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Extraction of Toxic Metals like Zinc, Copper and Lead, By Neem Leaf, Mango Seed, And Turmeric Powder

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Abstract: *Water pollution is one of the major issues that have to be addressed in the contemporary world. The pollution caused by heavy metals put the human lives in great danger. This paper aims at devising new methods to purify water in the most cost effective way possible, using mango seed powder, turmeric powder and neem leaf powder. The method checks for the purity attained by a sample on varying the rpm and temperature used in the process of purification.*

I. INTRODUCTION

Environmental pollution is caused by the introduction of pollutants in various nonliving components of environment like water, air, and soil. One of the major concerned pollutants of living environment is "Hazardous metals" also termed as "heavy metals". Heavy metals are the natural constituents of earth's crust.[1] Since they are nonbiodegradable they enter the food chain by biomagnification and ultimately affect the human beings. Heavy metals have a huge impact on the aquatic life. For the past few decades industrialization has been increasing exponentially. Environmental pollution has increased due to the pollution of water bodies by the discharge of heavy metals along the industrial waste water.[7]

Some of the heavy metals are copper, zinc, lead etc... Zinc in a minute quantity is essential for living beings. Zinc is responsible for an enormous number of different functions in the human body. Some of the functions of zinc in human body are stimulating the activity of 100 different enzymes, activating T lymphocytes, cures diarrhea etc. In humans zinc plays a indispensable crucial role. Although zinc is a necessary requirement for best health, excessive quantity of zinc will be catastrophic. The free zinc ion in solution is highly toxic to aquatic plants and animals.[3]Excessive absorption of zinc subdue copper absorption, the result is bone marrow repression and degeneration of the spinal cord.[4] Excessive intake of zinc results in death.

Lead has a wide application due to its characteristic property. Lead is used in lead acid batteries, ammunition, leaded glass, paints or other protective coatings and as a radiation shield in medical analysis.[11,5] As zinc, lead is a highly poisonous metal affecting most of the organs in the body.[2] Lead is mainly absorbed by the body, through inhalation (breathing) and feeding. The nervous system in adults and children are affected by lead poisoning. The toxic action of lead on the nervous system damages the major neurotransmission systems: the dopaminergic, colinergic and glutamatergic systems.[1] Long-term exposure to lead or its salts can cause mental retardation, abdominal pains etc. Increased lead concentration in blood results many blood disorders in mammals.[11]

Copper is essential to all living organisms as a mineral in trace amounts. Copper compounds have an extensive application in construction industry, fungicides, transmission electricity lines, power generation and wood preservatives (liquefied copper). [6]Increased absorption of copper has severe ill effects in living organisms. Wilson's disease caused due to accumulation of copper in body tissues. People suffering from Wilson's disease have their life at greater risk.[6,8] Alzheimer's disease is also caused by elevated copper level in the body. Copper enters our food chain along with the additives added to control algal growth during transportation of water.[8]

This project is based on how these industrial waste water can be treated efficiently, eco-friendly, economically before discharged them into water bodies. Recent studies have shown that heavy metals like copper, lead, zinc, ferrous, cobalt etc

can be removed using plant materials like palm pressed fibers, coconut husk, mango seed (***Mangifera indica***) , neem leaves (***Azadirachta indica***).

Removal of heavy metals by biosorption method is cost effective compared to other methods like coagulation, ion-exchange, reverse osmosis, membrane separation, solvent extraction, chemical precipitation, electro-filtration etc[9,10]

II. MATERIALS AND METHOD

All the chemicals used for the experiment were of analytical-reagent grade and employed without being purified any further. Distilled water was used in the preparation of the various solutions for calibration purpose and for the adsorption test experiment. All solutions were prepared in ppm scale with careful awareness to allow little or no margin of error.

CALIBRATION

20,40 and 60 ppm of $Pb(NO_3)_2$, $CuSO_4.10H_2O$, $ZnSO_4$solution of 0.02, 0.04, 0.06mg each was prepared in 100 ml standard flask using distilled water along with blank. After preparing the solutions for the required calibration scale they are given to the UV CISIBLE spectrometer 117. The absorbance of the solution was measured after 15 – 30 minutes. Ph of the solution was kept at 4.The absorbance of the coloured solutions has a linear relationship to the lead, copper and zinc concentration and it is measured at wavelength 269, 324, 310 nm against blank.

The Adsorption Characteristics (wavelength) of Heavy Metals (Pb, Zn, Cu) by ITS117 UV-Vis Spectrophotometer

Element	Wavelength
Cu	324 nm
Pb	269nm
Zn	310 nm

TABLE 1

PREPARATION OF ADSORBENT MATERIALS AND SAMPLE SOLUTION

1g each of powdered neem leaves, mango seed and commercially available turmeric, was weighed and taken in a large vessel to be later employed in a magnetic stirrer operating at various rpm and temperature after being mixed with the sample solution. The sample solution is prepared by taking 0.05 g each of $Pb(NO_3)_2$, $CuSO_4.10H_2O$, $ZnSO_4$salt and mixing all in a 250ml standard flask, diluted to 250 ml using distilled water and mixed thoroughly for obtaining a uniform sample solution. Ph of the sample solution was maintained at 4.

EXPERIMENTATION RESULT

TABLE 2 : Observation at 150rpm for 30 min

Sample No:	**7**			**8**			**9**		
	Pb	**Zn**	**Cu**	**Pb**	**Zn**	**Cu**	**Pb**	**Zn**	**Cu**
Temperature ^oC	**50**			**60**			**70**		
Initial concentration (ppm)	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Final concentration (ppm)	**16.21**	**10.174**	**11.3644**	**15.22**	**10.461**	**10.2601**	**15.55**	**10.1886**	**10.5116**
% of adsorbance	**67.5**	**79.65**	**77.27**	**69.16**	**79.16**	**79.47**	**68.9**	**79.62**	**78.97**

TABLE 3 : Observation at 200rpm for 30 min

Sample No:	4			5			6		
	Pb	**Zn**	**Cu**	**Pb**	**Zn**	**Cu**	**Pb**	**Zn**	**Cu**
Temperature ^{o}C	**50**			**60**			**70**		
Initial concentration (ppm)	**50**	50	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Final concentration (ppm)	**13.28**	**12.179**	**11.6503**	**13.08**	**12.584**	**11.717**	**12.94**	**13.703**	**12.6793**
% of adsorbance	**73.44**	**75.64**	**78.34**	**73.84**	**74.83**	**76.56**	**74.12**	**72.59**	**74.64**

TABLE 4 : Observation at 250rpm for 30 min

Sample No:	1			2			3		
	Pb	**Zn**	**Cu**	**Pb**	**Zn**	**Cu**	**Pb**	**Zn**	**Cu**
Temperature ^{o}C	**50**			**60**			**70**		
Initial concentration (ppm)	**50**	50	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Final concentration (ppm)	**11.52**	**11.56**	**12.45**	**11.75**	**10.9356**	**11.19**	**11.46**	**10.726**	**10.9242**
% of adsorbance	**76.96**	**76.88**	**75.1**	**76.49**	**78.18**	**77.62**	**76.36**	**78.54**	**79.81**

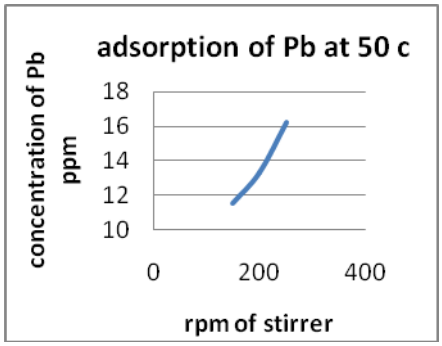
Conditions for sample 10 were obtained from the result of above analysis. Optimum temperature and rpm was 60^{o}C, 250 rpm respectively.

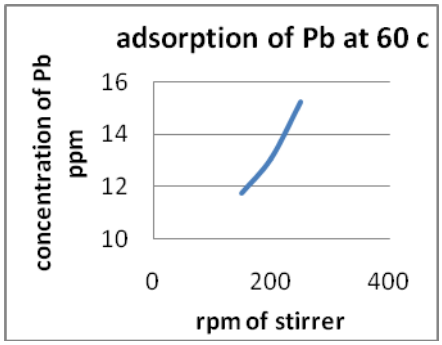
Element	Pb	Zn	Cu
Initial concentration	50	50	50
Final concentration	9.52	10.932	10.435
% of adsorbance	80.96	78.13	79.13

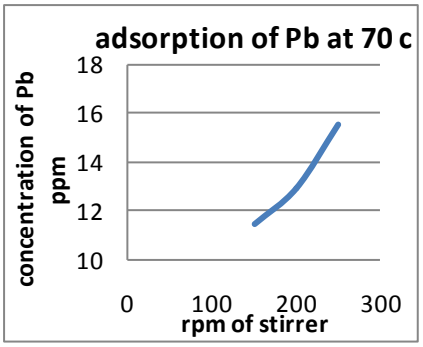
Effect of variation in agitation speed

The following are the graph showing variation of adsorption at different revolutions per minute (rpm). Graph is plotted against absorbance and concentration.

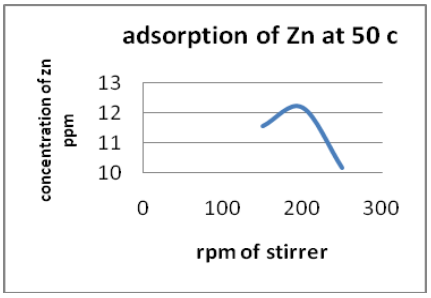
1. Lead

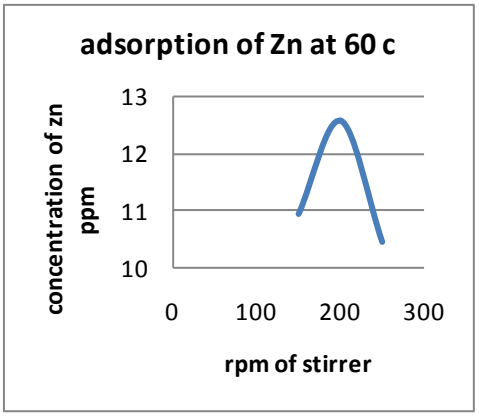


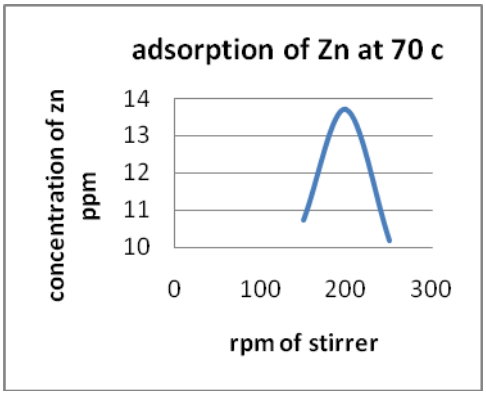




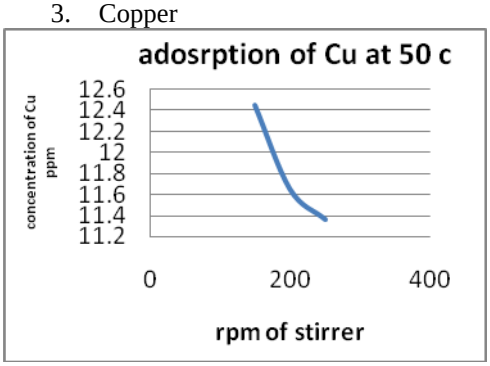
2. Zinc

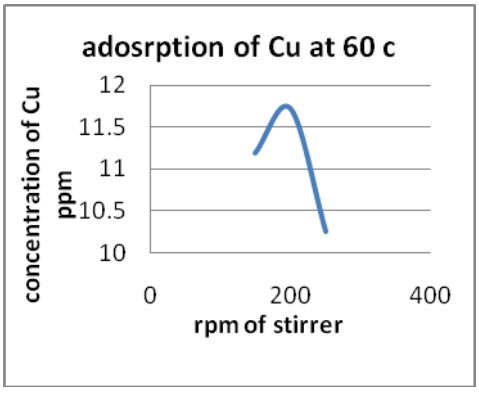


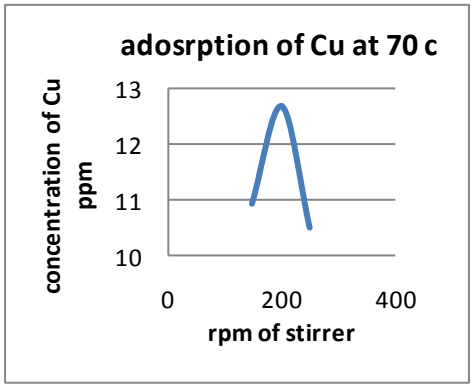




3. Copper







It is evident from the graph that adsorption of zinc and copper is maximum at 200 rpm and adsorption of lead increases as rpm increases.

Effect of adsorbents

We varied the amount of adsorbents in the experiment between 0.5g and 1.5g only to find that increase in adsorbents results in increase in rate of metal ions adsorbed owing to the increased adsorption activity.

Effect of temperature

We varied the temperature from 50^0 C to 70^0 C and an increased rate of adsorption was observed at 70^0 C.

Conclusion

From the experiment it is concluded that the efficient adsorption of lead is observed at 150 rpm,50^oC for zinc it is 250 rpm, 50^oC and for copper it is 150 rpm,70^oC.At higher temperature rate of adsorption of copper is more because of the higher activation energy of copper. There is a possibility for increase in the rate of adsorption with the increase in surface area (i.e. if more adsorbent are supplied).

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