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Removal of Phosphate from wastewater using natural adsorbents.

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Abstract: A study was undertaken to investigate the removal of phosphate from wastewater by natural adsorbents. The study was conducted by using different adsorbents which includes Ficuscarica, Moringaoleifera and Saw dust. The adsorption method was employed: parameters such as pH, contact time and initial phosphate concentration were studied. Theinfluence of the pHof the phosphate ionsolution on the uptake levels of the phosphate ion by different adsorbents used were carriedout between pH 3 and pH11. Experiment was done by varying contact time, biosorbent dosage and pH range to get the optimum value. The optimum percentage removal of phosphate was found to be more than 77% in Ficus carica,75% Moringa oleifera,70% in Saw dust. The highest percentage removal of phosphate was achieved at Ficuscarica.
Keywords : Waste water, Phosphate removal, Ficuscarica, Moringaoleifera, Saw dust.

Introduction

Environmental pollution is currently one of the most important issues facing humanity. Eutrophication of the water bodies is one of the most important environmental problems, which occurs in stagnant water bodies[1]. Phosphorus has been considered as a key element causing eutrophication, which leads to abundant development of aquatic plants, growth of algae, with some kinds of them being toxic, and to balance disturbance of organisms present in water[2-3]. This directly affects water quality through oxygen depletion, because of high biological oxygen demands, and acidification. This in turn harmfully affects fish and other aquatic life, microorganism and insects' growth and natural resorts deterioration. Consequently, the removal of phosphates from surface waters is absolutely necessary to avoid any kind of problems, particularly near urban areas. Wastes containing phosphates must meet the maximum discharge limits, which is typically between 0.5 and 1.0 mg P/liter.

Water of high quality is essential to human life and water of acceptable quality is essential for agricultural, industrial, domestic and commercial uses. Technical feasibility of various low cost adsorbents for ions removal from contaminated water has been received. Phosphorus usually occurs in wastewater and surface water in the form of organic phosphates (e.g. detergents) and inorganic phosphates (ortho- and poly-phosphates). In wastewater treatment technology, various techniques have been employed for phosphate removal. Despite the extensive experimental work carried out, phosphorus removal and recycling technologies have not been widely adopted because of the technical and economic drawbacks. Chemical coagulants used in water treatment it induce many diseases.[4-6]

The natural adsorbents and activated carbon such as Ficus carica, Moringa oleifera, Saw dust and other adsorbents which have adsorption capacity and are locally available. Therefore, they are inexpensive and little economic value. Controlling phosphorous discharged from municipal and industrial wastewater treatments is a key factor in preventing eutrophication of surface water.

Experimental

Preparation of phosphate solution

Artificial orthophosphate solutions were used throughout the adsorption tests. Initially, a stock solution of 100 ppm in orthophosphates was prepared by dissolving a certain amount of chemically pure $K_2HPO_4 \cdot 3H_2O$ in distilled water. An aliquot of the stock solution was mixed with a certain volume of water so that a phosphate solution prepared at the desired experimental concentration. Distilled water was used throughout all the tests. The fresh phosphate solutions were daily prepared to avoid possible precipitation of phosphate species. NaOH and HCl solutions 5% v/v were used as pH regulators.

Preparation of natural adsorbents

The raw materials i.e, Ficus carica, Moringa oleifera and Saw dust was collected from particular tree. One part of the raw materials was treated with two parts (by weight) of concentrated sulfuric acid and the same was kept in oven maintained at 150 to175 ºC for a period of 24h.The carbonized material was washed well with double-distilled water to remove the free acid and dried at 105 to 150 ºC for 24h. The dried materials was subjected to thermal activation at different temperature, viz., 200, 400, 600 and 800 ºC for 1h.The product obtained at temperature higher or lower 600ºC exhibited poor adsorption capacity probably (at high temperature) because of the collapse of a surface functional groups. The temperature and time were optimized by observing the surface properties of the activated product obtained by treating the raw materials for different intervals of time at the varying temperature mentioned above.The product so obtained was cooled and sieved to desired particle size such as 30-200, 200-250 and 250-300 mesh. Finally the product was stored in vacuum desiccators until required.

Result and discussion

Effect of pH:

The pH of the aqueous solution is an important variable, which influences the sorption of both anions and cations at the solid-liquid interface. The anion exchange capacity is strongly governed 1 by the pH of the solution and by the surface chemistry of the solid.

To study the influence of pH the adsorption capacity of Ficus carica, Moringa oleiferaand saw dust adsorbents for phosphate, experiments were performed at room temperature, for several contact time, using various initial solution pH values 2 to 12 phosphate solution, with initial concentrations1and 5mg/l is shown in Fig.1.

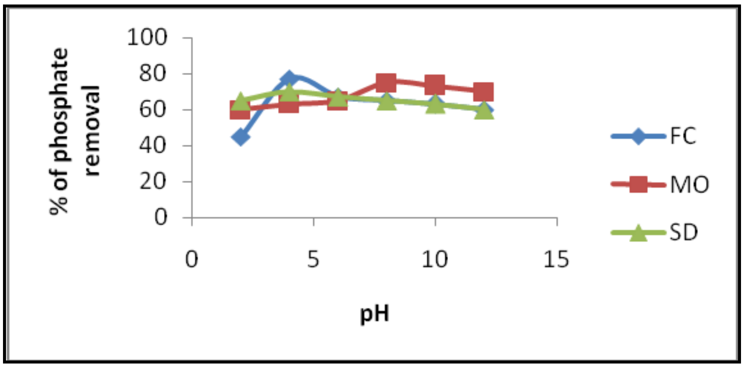

Fig.1 Effect of pH

Experimental condition (Adsorbent dosage 0.5g, Initial Concentration 5ppm, pH-2-12, Stirring time 90 min)

Effect of adsorbent dosage.

To investigate the effect of adsorbent dose on the phosphate adsorbtion onto various adsorbtion surfaces, experiments were carried out with initial phosphate concentration 100 and 500mg/l and various adsorbent dosesatroom temperatureand at a constant stirring speed of190 rpm for different contact time. The result show that the percent removal increased with increasing adsorbent dose due to the increase in the total available surface area of the adsorbent particles.0.5g adsorbent doses was needed to highest percentage removal of phosphate from wastewater.Ficuscarica activated carbon was highest percentage removal of phosphate compared with other activated carbon is shown in Fig.2.

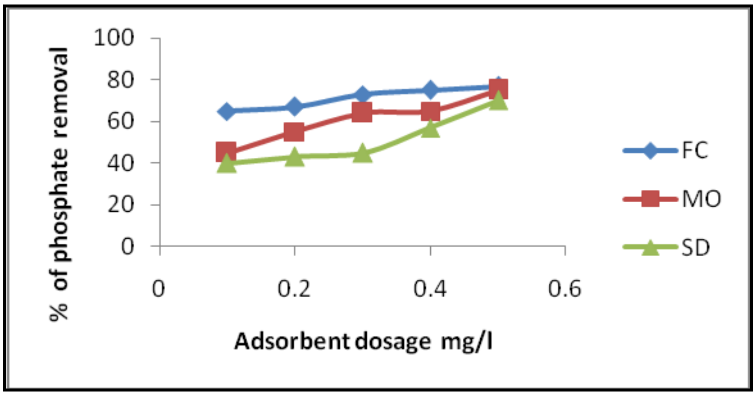

Fig.3 Effect of Adsorbent dosage

Experimental condition (Adsorbent dosage 0.1-0.5g, Initial Concentration 5ppm, pH-3, Stirring time 90 min)

Effect of contact time

The effect of contact time on the removal efficiency of different adsorbents for phosphate studied. The rate of uptake of ions was quite rapid. The ion removal in the first 1hr using natural adsorbents 77% of Ficuscarica, 75% of Moringaoleifera, 70% of saw dust were used removal of phosphate from wastewater in 90 min-[1] is shown in Fig.3.

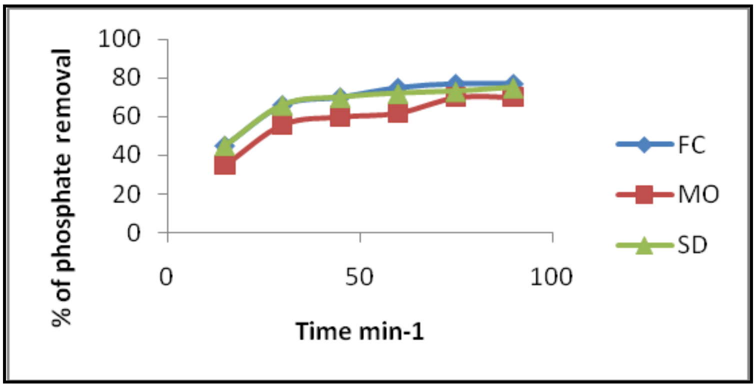

Fig.3 Effect of contact time

Experimental condition (Adsorbent dosage 0.5g, Initial Concentration 5ppm, pH-3, Stirring time 15-90 min)

Effect of initial concentration.

To investigate the effect of initial concentration on the phosphate adsorption, experiments were carryout with initial phosphate concentration of 1 and 5mg/l and varying initial concentration at room temperature and constant stirring speed of 190rpm for different contact time. The effect of initial concentration increases percentage of adsorption decreases.Active sites of the activated carbon decreases so percentage of adsorption decreases is shown in Fig.4.

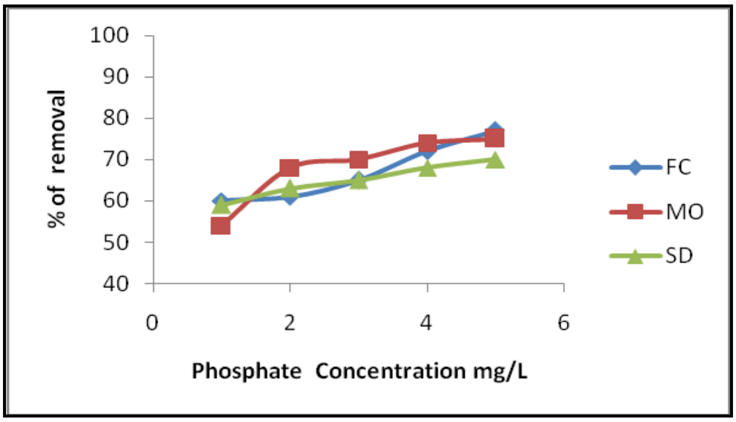

Fig.4 Effect of initial concentration

Experimental condition (Adsorbent dosage 0.5g, Initial Concentration 1-5ppm, pH-3, Stirring time 90 min)

Effect of Temperature

The effect of temperature on phosphate removal using Ficuscarica, Moringaoleiferaand Saw dust were investigated at 60, 90,120,150,180 º C and data were represented in Fig.5. The nature of curve shows that the percentage removal was continuously increasing with increasing temperature. A straight line was observed after 180 º C for all coagulants. The highest removal of phosphate was found to be 65% when Ficuscarica was used.

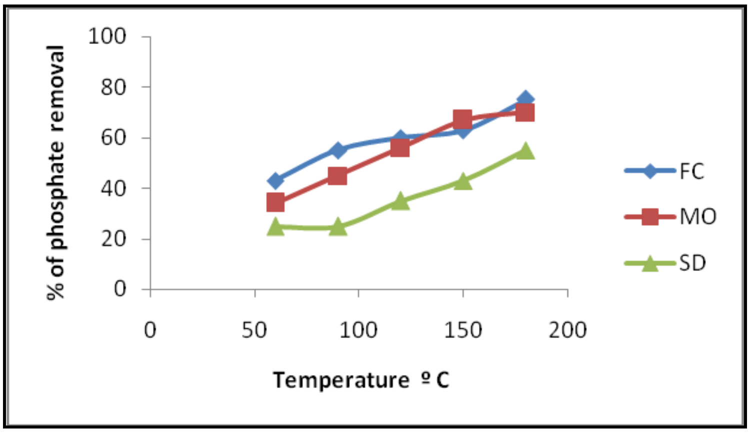

Fig.5 Effect of Temperature

Experimental condition (Adsorbent dosage 0.4g, Initial Concentration 1-5ppm, pH-4, Stirring time 120 min, Temperature 60-180 º C)

Conclusion:

Ficuscarica, Moringaoleifera, Saw dust were significant improvement in removing phosphate from wastewater was found.Maximum phosphate removal was achieved at high adsorbent dosage.Ficuscarica seed was highest removal of phosphate compared with other activated carbons. Natural coagulants are environmental friendly material and low cost method to remove the phosphate from wastewater.

References

1. Ebaid RA and El-Refaee IS. Utilization of rice husk as an organic fertilizer to improve productivity and water use efficiency in rice fields. African Crop Science Conference Proceedings., El Minia, Egypt,2007, 8; 1923-1928.

2. Girgis BS and El-Hendawy A-N A. Porosity development in activated carbons obtained from date pits under chemical activation with phosphoric acid. Microporous and Mesoporous Materials., 2002, 52; 105–117.
3. Muthuraman G and Sasikala S. Removal of turbidity from drinking water using natural coagulants. Int. J. indus and Engin.chem 2014, 20; 1727-1731.
4. Muthuraman G and Sasikala S. Proteins from natural coagulants used as potential application of turbidity removal from drinking water. IJEIT., 2013, 3;283-287.
5. RavikumarK ,Prof.Sheeja AK. Heavy metal removal from water using Moringaoleifera seed coagulant and double filtration. International Journal of Scientific & Engineering Research, 2013, 4;10-13.
6. Mohammed Mansour salehsaif, Siva kumar N, Sivakumar M.N.V. Biosorption of cadmium by Strychnospotatorum seed proteins :Adsorption kinetics, Proteins, Nanoparticles for Enhancing Cd removal and relevance to wastewater treatment. Libyan Agricultural research center Journal International.2012, 3;269-278.

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