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REMOVAL OF DYES AND HEAVY METALS FROM AQUEOUS SOULTION USING RICINUS COMMUNIS AS AN ADSORBENT- A REVIEW

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ABSTRACT

Today's world is burdened with the need for potable water even with the numerous water bodies that exist. Among several other techniques, adsorption has become widely used for the removal of heavy metal ions and dyes from aqueous solution and numerous adsorbents for water treatment have therefore been prepared over the years. Ricinus communis effectively treat water by adsorption of both heavy metal ion and dyes from aqueous solutions. Some of these RC – when modified with chemicals – also have the abilityto efficiently remove heavy metal ion and dyes from water. Ricinus communis. Have higher adsorption capacityand better life cycles, therefore it shows an excellent potential in adsorption process. This article reviews the various Ricinus communis carbon that have been prepared recently and used as adsorbents in the removal of heavy metal ion and dyes from aqueous solutions. A special focus is placed on ricinus communis that are not only interesting from an academic point of view but also effectively reduce the concentration of pollutants in water.

KEYWORDS: Adsorption, Ricinus communis carbon, Heavy metal & Dyes, Isotherms, Kinetic models.

INTRODUCTION

Environmental pollution due to industrial effluents is of major concern because of their toxicity and threat for human life and the environment. The discharge of various Industrial effluents to the water bodies has raised much concern because of potential health hazards associated with the entry of toxic components into the food chains of humans and animals. The treatment of industrial wastewater is carried out in various ways, in order to remove dyes, pigments, heavy metals, organic pollutants and other biological impurities. A number of technologies have been developed over the years to remove various pollutants present in the water.[1] The methods are chemical precipitation, electro deposition, ultra filtration, ion exchange, activated carbon adsorption and biological processes.[2] Among these methods, adsorption is by far the most versatile and widely used method because of its low cost and ease of operation. Biosorption of pollutants on some agro waste material is getting importance as an alternative way of water treatment because of its low cost, user friendly nature and ease in handling. So various types of agro waste materials are investigated in all over the world for removing dyes and other pollutants.

Dyes are widely used to add value on the appearance of the products such as textiles, printing and food. There are more than $7x10^5$ tons of dyes produced annually, but 12% of them discharged in effluent and result in environmental problem.[3] Dye is a visible pollutant its existence can severely affect the surface water quality, aquatic eco system and food chain.[4] Likewise some metals can have toxic or harmful effects on many forms of life. Among the most toxic metals are Chromium (Cr), Copper (Cu), Lead (Pb), Zinc (Zn) and Mercury (Hg), Which is one of the most hazardous priority substances in the list the pollutants contained in the water framework Directive (Directive 2000/60/EC). The dyes are discharged from various textile industries like Tirupur, Erode and Karur in to Noyyal River. So the Noyyal River gets polluted by number of dye pollutant so it is very essential to remove these kinds of dyes and metal ions from wastewater. Therefore there is a need to look for low cost alternatives in easily available biomaterials which can adsorb dyes and metal ion from wastewater. In this review we emphasis the activated carbon developed from Ricinus communis, as an adsorbent for the removal of dyes and metal ions from water. The main disadvantage of this plant is to produce drought where the place it is cultivated. So it affects the growth of the other plants.

Therefore the main objective of this review was to evaluate the possibility of using Ricinus communis to develop a new low cost activated carbon and study its application to remove dyes and metal ions from the simulated wastewater.

REMOVAL OF METAL ION BY RICINUS COMMUNIS SEED SHELL

Removal of Fe(III)

K.Karunakaran et al.,[5] prepared the activated carbon from Ricinus Communis Seed Shell an agricultural waste, abundance, cheapness and environmentally friendly nature could be used as potential adsorbent for the removal of Fe(III) from aqueous solution contains heavy metal sand polluted water. The Various parameters such as pH, contact time adsorbent dosage were studied. The adsorption of Fe(III) was depended on the pH of the solution. Based on the results, the optimum contact time is 30 minute sand adsorbent dosage is 50 mg/L. Polypyrrole conducting polymer is the most important conducting polymer that can be synthesized chemical polymerization as coated form on the surface of RCC from aqueous solution. It was found that polypyrrolebased conducting polymer was better adsorbent for removal Fe(III) compared to RCC from aqueous solution. The metal ion adsorption obeyed both pseudo second order model and The Freundlich adsorption isotherm model based on the experimental and calculated qe value Theremoval of Fe(III) is simultaneously increased with increase in the temperature from 30^{o}C to 50^{o}C.

REMOVAL OF METAL ION BY RICINUS COMMUNIS Pericarp

Removal of Ni(II)

S. Madhavakrishna et al.,[6] prepared activated carbon from Ricinus communis Pericarp is very effective adsorbent in removal of Ni(II) ions from aqueous solution. The Various parameters such as pH, contact time adsorbent dosage were investigated. Increase in adsorbent dosage and agitation time increases Ni(II) ion removal at the optimum pH of 5±0.2.The adsorption followed both Langmuir and Freundlich isotherm models. The desorption studies reveals that recovery of Ni(II) ions from adsorbent is possible.

Removal of Pb(II)

S.Madhavakrishnan et al.,[7] prepared the activated carbon from Ricinus communis pericarp is very effective adsorbent for the removal of Pb (II) ions from aqueous solution. Batch mode adsorption experiments were carried out by changing contact time, metal ion concentration, carbon concentration and pH to assess kinetic and equilibrium parameters An increase in the adsorbent dosage and agitation time increase Pb(II) ion removal at the optimum pH5±0.2. The adsorption data fitted with both Langmuir and Freundlich isotherm models. Desorption studies reveal that the recovery of Pb(II) ion from adsorbent is possible.

Removal of Ni(II) and Cu(II)

M. Makeswari et al.,[8] prepared Tannin gel derived from Ricinus Communis leaves as a adsorbent has been used an efficient and economical alternative in Cu (II) and Ni (II) ion removal from water. The Various parameters such as pH, contact time adsorbent dosage, metal ion concentration, pH_{zpc} were carried out. The maximum percentage of adsorption for the removal of Cu (II) ion was found to be 76.92% at 7.04pH and for the removal of Ni (II) ion was 71.74% at 7.12 pH. The adsorption of Cu (II) and Ni (II) ions followed the Pseudo-second-order and Intra particle diffusion rate equations and fits the Langmuir, Freundlich and Frenkel-Halsey-Hill isotherm equations well. TGLRC will be recovered by desorption method by using proper desorption agent like H_2O by batch mode study. Activated carbon developed from Ricinus Communis leaves can be an attractive option for heavy metal removal from water and waste water since test reactions made on stimulated waste water showed better removal percentage of Cu (II) and Ni (II) ions.

REMOVAL OF DYE BY RICINUS COMMUNIS EPICARP

Removal of Methylene blue dye

T.Santhi et al.,[9] prepared the bio adsorbent from epicarp of Ricinuscommunis, a low cost agricultural waste, could effectively remove MB from an aqueous solution. The batch experiments such as agitation time, dye concentration adsorbent dosage and pH were studied. The optimal pH for favorable adsorptionof dye was 7. The change of particle size had an effect on the bio adsorption of dye. The adsorbent size of 125-250 μm at room temperature (32±2^{o}C). The isothermal data fitted the Langmuir and Freundlich model. So, the adsorption was physisorption. The bio adsorption processes followed the pseudo- first order rate kinetics.

Removal of Crystal violet dye

S. Madhavakrishnan et al.,[10] prepared the activated carbon from Ricinus communis pericarp was an effective adsorbent for the removal of the crystal violet dye from aqueous solution. Batch mode experiments were carried out by using agitation time, dye concentration and contact time. In batch mode adsorption studies, the adsorption was dependen**t** on the solution pH, carbon dosage and initial dye concentration. Adsorption followed both Langmuir and Freundlich isotherm models. The adsorption capacity was found to be 48.0 mg/g at an initial pH of 6.8±0.2 for the particle size of 125-250 μm. Desorption studies reveals that recovery of dye from adsorbent was possible.

Removal of Malachite green dye

M. Makeswari et al.,[11] prepared the activated carbon from microwave activated epicarp of Ricinus communis (MRC) and microwave assisted zinc chloride activated epicarp of Ricinus communis (ZRC) for the removal of malachite green from aqueous solution. Batch equilibrium studies such as Effect of adsorbent dosage, pH of the solution, initial dye concentration were studied. The optimum conditions were microwave power of 100 W, microwave radiation time of 4 min, concentration of zinc chloride of 30% by volume and impregnation time of 16 h. SEM micrographs showed that the external surface of the chemically activated

carbon was full of cavities compared with untreated Ricinus communis. The activated carbon prepared could effectively used as adsorbent for the removal of basic dye from aqueous solutions. Adsorption was found to be maximum in the pH of 5. Langmuir isotherm models given were fitting better than Freundlich, Temkin and Dubinin-Radushkevich isotherms interpreting the adsorption phenomenon of MG. MG adsorption system follows pseudo-second-order kinetic model, based on the assumption that the rate-limiting step may be chemisorption process. MG adsorption rate onto MRC and ZRC was greater in single system (S) than in binary system (B) due to the competitive adsorption of dye onto the active site of the activated carbon. Among MRC and ZRC, ZRC shows most adsorption ability than MRC in single and binary system

Removal of Reactive yellow dye

K. Manickavasagam et al.,[12] prepared carbon Ricinus Communis pericarp, an agricultural waste can be effectively usedas a raw material for the preparation of activated carbons using sulphuric acid activation method. Fromthe SEM analysis of RCP carbon, it was found that there are holes and cave type opening on the surface of adsorbent, which provides more surface area for the adsorption of dyes. The RCP Carbon was used for the removal of Reactive Yellow from aqueous solution. There was no major change in percentage removal of dye over entire pH range. In the batch mode adsorption, percent adsorption increased with increase of agitation time, carbon concentration and decreases with increasing particle size of the adsorbent. The adsorption kinetics of RCP carbon followed the first order and the pseudo second order rate equation for all the dyes. Adsorption of Reactive Yellow obeys both Langmuir and Freundlich isotherm indicates that the adsorption process is favorable. Elovichequation and Tempkin isotherm indicates that adsorption of Reactive Yellow on the activated carbon is spontaneous. Desorption was not even 35 % and it was concluded from the results that both chemisorption and physisorption were plays very important role inthe removal of dye. The present results show that complete removal of color made possible by using sufficient adsorbent dosage. The percent removal of dye by batch mode studies for industrial waste waters was lower when compared to synthetic dye.

REMOVAL OF DYE BY RICINUS COMMUNIS STEM POWDER

Removal of Methylene blue dye

Rabia rehman et al.,[13] prepared the activated carbon from Ricinus scommunistem powder is avery effective biosorbent for removal of cationic dyes from waste water. Here adsorption capacity of Ricinuscommunis stem powder had been investigated for removal of Methylene Blue dye. For comparison, Ricinuscommunis stem powder was treated with formalin to enhance its adsorption capacity. Isothermal and thermodynamic studies were carried out after optimizing adsorption conditions. The results indicated that Ricinuscommunis stem powder had maximum adsorption capacity of 11.59 mg/g, which is improved after formalin treatment, i.e.19.45 mg/g. Thermodynamic and separation factor values supported the feasibility of this process. S.E.M studies indicated the porous structural aspects of Ricinuscommunis stem powder, suitable for removing Methylene Blue.

REMOVAL OF DYE BY RICINUS COMMUNIS SEED RESIDUE

Removal of Methylene blue dye

Lee lin zhi et al.,[14] prepared from castor bean residue as the precursor of activated carbon by metal chloride salts as activating agent. ZnCl2, NaCl and KCl were used to activate the castor bean residue and the performance was investigated by adsorption of methylene blue and its correlation with the specific surface area. ZnCl2-activated castor bean cake with had the best adsorption result with maximum capacity of 213 mg/g and specific surface area of 643 m2/g. The adsorption of methylene blue for all metals.

CONCLUSION

A review of various processes and Ricinus communis adsorbents for heavy metal and dye removal shows that adsorption process has great potential for the elimination of heavy metals and dye from Industrial wastewater using Ricinus communis and its modified forms . As Illustrated throughout the article, Ricinus communis have significant advantages of established adsorbents for water treatment. Most notably i) easy availability ii) Excellent performance iii) Continuous operation. More studies should be carried out for low-cost adsorption process to promote large scale use of non-conventional adsorbents. Low cost adsorbents should be used to minimize cost and maximize heavy metal and dye removal efficiency.

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