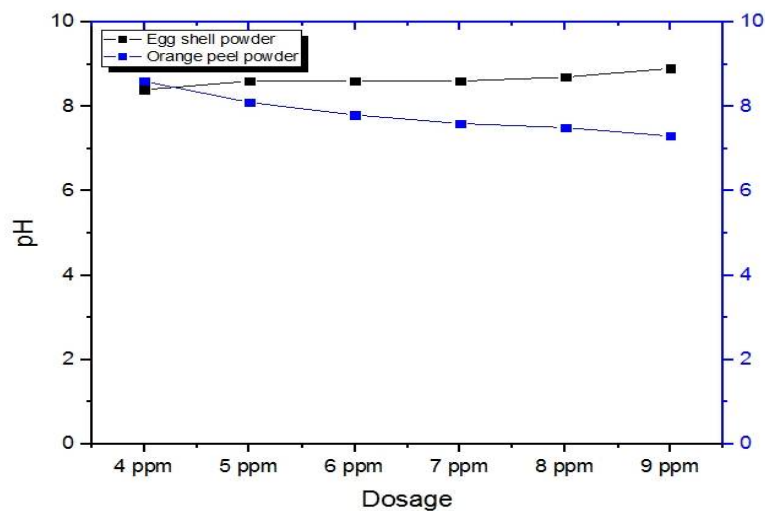


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From figure 10 it is concluded that the removal of turbidity is high in the case of orange peel powder at lower intensity, if the dosage is increased the removal percentage has been reduced and the removal percentage in the case of egg shell powder is high compared with orange peel. This phenomenon is mainly due to the colour of the both the samples. The colour of the egg shell powder is white when the egg shell powder is mixed with water the colour mild change in colour has been noted in water. The same manner the initial colour of the orange peel powder is brown. When this sample is added with water the colour of the water mildly changes to light brown colour this is the main reason for the removal of turbidity value decreases with increase in percentage of orange peel powder compared with egg shell powder. The removal of pH has been illustrated in figure 11.



**Figure 11 pH values for different dosage**

From figure 11 it is concluded that when egg shell powder content is increased in the waste water it increases the pH value of the samples. This is mainly due to the chemical composition of the egg shell powder which is alkali in nature will increase in the pH value. But in the case of orange peel powder when the orange peel powder content is increased the pH value of the samples has decreased this is mainly due to the chemical composition of the orange peel powder is acidic in nature this will neutralize the compounds present in the waste water. The chemical analysis has been carried out to identify the heavy metal contamination has been carried out with the help of atomic adsorption spectroscopy that results for the initial waste water samples collected is listed in figure 12

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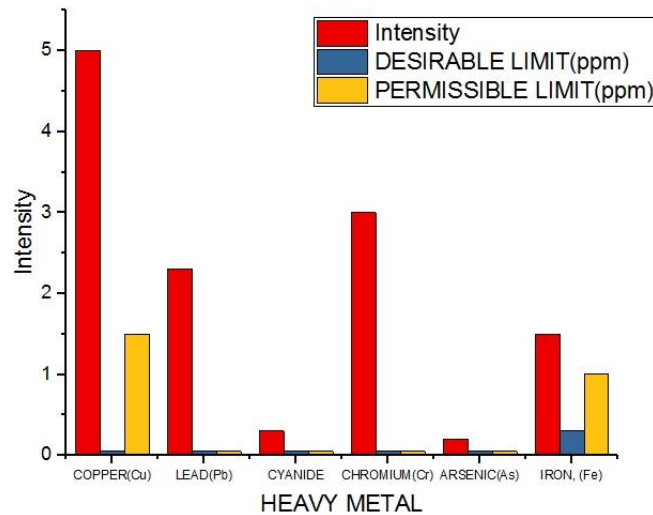


Figure 12 Heavy metal contamination in waste water

From figure 12 the heavy metal contamination is almost very high which are the toxic substances present in the industrial waste water. The water hyacinth is allowed to grow in the waste water for a period of one day and the removal percentage is noted in the figure 13.

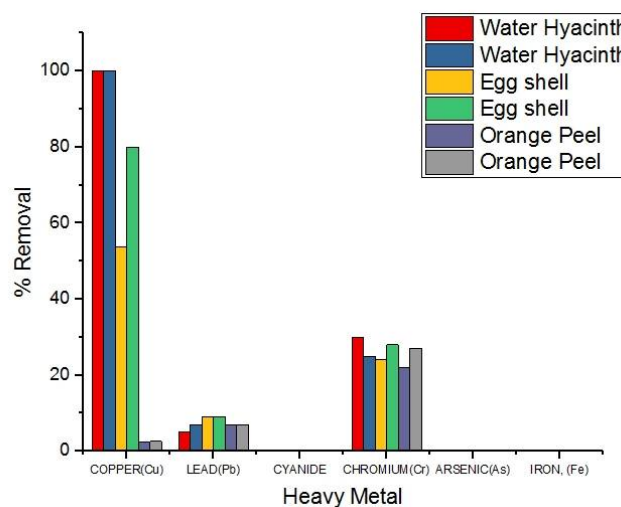


Figure 13 Heavy metal removal Comparison

Form figure 13 it is concluded that the heavy metals copper, Lead and chromium has been removed and the other three heavy metals has not been removed with the help of this three low cost natural adsorbents. The water hyacinth removes 100% of the copper present in waste water by planting the water hyacinth for a period of one day. In the case of lead

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removal water hyacinth participates somewhat low compared with other two adsorbents. In the case of removing lead water hyacinth participates major role comparing with other three natural adsorbents. The main reason for this kind of heavy metal removal is adsorption of the heavy metals by the water hyacinth. In the case of Egg shell powder the removal percentage is in the range of 60 -80% in removing copper and comparatively low for other heavy metals. In the case of orange peel the removal percentage is very low for all the cases. This is mainly due to the orange peel is not capable of adsorbing any heavy metal on its surface.

## V. CONCLUSION

- The heavy metal contamination is very high in the natural stream located very near to the spinning mills in kovilpatti and rajapalayam region.
- The water hyacinth is not efficient in removal of the hardness, Suspended solids, Turbidity and pH value • When egg shell powder is added 10 ppm to the volume of the waste water the amount of suspended solids decreased at a percentage of 96% due to the adsorption capacity of the banana stem extracts at 48 hours.
- When orange peel is added 10 ppm to the volume of the waste water the amount of suspended solids decreased at a percentage of 82% due to the adsorption capacity of the banana stem extracts at 48 hours.
- The hardness value of waste water is decreased at a percentage of 60% when egg shell powder is added at 10 ppm to the volume of the waste water
- The hardness value of waste water is decreased at a percentage of 30% when orange peel is added at 10 ppm to the volume of the waste water
- The turbidity of the samples also decreased due to the addition of egg shell powder by a percentage of 70% when 10 ppm is added in volume of egg shell powder that has been added to the waste water.
- The turbidity of the samples also decreased due to the addition of orange peel powder by a percentage of 65% when 10 ppm is added in volume of Orange peel powder that has been added to the waste water.
- Water hyacinth was found to be very efficient in removal of the copper and Lead compared with other three adsorbents

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