

Biosorption of a Carcinogenic Dye Methyl Orange by Pinus Gerardiana Nuts Shells, Manilkara Zapota Seed Shells, Arachis Hypogaea Nuts Shells and Other Nuts Shells from Its Aqueous Solution

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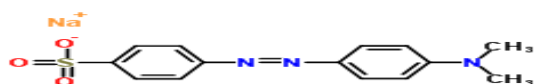
Abstract

Methyl orange is an anionic dye. In this study the adsorption characteristics of nuts shells for the removal of methyl orange dye from its aqueous solution is studied. The nuts shells used as biosorbents in this study are Pinus gerardiana(Chilgoza) shells, Manilkara zapota(Chickoo) seed shells, Arachis hypogaea (Peanut) shells, Juglans regia(walnut) shells, Prunus armeniaca (Apricot) shells, Pistacia vera(Pistachios) shells. Time for adsorption, Dosage of adsorption and comparison of adsorption capacity of the biosorbents is also studied. The Freundlich and Langmuir adsorption isotherms have been verified by the experimental data.

Keywords - Methyl orange, Adsorption, Adsorption isotherms, Biosorbents, Nuts shells

I. INTRODUCTION

There are large number of synthetic dyes which are acting as water pollutants and some of them are carcinogenic¹ in nature. These can be removed from water by number of methods. The use of biosorbents for removal of dyes is an ecofriendly practice and is gaining importance these days. These biosorbents can be plant or animal products like fruit peels^{2,3,4,5,6}, vegetable peels^{2,3}, fruit parts^{7,8}, nuts shells^{9,10}, cereal bran¹¹, plant parts^{12,13}, microorganisms¹⁴, egg shells¹⁵ etc. In this study removal of methyl orange dye from its aqueous solution using nuts shells is studied.



Methyl orange is a synthetic organic dye. The nuts shells used as biosorbents are as follows Pinus gerardiana(Chilgoza) shells, Manilkara zapota(Chickoo) seed shells, Arachis hypogaea

(Peanut) shells, Juglans regia (walnut) shells, Prunus armeniaca (Apricot) shells, Pistacia vera(Pistachios)shells and mixture of these nut shells.

Pinus gerardiana (Chilgoza): In India it is found in the dry inner valley of North West Himalayas and chilgoza nuts are rich in carbohydrates, proteins, fats with no cholesterol like other edible pine nuts¹⁶

Manilkara zapota(Chickoo): It is cultivated throughout India, though it is a native of Mexico and Central America. Chickoo fruit contains phenolic compounds, carbohydrates, proteins, fats, minerals, vitamins like ascorbic acid etc. and enzyme like polyphenol oxidase¹⁷.

Arachis hypogaea (Peanut/Groundnut): The peanut belt in south India generates sizeable quantities of crop residue that can be recycled which improves soil fertility and productivity of crops. Peanut shells contain organic compounds and other nutrients¹⁸.

Juglans regia (walnut): Its tree is tall deciduous tree of about 20 meter length. It belongs to the family Juglandaceae comprises several species and are spread all over the world¹⁹.

Prunus armeniaca (Apricot): Apricot tree is a small tree, 8-12 m tall. Apricot fruit has a high nutritional value as it is a good source of fibers, minerals, vitamins²⁰.

Pistacia vera(Pistachios): Pistachio is widely cultivated in the Mediterranean region and probably originated in central and south Asia. Its nuts contains carbohydrates, proteins, fats, minerals, vitamins²¹. Its nuts shell has tan to yellow color.

II. MATERIALS AND METHODS

A. Adsorbent Preparation

The shells of the following nuts Pinus gerardiana(Chilgoza) shells, Manilkara

zapota(Chickoo) seed shells ,Arachis hypogaea (Peanut) shells , Juglans regia(walnut) shells , Prunus armeniaca (Apricot) shells ,Pistacia vera(Pistachios) shells are collected .These shells were washed thoroughly with water and then with HCl and then dried ,grounded to fine powder and sieved for uniformity and are stored separately in air tight containers.

B. Adsorbate Preparation

3x10⁻⁵M methyl orange solution is prepared as stock solution .Its colorimetric studies are carried out at 500nm.This stock solution is made into various dilutions for performing adsorption studies.

III.EXPERIMENT

From the stock solution of methyl orange different dilutions are prepared for testing the adsorption characteristics of adsorbents. The amount of adsorbent used was 0.1gm /50ml of adsorbate. A Constant time of 90 min. is maintained for every adsorption and the adsorbate is filtered and filtrate is collected and its optical density value is determined to check the discoloration.

IV. RESULT AND DISCUSSION

The adsorption properties of the nuts shells of Pinus gerardiana(Chilgoza) , Manilkara zapota(Chickoo) ,Arachis hypogaea (Peanut) , Juglans regia(walnut) , Prunus armeniaca (Apricot) ,Pistacia vera(Pistachios) have been studied by using Freundlich and Langmuir adsorption isotherms .

Langmuir adsorption isotherms equation is $C_e/x/m = ab * C_e/1+ab$ where a and b are Langmuir constants.

Freundlich adsorption isotherms equation is $\ln x/m = \ln k + 1/n * \ln C_e$

Table 1
Adsorption constants for methyl orange
Langmuir isotherm parameters

Adsorbent	a	b	K _L
Pinus gerardiana(Chilgoza) shells	3968253.9	5.0x10 ⁻⁷	2
Manilkara zapota(Chickoo) seed shells	925925.9	9.0x10 ⁻⁷	0.83
Arachis hypogaea (Peanut) shells,	175131.3	7.6x10 ⁻⁶	1.33
Juglans regia (walnut) shells	1250000	2x10 ⁻⁶	2.5
Prunus armeniaca (Apricot) shells	380228.1	1.8x10 ⁻⁶	0.71
Pistacia vera(Pistachios)shells	363636.3	2.7x10 ⁻⁶	1
Mixture of Above mentioned nut shells	1201923.0	2.0x10 ⁻⁶	2.49

Langmuir Adsorption Isotherm graph for Methyl orange

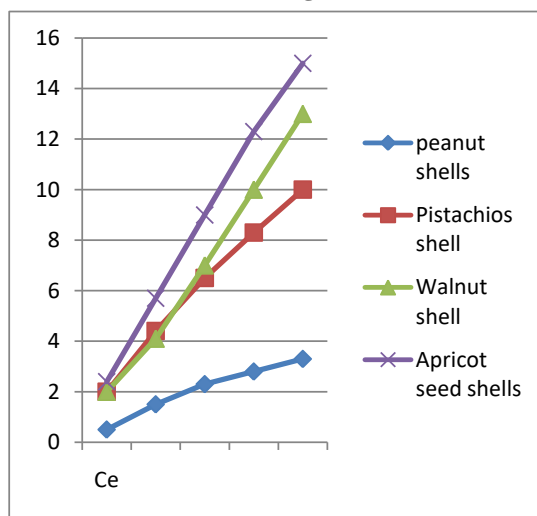


FIG. 1

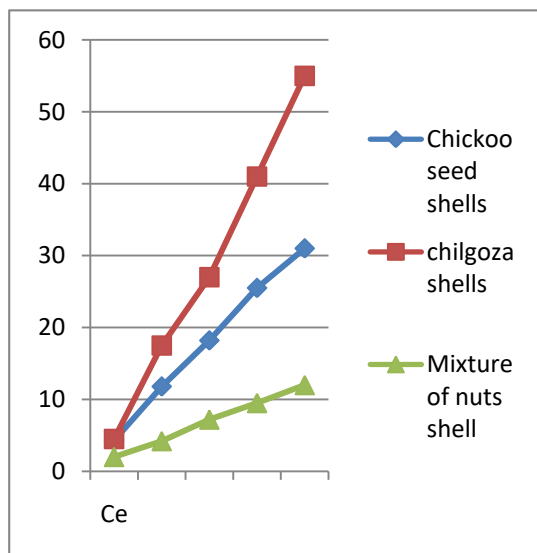


FIG. 2

Table2: Adsorption constants for methyl orange Freundlich isotherm parameters

Adsorbent	k	n
Pinus gerardiana(Chilgoza) shells	1.99x10 ⁻⁵	4.5
Manilkara zapota(Chickoo) seed shells	3.16x10 ⁻⁶	9
Arachis hypogaea (Peanut) shells,	1.99x10 ⁻²	1.4
Juglans regia (walnut) shells	2.5x10 ⁻⁵	10
Prunus armeniaca (Apricot) shells	3.98x10 ⁻⁵	2.5
Pistacia vera(Pistachios)shells	6.3x10 ⁻⁵	4.5

Mixture of Abovementioned nut shells	1.58×10^{-5}	11
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Freundlich Adsorption Isotherm graphs for Methyl orange

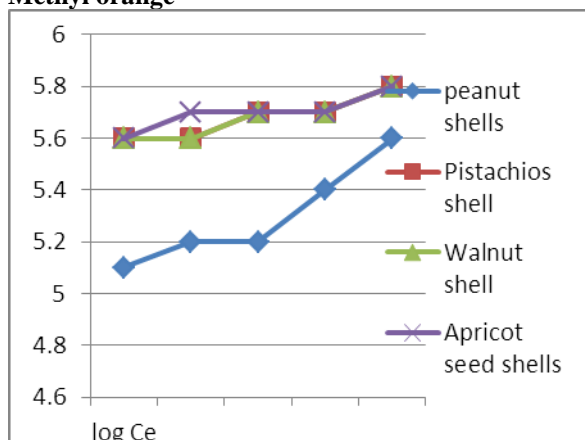


FIG 3

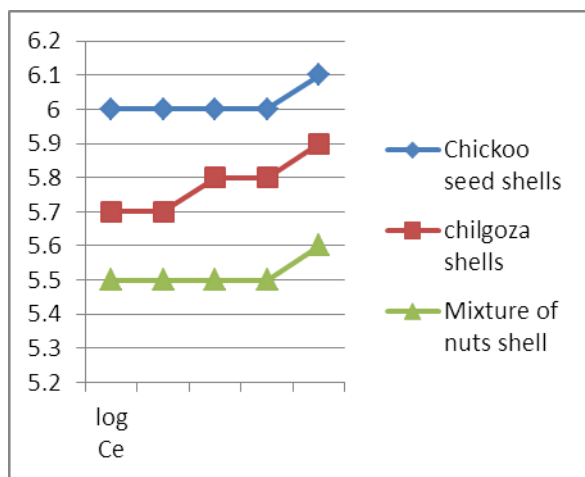


FIG 4

V. CONCLUSION

The adsorption properties of the biosorbents studied have the following efficiency. Peanut shells, Walnut shells and Apricot shells have good adsorption efficiency. Pistachios shells have moderate efficiency while Chilgoza shells and Chickoo seeds shells have less adsorption efficiency for methyl orange dye in aqueous solution.

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