

AN EXPERIMENTAL INVESTIGATION ON REMOVAL OF CHROMIUM IN TANNERY EFFLUENT MIXED LAKE WATER BY ADSORPTION TECHNIQUE

S. Abdul Munaf

*PG Scholar, Department of Civil Engineering
Pandian Saraswathi Yadav Engineering College, Sivagangai, Tamil Nadu*

G. Raghadharini

*Assistant Professor Department of Civil Engineering
Pandian Saraswathi Yadav Engineering College, Sivagangai, Tamil Nadu*

Abstract

In this world heavy metals removal on land surface creates many dangerous effects. Disposal of chromium on land, surface water bodies will harmful for the users of the world. This chromium cause very harmful illness like eye irritation, skin diseases, ingestion hazards, respiratory tract, etc. so we have to take the control measures for the disposal of heavy metal like Cr by industrial activities. Here I used the technique which is called batch adsorption technique. It is very compact and small in scale and having high efficiency of removal of chromium in surface water bodies. In this investigation, locally available and inexpensive Mustard and Prosopis juliflora are using as a low cost adsorbents, on that the mustard is used as bio adsorbent are used to remove chromium from water. The removal of this metal ion from water in the batch method of adsorption have been studied and discussed. In this investigation we obtained that all the adsorbents which we used are having good adsorption capacity of chromium. But crushed mustard (98.3%) and ash mustard (97.1%) work is better than other adsorbents. Simply says when the contact time will increase then adsorption also increase.

Keywords: Cr – chromium, bio- adsorbent, crushed mustard, ash mustard, prosopis juliflora.

Introduction

The Heavy metals have vast industrial applications due to their technological importance. As a result of inappropriate waste-disposal of industries, such as electroplating, leather tanning, wood processing and alloy preparation, significant amount of chromium has been discharged into the environment. Chromium is the seventh most abundant element on earth and exists in several oxidation states. Chromium (Cr) is a naturally occurring element with atomic number 24 and atomic mass of 51.996 amu. The element belongs to the group of transition metals and in the oxidation state elementary presents an electronic configuration $4d^5s^1$. The most prevalent forms of chromium in the natural environment are hexavalent and trivalent. Chromium is a naturally occurring element found in rocks, animals, plants, soil and in volcanic dust and gases. It exists in different oxidation states that range from +2 to +6. The most stable forms are Cr(VI) and Cr(III), although they significantly differ in biological, geochemical and toxicological properties. Cr(III) occurs naturally in the environment at a narrow concentration range and is considered to be less toxic than Cr(VI). Hexavalent chromium is used extensively in industrial processes such as electroplating, tanning, textile dyeing, corrosion inhibition and wood treatment, all of which produce discharge of chromium-containing effluents. When it is released to the environment, Cr(VI) is a potential contaminant of groundwater that can participate in trophic transfer in food chains. The United States

Environmental Protection Agency has identified Cr(VI) as one of the 17 chemicals posing the greatest threat to humans. The permissible limit for total chromium in drinking water is 0.05 mg/L (WHO2004).

Objective

1. To find the places where the disposal of chromium on surface water bodies by the industrial activities.
2. To examine the pond and find out the disposal of chromium by tannery plants situated near trichy airport.
3. To analyze the water quality of the concerned area and prepare detail assessment of the Investigation.
4. To compare the reports with standard limits.

Study Area

Trichirapalli is the fourth largest city in TAMIL NADU, INDIA. Trichirapalli is located in the central region of Tamil Nadu state between 10°48'36" N and 78°41'08.16"E longitude at an altitude of 78m. Trichirapalli is fed by Cauvery and Kollidam River and the inner areas are fed by pond water around it. Trichirapalli is an important educational center in Tamil Nadu and it earned the title of ENERGY EQUIPMENT AND FABRICATION OF INDIA. The southern west part of the district is ranged by Western Ghats mountain range and the water quality is so good and the soil is very fertile. Pyrolysis is a thermo chemical decomposition of organic material at elevated temperatures in the absence of oxygen. Pyrolysis products always produce solid (charcoal, biochar), liquid and non – condensable gases.

Materials Required for the Experiment

The samples were collected near the tanneries surrounding area. The sample is collected in the lake which is located behind the tannery. In this lake the people surrounding taking the water for the drinking purposes. The site that I selected was not wealthy in portable water in conditions. It would not contain good water quality parameters. This is contaminated by this tannery effluent. The tannery effluent having high poisonous character. This effluent is disposed near the lakes, ponds, any other water resources.



Figure 1 View of a lake

This is the place where I took the water sample for the process. Near the tanneries more number of surface water bodies are available and the treated and non treated effluents are disposed by the tanneries. As per government order they must have effluent treatment process (ETP). But here more no tanneries not having that provision, but some would having that even the disposed some amount of heavy metals on the lakes, ponds, any other surface water bodies. From the tannery the effluents are removed in the nearby area where the pond is located and because of the effluents the pond got contaminated very much. Because of the poor sanitary and sewage conditions the water quality of these sites are highly affected. Type of adsorbents using are Mustard, Crushed Mustard, Prosopis juliflora leaves, Prosopis juliflora leaf Extract, Leaf Ash.



Figure 2 Seemai karuvelam



Figure 3 Cactus



Figure 4 Mustard

Experimental Procedures

In this investigation, locally available and inexpensive Mustard and Seemai Karuvelam were used as adsorbents, on that the mustard is used as bio sorbent are used to remove chromium. The removal of this metal ion from wastewater in the batch method of adsorption have been studied and discussed. Scanning Electronic Microscopic image was also used to understand the surface characteristics of adsorbent before adsorption studies. Effects of various factors such as pH, adsorbent dose, adsorbate initial concentration and time were analyses on phase-II. The initial concentrations of chromium were considered 10-30mg/L in batch method.

Batch Method of Adsorption Process

This process is carried out on various circumstances. The influence of contact time, pH, Temperature, and Adsorbent dose on the process to be studied. The adsorbents are finely crushed in a crucible and they are batched by 0.5g, 1g and 2g respectively. After batching is done the adsorbents are put into sample and they are mixed well. The samples are tested at 0 mins, 15 mins, 30 mins and 60 -180 mins with the help of a Digital Spectrophotometer. The values that are obtained from the display are noted carefully. The calculation is done by simple formulae,

$$\text{Adsorption \%} = ((C_0 - C_1) \times 100) / C_0$$

C_0 – concentration of the lake water sample without adsorbent

C_1 – concentration of the solution after adding adsorbent at different time interval

Acceptable and Rejection Criteria

The below criterion are suggested and followed by B.I.S.

Table 1 Standard parameters for portable water property acceptable rejectable

Property	Acceptable	Rejectable
Turbidity	2.5	10
Total dissolved solids	500	2000
Ph	6.5-8.5	6.5-9.0
Alkalinity as CaCo ₃	200	600
Total hardness as CaCo ₃	200	600
Calcium	75	200
Magnesium	30	150
Iron	0.1	1
Manganese	0.05	0.5
Chlorides	200	1000
Sulphate	200	400

Table 2 Instruments to analyze the water

Property	Range
Color	Pale yellow
Odour	Pungnut-smell like rotten egg
Turbidity	10.1
Ph	8.60
Mg	80
Cr VI	0.12
Fe	Nil
Tot Alkanity	186

Batch means group of adsorbents are used for the removal of chromium present in the water. Degradation of chromium content depends upon time and adding of adsorbents to the water samples. Here we take mustard in the original shape. It is mixed with water and rotating for 30, 60, 90, 120 mins.

After that this sample is carried out for the spectro photo meter process. The mustard condiment made from the seeds of the *B. juncea* is called brown mustard and is considered to be spicier than yellow mustard. Crushed mustard means crushing the mustard very effectively and get powder like

mustard for the further process. It is mixed with sample water and rotating shaker is used for the adsorption process for 30, 60, 90, 120, mins for the deep adsorption by adsorbents. Crushed mustard are very effective in adsorption process. Using some heavy weight tool is used to crushed the mustard very effectively.

This type of method is called practical method. In this process juliflora leaves are to be taken for the experimental investigation. Leaves are segregated separately and mixed with water sample for the adsorption process. Grinding the leaves and using the filter paper to extract that leaf getting some liquid nature product. Ash mustards were developed by heating that leaves at 100 degree Celsius heat using hot plate for some hours then colour will change like brownish one form of ash. Rotating shakers are used to giving the momentum to the adsorbents where in the water sample for the adsorption process taking over for some hours what we needed. Spectrophotometer techniques are used to measure the concentration of solutes in solution by measuring the amount of the light that is absorbed by the solution in a cuvette placed in the spectrophotometer. The spectrophotometer light intensity as a technique is to measures function of wavelength.

There are two basic types of atomic spectrometers: emission and absorbance. Spectrophotometer is a method to measure how much a chemical substance absorbs light by measuring the intensity of light as a beam of light passes through sample solution. The basic principle is that each compound absorbs or transmits light over a certain range of wavelength. A spectrophotometer is an analytical instrument used to quantitatively measure the transmission or reflection of visible light, UV light infrared light. Spectrophotometers measure intensity as a function of light source wavelength.

Experimental Investigations

Removal data for the Chromium by Batch -1

Table 3 For removal data for the chromium By 0.25 gram adsorbents for 50 MI lake water

Batch 1	Mustard (%)	Crushed mustard (%)	Prosopis juliflora leaf (%)	Leaf extract (%)	Leaf ash (%)
30 Mins	52	37.5	45	37.5	49.0
60 Mins	74	92	80	69.0	53.0
90 Mins	83	90	90	78.0	75.0
120 Mins	94	100	97	92	93

The following graph shows the removal efficiency of chromium using five type of adsorbents for batch-1.

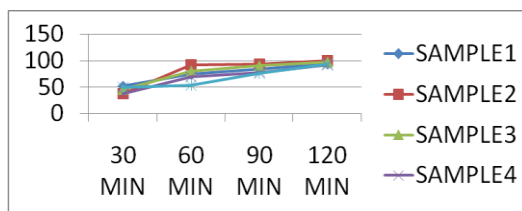


Figure 5 Adsorption of chromium by Batch-1

Removal data for the Chromium by Batch -2

Table 4 For removal data for the chromium by 0.5 gram adsorbents For 50 MI lake water

Batch 1	Mustard (%)	Crushed mustard (%)	Prosopis Juliflora leaf (%)	Leaf extract (%)	Leaf ash (%)
30 Mins	61	71	67	66	46
60 Mins	83	82	82	84	75
90 Mins	87.5	92	91	92	86
120 Mins	97	99	99	99	98

The following graph shows the removal efficiency of chromium using five type of adsorbents for batch-2.

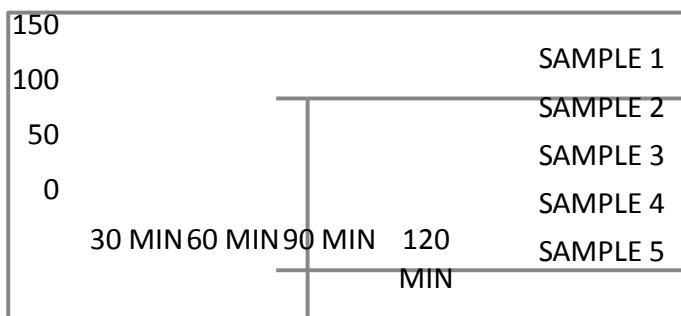


Figure 6 Adsorption of chromium by batch – 2

Removal data for the Chromium by Batch -3

Table 5 For removal data for the chromium by 1 gram adsorbents for 50 MI lake water

Batch 1	Mustard (%)	Crushed mustard (%)	Prosopis juliflora leaf (%)	Leaf extract (%)	Leaf ash (%)
30 Mins	92	57	70	72	50
60 Mins	73	64	83	90	67
90 Mins	83	76	91	90	76
120 Mins	96	92	99	99	99

The following graph shows the removal efficiency of chromium using five type of adsorbents for batch-3.

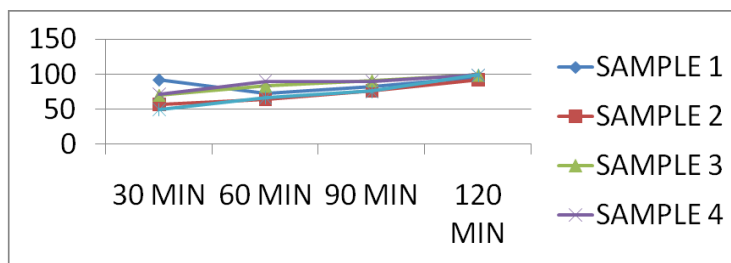


Figure 7 Adsorption of chromium By batch – 3

Conclusion

The removal of Chromium from the water by using various batch process, which could be summarized and concluded as:

1. According to the result the removal performance of chromium from natural lake water using locally easily available mustard and prosopis juliflora both are good.
2. Among all five adsorbents the maximum removal percentage for Crushed Mustard is 98.3% and Leaf Ash of Prosopis Juliflora is 97.1% avg.
3. Here we noticed that Crushed Mustard is having max removal than the Leaf Ash. → Above findings we may concluded that these type of all five adsorbents are very useful, economic, and quite rapid.
4. Finally I conclude that these adsorbents can successfully used for the removal of chromium from sample lake water and any other waste water.

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