



ANALYSIS OF SUBSTRATE EFFECT IN WASTE WATER TREATMENT USING LOW COST ADSORBENT

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ABSTRACT:

Contaminants enter water resources as a result of domestic and industrial activities. An irregular release of wastes into aquatic ecosystem can cause deleterious effect to the nature. Conventional wastewater treatment plants (WWTPs) may not be effective in removing all pollutants present in water. In present day scenario the availability of raw materials is serious issue and the usage of costlier material may not be affordable. Hence the usage of low cost material acts as only option for universal application. Present study employs usage of coconut, cashew nut, and groundnut shell ashes substrate to treat the wastewater. This study mainly aims in formulating a low cost adsorbent for removing heavy metals from the water and find out the different types of substrate effects in wastewater. Batch experiment for the study was carried out using different substrate and synthetic samples of known concentration. The study shows that substrates behave different with the various combinations in removal of metals from water samples. The maximum removal of metals is achieved using 50:50 ratio irrespective of the materials used. The Cashew nut: Groundnut

combination act as the most effective combination (especially 50:50) in removal of almost all trace metals that were studied.

Keywords: Batch experiment, Natural material, Substrate, trace metal removal, water treatment, Coconut Shell Ash, Cashew Nut Shell Ash, Groundnut Shell Ash.

1. Introduction:

Water is most common liquid on Earth and one of the most important requirements for the entire eco system. Water covers 71% of the Earth's surface, but 96.5% of water is found in seas and oceans, 1.7% in the ice caps. A small fraction of 0.001% is in the air as vapour and as clouds. Less than 1% of water only is in accessible condition (21).

In current scenario the availability of pure and fresh water is affected by many reasons like, over exploitation, climate change, pollution and so on. Water pollution affects the entire biosphere. In almost all cases the effect is damaging not only individual species and population, but also the natural biological communities. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water, or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water. Contamination of water by toxic heavy metals through wastewater discharge by industrial activity is one of the major environmental issues. Rapid industrialization has seriously contributed to the release of toxic heavy metals in the water streams. In connection with the attempts carrying out by lot of researchers to purify the water present study tries to found a new low cost adsorbant as a substrate material for the water treatment.

2. Materials and Methods

In present study following materials were used a substrate for the treatment process of water samples studied.

Groundnut Shell Ash

Groundnut shells are cheap and readily available in high quantity (Fig. 1a). Groundnut shell is one of such natural agro waste filler used and it contains cellulose, hemicellulose and lignin.

Cashew nut Shell Ash:

Cashew nut shells are high density and it requires high level temperature to make it as ash (Fig. 1b). Cashew nut has more strength and it is used for carbonization. It is a good adsorbent material.

Coconut Shell Ash:

Coconut shells are cheap and readily available in high quantity. Coconut shell contains about 65 – 75% volatile matter and moisture which are removed largely during the carbonization process (Fig. 1c). During the carbonization of coconut shells, volatiles amounting to 70% of the mass of coconut shells on dry weight basis are released to the atmosphere, yielding 30% of coconut shell mass of charcoal.



Fig 1 – a) Groundnut shell ash; b) Cashew Nut Shell Ash; c) Coconut Shell Ash

Synthetic samples containing trace metals lead, copper, manganese, zinc, cobalt, chromium of 20ppm each were prepared in the laboratory using analytical grade salts

Batch Experiment

The batch experiment was carried out in part for the treatment of the synthetic samples (Fig. 2). Total of 8 sets of batch experiments was carried out using various proportions of ashes collected.

The flow test for various materials has done to decipher the flow rate through the material. The column (2 Liter) is filled with the materials one by one. Then the water (1 Liter) is filled in the column and collected in the bottom to know the flow time (table 1). The samples after and before treatment were analysed using atomic absorption spectrometer in department of geology, Presidency college, Chennai.

Table 1 - Flow Rate in different filters

Batch Experiment	Filter Set (100 gms)	Flow Time/ Litre
Set 1	CaN + GN (25:75)	30 min
Set 2	CaN + GN (50:50)	30 min

Set 3	CaN + GN (75:25)	30 min
Set 4	CO +GN (25:75)	30 min
Set 5	CO + GN (50:50)	30 min
Set 6	CO +GN (75:25)	45 min
Set 7	CaN + CO (75:25)	38 min
Set 8	CaN + CO (50:50)	30 min

Cahsew nut (CaN), Groundnut (GN), Coconut (CO)



Fig 2 – Experimental set up

3. Results and Discussion

To understand the efficiency of the natural adsorbents as substrate is remaining trace metals where compared. The substrate were not activated and used in their natural forms. The main idea for using the natural ash was to identify and understand the influence of their characteristics during filtration.

Coconut and Groundnut Ash (CO & GN)

The coconut and groundnut combination (fig 3) shows that the concentration of metals varied with different composition of (CO&GN) percentage. The high concentration of chromium and manganese in CO 25% and GN 75% shows that the influence of GN shell ash in the filtration proves, whereas the metal zinc shows high concentration than the synthetic sample in both 50:50 & 75:25 indicating the influence of GN shell.

Cashew nut and Groundnut Ash (CaN & GN)

The CaN & GN (fig 4) experiment shows that high proportion of groundnut results in high concentration of zinc, manganese and lead.

Cashewnut and Coconut Ash (CaN & CO)

The CaN & CO (fig 5) experiment shows that the concentration of the synthetic samples does not show any reduction in concentration, instead shows high concentration in almost all metals. The high concentration / increasing concentration of the metals might be due to desorption of metals from the ashes.

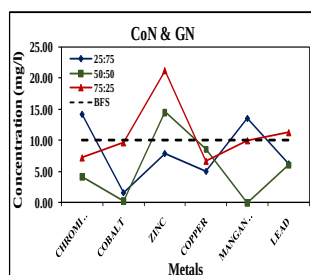


Fig. 3

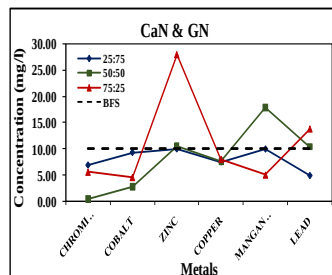


Fig. 4

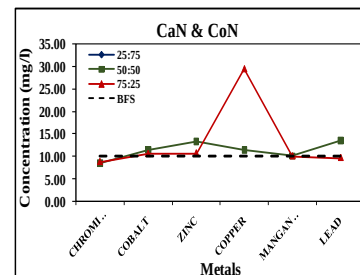


Fig.5

To understand the effects of filtration & adsorption of metals by the substrates and individual metals were studied. The concentration of chromium considerable decreases when filtered with CaN & GN, especially the removal chromium is maximum when 50:50 CaN & GN (Fig. 6) used as an increasing the percentage of both the ashes results in desorption of the metals or removal capacity of the metals by these ashes. The removal of cobalt is more effective in CO & GN followed by CaN & GN, 50:50 ratio (Fig. 6) was effective in removal of this metal. The metal zinc shows increasing trend when filtered using Co & GN (Fig. 6). The CaN & GN shows maximum removal of zinc at 50:50 ratio (Fig. 6). Zinc is removed maximum at 75:25 for Ca & Co set (Fig. 6). The copper shows very low concentration or maximum removal in 50:50 of CaN & GN (fig. 6). The CoN & GN also shows considerable effectiveness in removing copper from the water (fig. 6). The removal of manganese was maximum at 50:50 of Co & GN (fig. 6). Other compositions shows that desorption of manganese from the substrates (Fig. 6). The removal of lead is maximum in CaN & GN (25:75), Co & GN (50:50) (Fig. 6).

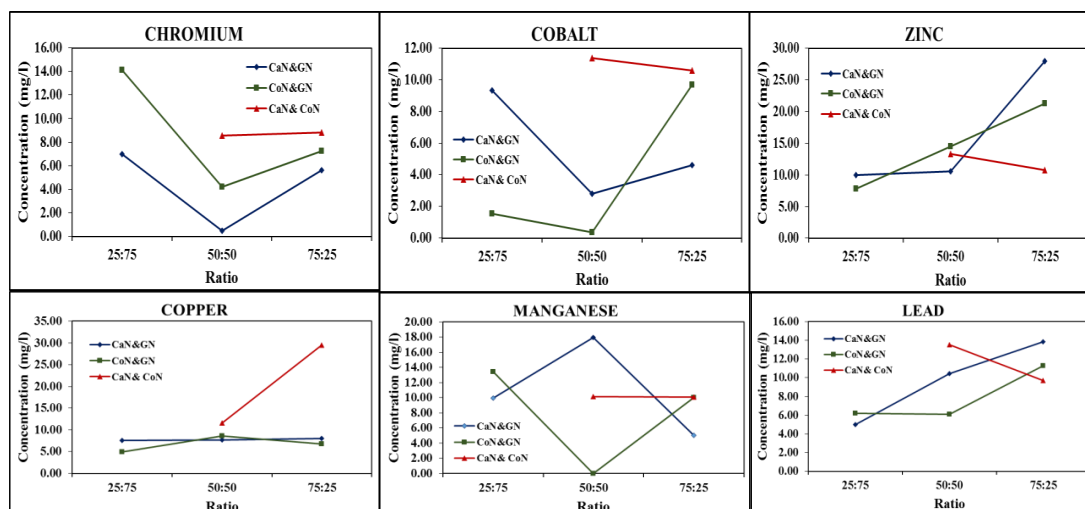


Figure 6 – Behaviour of various metals for various substrates used.

4. Conclusion

From the study it is cleared evident that the substrates behave different with the various combinations in removal of the metals from the water surfaces. The maximum removal of metals were achieved using 50:50 ratio irrespective of the materials used. The CaN& GN combination act as the most effective combination (especially 50:50 of CaN& GN) in removal of almost all trace metals that were studied.

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