

Dye and Heavy Metal Removal from Solution by Neem-A Review

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ABSTRACT: This review article is about the removal of dyes and heavy metal removal from solution with the help of neem leaves. This article presents about dyes, heavy metals, classification of the dyes, toxicity of the dyes, and its removal by adsorption with the help of neem leaves. Dyes and heavy metals which are present in waste water are removed using neem leaves by adsorption. The effectiveness of the dye and heavy metal removal with the help of neem leaves has been presented here. The paper includes adsorption factors of dye such as pH, dosage and contact time. Suitable conclusions have been drawn forward from various literature reviewed.

KEYWORDS: Dyes, Heavy metals Adsorption, Dosage, pH, Neem.

I. INTRODUCTION

Dyes are chemical compounds that shows affinity to substance by imparting colour to substrate. Dyes are coloured because they absorb wave lengths of lights. Dyes are mainly used in many advance technologies eg leather tanning, food processing, plastics, printing and dye manufacturing industries. Dyes can be predicated with inert salts to produce a lake pigment. Dyes can be classified into two categories namely, natural dyes and synthetic dyes. Natural dye sources are berries, bark, and wood. Synthetic Dyes are replacing natural dyes. There are many methods for the removal of dye from solution. Heavy metals are available in the earth's crust in different concentrations and due to change in life cycles they may be accumulated in soils, fresh water and waste water and it becomes toxic. The removal of these are by adsorption, chemical coagulation, oxidation, membrane separation. The most effective method is adsorption. The adsorption can be done with the help of activated carbon and others. Neem is a medicinal plant and its products have been used for many purposes. The current research is to find an alternative way to activated carbon which is costly and use of neem leaves which are found to have good adsorptive capacities. This review paper is to find out the adsorptive effectiveness of the dye with the help of neem leaves.

The physicochemical characteristics of fresh Neem leaves have been reported as follows (Neem Foundation, 1997)

Properties of Neem leaves [8]

Proteins 7.1% Fat t 1.0%, Fiber 6.2%, Carbohydrates 22.9%, Minerals 3.4%, Calcium 510 mg/100 g, Phosphorous 80 mg/100g, Iron 17 mg/100 g, Thiamine 0.04 mg/100 g, Niacin 1.40 mg/100 g, Vitamin C 218 mg/100 g, Carotene 1998 microgram, Calorific value 1290 Kcal/Kg/100 g, Glutamic acid 73.30 mg/100 g, Tyrosine 31.50 mg/100g Acid, Aspartic acid 15.50 mg/100 g, Alanine 6.40 mg/100 g Proline 4.00 mg/100 g, Glutamine 1.00mg/100 g.

II. CLASSIFICATION AND TOXICITY OF DYES


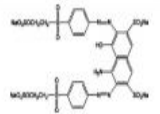

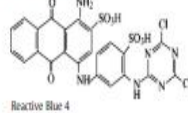

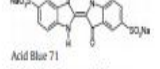

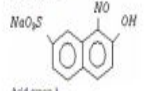




Dyes are classified according to structure, colour and application methods. Chemical classification of dye are presented in table 1.

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Table 1 Classification of Dyes

| Class | Chromophores | Example |
|---------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Azo dyes |  |  Reactive Black 5 |
| Anthraquinone dyes |  |  Reactive Blue 4 |
| Indigoid dyes |  |  Acid Blue 71 |
| Nitroso dyes |  |  Acid green 1 |
| Nitro dyes |  |  Acid Yellow 24 |
| Triarylmethane dyes |  |  Basic Red 9 |

Several kinds of dyes are used in the industries and are discharged into the rivers, sea and other water bodies there by causing pollution. Due to the toxic effects, it has been said that it causes respiratory, diseases. As some are carcinogens the removal of the dye is desired

III. ADSORPTION

The term ‘Adsorption’ was first used in 1881 by German physicist Heinrich Kayser .Adsorption is a surface phenomenon in which liquid or gaseous molecules adhere to the surface of the solid material. Adsorption is mainly divided into three-physical, chemical and biological. Adsorption is mainly described through isotherms namely, Linear, Freundlich, Langmuir, BET isotherms. Adsorbent is defined as the solid material which adsorbs other materials. Adsorbate is usually the substance which is adsorbed. Neem leaf is the adsorbent used here for the study. Physical adsorption is based on the Vander Waals forces between adsorbent and adsorbate. Chemical adsorption is due to strong chemical bonding with the molecules. Factors affecting adsorption are adsorbent surface area, adsorbent particle size, temperature, pH, contact time, adsorbent dosage and their interactions.

A. Effect of Adsorbent dosage

Dosage is an important factor in the adsorption. With the increase in the dosage there will be increase in adsorption. It depends on the saturation limit of the adsorbent. This helps us to get an idea about the amount adsorbed even with the smallest amount, which will be economical.

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Table 2: Effect of Adsorbent Dosage on Dye and Heavy metal Removal

| No. | Effect of Adsorbent dosage | | |
|-----|----------------------------|------------------|-----------------------|
| | Dye Name/Heavy Metal | Adsorbent Dosage | Percentage of removal |
| 1 | Brilliant Green dye | 0.63gm | 98% [8] |
| 2 | Methylene Blue dye | 2.00gm | 100% [11] |
| 3 | Remazol Blue RR dye | 1.00gm | 90% [1] |
| 4 | Cd(II) | 0.60gms | 70% [3] |
| 5 | Cr(IV) | 1.6 gms | 87% [11] |
| 6 | Pb(II) | 1.2gms | 93% [9] |
| 7 | Zn | 0.15gms | 70-80% [12] |

B. Effect of pH of the solution

The most important factor of the solution is pH. As pH changes adsorption capacity also changes.

A study about methylene blue solution with the help of neem leaves was done by Kishna.G. (2005). It was found that adsorptive capacity remained same in the range of pH 5-8. It was found that at minimum pH adsorbent surface will be negatively charged and attracts most of the molecules.

Remazol RR dye from solution with help of neem leaves by Ana Paul Serafini Immich (2009) studied about effect of pH of the solution. Here pH was maintained between 8,9,10 and the adsorption was found to be high in this pH range. Bio sorption of zinc was studied by Mamoon Arshad (2008). pH range was from 1.0 to 6.0. It was found that the adsorption carried out in pH 4 and 5 showed maximum removal of 86.5 % .pH beyond 6 was not taken into consideration because of the precipitation of Zn.. Another experiment on Pb was done with the help of neem leaves by Krishna G Bhattacharya and the pH range was between 2.0 to 7.0. It was found that the removal rate reached constant value between pH 4.5 to 5.5. Low pH decreases the adsorption of Pb. It might be because of H⁺ ions on the adsorbent surface.

Arunima Sharma and Bhattacharya did a work on Cr(IV) with neem leaves and it was found that the maximum adsorption was between 4.5 and 7.5. In another work done by Krishna.G.Bhattacharya on removal of Cd(II) it found that 93% of removal was obtained at pH 9.5.

Effect of contact time

Contact time is another factor which should be considered mainly for adsorption. While Contact time increases there might be chances of saturation. It is mainly due to the fact that adsorption sites may be filled with the molecules that are adsorbed. Contact time varies according to different adsorbents. It is because of the pores or the sites that are present in the adsorbent.

Krishna.G,Bhattacharya (2005) found out that adsorption increased to 71.5% when the time was increased to 5 hours. When the dosage was increased it was also found out that adsorption increased considerably to 98% in 6 hours. Remazol blue dye reduction with the help of neem leaves, the contact time was found out with help of kinetics and removal was 90%.

In different experiments conducted for the removal of dyes with the help of neem leaves, the adsorbent should be in contact for a particular amount of time as dyes need adequate time to be adsorbed on the leaves.

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IV. CONCLUSION

From the literature referred it is observed that adsorption not only depends on the nature of the material but also on the characteristics such as pH, dosage, contact time etc. This review article presents removal of dyes and heavy metals with the help of neem leaf powder. Expensive activated carbon can be replaced with neem leaves which is locally available everywhere and small amount of neem leaf powder is sufficient for the removal

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