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Research Article

Experimental Dose Optimization for Cu removal from water using Neem leaves

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Abstract

The selection of a potential biomass from the different types of low cost biomaterials that are readily available is a major challenge in the application of biosorption like Neem tree (Azadirachta indica). Though the use of biomass for environmental purposes has been in practice for long, researchers are hopeful that the method will lead to an alternative economical method for the removal of heavy toxic substances from wastewater. Biosorption have been seen as a new technology, and has been put to use in various applications for a very long time. Biosorption is a good applicant for the removal of toxic metals like Copper metal from large volume and lower concentration of aqueous solutions. The selection of a potential biomass from the different types of low cost biomaterials that are readily available is a major challenge in the application of biosorption. Neem tree (Azadirachta indica) is a distinctive mahogany tree among the Malecite family and is an inhabitant in the Southeast Asia regions and can also be found in different countries worldwide. For a very long time, its product have been widely used and proven to be effective in solving variety of problems in relation to public health, agriculture, environmental pollution and also population control. Neem has certain powerful chemical ingredients; they are azadirachtin, salannin, meliantriol, nimbin and nimbidin. This chemical compounds were found to have a great metal binding capacity . Adsorbent dose, It is the most influential parameter to calculate the adsorption capacity, as increase in amount of adsorbent with fixed volume reaction mixture leads to increase in number of active sites available for the adsorption to takes place but simultaneously it decrease the adsorption capacity as they are inversely proportional. while removal percentage will increase.

Keywords*: Biosorption , Azadirachta indica , Copper metal, dose optimization*

Introduction

Water is essential for the survival of any form of life. On average, a human being consumes about 2 lit of water every day. The demand of water has been growing day by day due to exploding population and industrialization. In recent years an increasing threat to ground water quality due to human activity has become of great importance. The adverse effect of ground water quality are the result of man's activity at ground surface, unintentionally by agriculture, domestic, and industrial effluents, unexpectedly by sub-surface or surface disposal of sewage and industrial wastes. The quality of ground water is resultant of all the processes and reactions that have acted on the water from the moment it condensed in atmosphere to the time of discharge by a well. Therefore quality of water varies from place to place, with the depth of water table and from season to season. A vast majority of ground water quality problems are caused by contamination, over-exploitation or combination of the two. Most water quality problems are difficult to detect and hard to resolve. Water quality is slowly but surely declining everywhere. The wide range of contamination sources is one of the many factors contributing to the complexity of water assessment.

Sources of water pollution

Saltwater encroachment associated with over drafting of aquifers or natural leaching from natural occurring deposits are natural sources of groundwater pollution. Most concern over groundwater contamination has centered on pollution associated with human activities. Human groundwater contamination can be related to waste disposal (private sewage disposal systems, land disposal of solid waste, municipal wastewater, wastewater impoundments, land spreading of sludge, brine disposal from the petroleum industry, mine wastes, deep-well disposal of liquid wastes, animal

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feedlot wastes, radioactive wastes) or not directly related to waste disposal (accidents, certain agricultural activities, mining, highway deicing, acid rain, improper well construction and maintenance, road salt).

Causes of Water Pollution

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water and what is a contaminant. High concentrations of naturally occurring substances can have negative impacts on aquatic flora and fauna.

Pathogens

Disease-causing microorganisms are referred to as pathogens like Burkholderia pseudomallei Cryptosporidium parvum Giardia lamblia Salmonella Norovirus and other viruses Parasitic worms including the Schistosoma type. Organic water pollutants include:

1. Detergents
2. Disinfection by-products found in chemically disinfected drinking water, such as chloroform
3. Food processing waste, which can include oxygen-demanding substances, fats and grease
4. Insecticides and herbicides, a huge range of organo halides and other chemical compounds
5. Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion byproducts, from storm water runoff.
6. Volatile organic compounds, such as industrial solvents, from improper storage.
7. Chlorinated solvents, which are dense non-aqueous phase liquids, may fall to the bottom of reservoirs, since they don't mix well with water and are denser.
8. Polychlorinated biphenyl (PCBs)
9. Trichloroethylene
10. Perchlorate

Various chemical compounds found in personal hygiene and cosmetic products. Drug pollution involving pharmaceutical drugs and their metabolites Inorganic water pollutants include:

1. Acidity caused by industrial discharges (especially sulfur dioxide from power plants)
2. Ammonia from food processing waste
3. Chemical waste as industrial by-products
4. Fertilizers containing nutrients--nitrates and phosphates—which are found in storm water runoff from agriculture, as well as commercial and residential use.
5. Heavy metals from motor vehicles (via urban storm water runoff) and acid mine drainage
6. Silt (sediment) in runoff from construction sites, logging, slash and burn practices or land clearing sites.

Material and Methods

A. Preparation of adsorbent

Neem leaves collected from neem tree and washed out by distilled water to removed dust and impurity of leaves surface and dried one day in sunlight. Further dried it in oven to remove excess moisture in neem leaves. Take out the neem leaves and put it in crucible and burn it in muffle furnace till it completely turns into carbon format. Take out the burn leaves and crush it. Sieve it to get 75 μm size particles. Store it in plastic bottle for further use. Kept clean and dry place so as free from moisture attack.

B. Metal salts used and preparation of stock solution of Cu metal ions

Present study was focused cupper ion was used as the adsorbate. A 10.5 g of Cupper Sulphate with 1000 mL of distilled water was prepared by dissolving accurately weight amount of Cupper Sulphate distilled water. Appropriate dilution of the stock solution was carried out in order to obtain the desired concentration of Cu solution used later in the experiment. The solutions were prepared using a standard flask. The range of concentrations used was prepared by serial dilution of the stock solution with deionized water.

C. Batch sorption experiment

Batch experiments were carried out at room temperature using a conical flask by shaking a mixture of 0.1 g of prepared leaves powder and 20 mL of Cu solution in a centrifuge tube, at agitation rate of 150 rpm for allowing sufficient time for adsorption equilibrium. All samples were carried out in duplicate under the same conditions and the average results were taken. After agitation, the powder was removed by filtration using filter paper. The selected experimental design parameters are as given in Table no. 1

Table 1 Selected Experimental Design Parameter

Sr No.	Parameter	Values tries for neem adsorption
1	Adsorbent Dose in g/100ml	0.1.0.2,0.3,0.4,0.5
2	Agitation Time in Min	20 min
3	pH of solution maintain	7
4	Temperature of Solution	30 ^{0}C or room Temperature

Analysis

The concentration of Cu in the filtrates as well as in the control samples were determined by using GBC Avanta Flame atomic Absorption Spectroscopy (AAS). Percentage removal of metal ions can also be computed using the following equation:

1) % removal of Cu ion from solution after adsorption= (Cu contain in neem residue after adsorption x 100)/(Total Cu contain before adsorption)

2) % retained Cu ion in solution after adsorption= (Cu contained in solution after adsorption process) X100/(Total Cu contain before adsorption)

The dose indicate Maximum of formula-1 (% removal of Cu ion from solution after adsorption) is optimum dose of NLP for Copper removal from given solution. Further there will more Batch sorption experiment will give more accurate result.

3. Results and Discussion

Table 2 Analysis Result Chart

Dose of neem g/ 100 mL	Initial Cu contain in neem leaves	Initial Cu contain in Distilled Water after addition of Cu ion	Total Cu contain before adsorption	Cu contain in neem residue after adsorption	Cu contain in Solution after adsorption process	Total Cu contain after adsorption	% retained of Cu ion in solution after adsorption	% removal of Cu ion from solution after adsorption
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
			a+b			d+e	(e/c)*100	(d/c)*100
0.1	100.12	300.12	400.24	25.3	250.15	275.45	62.50	6.32
0.2	100.12	300.12	400.24	100.5	197.15	297.65	49.26	25.11
0.3	100.12	300.12	400.24	150.4	170.2	320.6	42.52	37.58
0.4	100.12	300.12	400.24	170.2	100.4	270.6	25.08	42.52
0.5	100.12	300.12	400.24	180.4	90.2	270.6	22.54	45.07

The level 1 result shows 6.32% removal of copper from solution after adsorption, and the corresponding neem dose is 0.1 g/100ml. The level 2 result shows 25.10 % removal of copper from solution after adsorption, and the corresponding neem dose is 0.2 g/100ml. The level 3 result shows 37.58 % removal of copper from solution after adsorption, and the corresponding neem dose is 0.3 g/100ml. The level 4 result shows 42.52 % removal of copper from solution after adsorption, and the corresponding neem dose is 0.4 g/100ml. The level 5 result shows 45.07% removal of copper from solution after adsorption, and the corresponding neem dose is 0.5 g/100ml. Hence the level 5 result shows maximum % removal of copper . Therefore according to this experimental setups and result analysis the dose used in level 5 setup 0.5 g/100ml is a optimum dose of NLP (Neem Leaves Powder) and NLP can be used as coagulant, disinfectant.

Conclusion

The surface drain water from industrial area contain Chlorine, high BOD, high COD, Copper, Zinc, Cadmium, Mercury, Lead, Arsenic are present. The contains of industrial effluent further on percolation in soil may mix with the ground water aquifer causing contamination of ground water. The contents of effluent may cause for soil contamination and also harmful to irrigated crop quality.

Pollution / contamination causes Plant growth retardation with stunted fruits, leaves and stem in high salinity. Acess amount of Lead causes burning in mouth, severe inflammation of gastro-intestinal tract with vomiting and diarrhea. Chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, and anaemia etc. Some plants accumulate it that may have harmful effect on human health. Very high concentration may reduce root growth. Trace of lead in metal plating baths will affect smoothness and brightness of deposits in industries. Acess amount of Arsenic causes skin damage, circulatory problems, increased risk of skin cancer Acess amount of Mercury causes nurological and renal disturbances. Excess causes gonadotoxic and mutagenic effects and disturbs the cholesterol metabolism. Acess amount of Sodium causes increase total salinity, has adverse effect on sodium sensitive species such as fruit trees and avocados. Excess amount of Chloride causes direct toxic effect with sodium.

The Neem leaves commonly available waste material in India. It is useful in medicine, but utilization of Neem leaves using various treatments can be used as a low cost adsorbent instead of high cost adsorbent. In the present work the Neem Leaves Powder converted into the activated carbon by chemical activation. There is a tremendous potential in these materials to be explored as industrial low cost effective adsorbents.

Adsorbent dose, It is the most influential parameter to calculate the adsorption capacity, as increase in amount of adsorbent with fixed volume reaction mixture leads to increase in number of active sites available for the adsorption to takes place but simultaneously it decrease the adsorption capacity as they are inversely proportional while removal percentage will increase. So this removal technique is very useful for heavy metal, and other metal removal.

Future Scope

Most of the treatment systems for drinking water have to be tried out at the community level to be cost effective and affordable. Therefore, it will be more appropriate to build and operate water treatment systems on the principle of full cost recovery. The water supplied from the system has to be affordable to all classes of the society as drinking is essential for survival. Therefore, unit cost of production should be minimized for commercial viability.

The optimal plant design, proper selection of remedial method, generating sufficient demand etc. are important for bringing down the cost of production.

New techno institutional models need to be evolved to manage the system in order to make them self sustaining. Involving private sector in provision of clean and safe drinking water would be a major step towards achieving this.

The Copper (adsorbents) used for the removal of heavy metal ions from water and wastewater. In this study, the Azadirachta indica (Neem) leaves derived have been utilized as suitable and effective adsorbents for the removal of heavy metal ions from wastewater. Several methods are available to modify the adsorbent surfaces chemically, and many plant matters are available as cost-free adsorbents, which may be utilized and modified, by any of the established surface modification methods. The prepared adsorbents may definitely be a better alternative to the commercially available adsorbents.

Therefore, a detailed batch adsorption study in the removal of heavy metal ions from water and wastewater could be carried out. Both industrially and commercially, adsorption is carried out in a packed column using activated carbon. Furthermore, the batch adsorption study is applicable only to laboratory or small scale industries, and not for large scale and commercial applications. There are a lot of unexplored plant matters, and agricultural wastes available in India, which can be utilized to treat different kinds of industrial waste water. These materials can be chemically treated and surface modified, using physical or chemical methods, to prepare more efficient adsorbents, which serve as better alternatives to the commercial adsorbents.

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