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REMOVAL OF CANGO RED DYE FROM INDUSTRIAL EFFLUENT USING GARLIC PEEL AS A BIOADSOBENT

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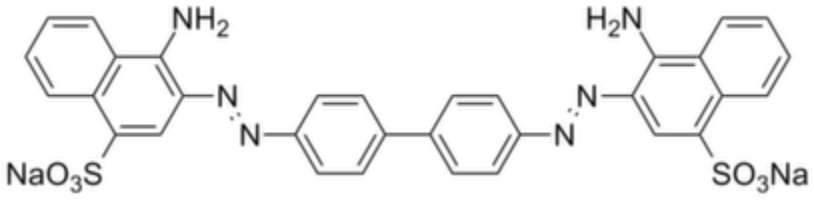
Abstract: *Adsorption of cango red dye on powder of garlic peel has broad technical applications. Along this encouragement a simple approach of UV-vis spectrophotometry technique assisted to measure adsorption of cango red dye (adsorbate) on powder of garlic peel (bioadsorbent). Adsorption study of dyes with UV-Vis spectrophotometry is one of the quick approaches.Garlic peel has much potential to remove cango red dye experimentally proved in this research study. Results indicate that factors pH, initialconcentration of dye, contact time, adsorbent doseand temperatureimpressive role on the adsorption of dye.Most importantly, removal of cango red dye by thebioadsorbentlike garlic peel is low cast practice which can be used in developing countries like Pakistan.*

Keywords: Adsorption,Cango red dye, Garlic peel, azo-dye,Adsorbate, Adsorbent, Bioadsorbent, UV-Vis spectrophotometer, Pakistan

1.0- Introduction

In recent years, use of dyes has been grown in anuncontrolled manner approximately in every field [1] of life such as textile, paper, plastic, paint, rubber, letther, pharmaceutical, food cosmetic, dyestuff etc.These dyes may be natural or synthetic in nature [2] such as Termeric, Weld, Eucalyptus, Cutch, Onion, Flossophorae, Henna, Teak, Berberry, Indigo, Jacjfruit, Cochineal, Indian rhubarb, Congo red, Methyl (red and orange), Martius yellow, Remazol, Disperse blue, Benzanthrone and Methylene blue etc.Usage of these dyes in industries was mainly as coloring agent led to water contamination [3] because of direct mixing of industrial effluent into water bodies without proper treatment.This practiceproduceddrastic situation to human as well as other living organisms due to harmful effects of dyes on heath [4][5]. It was became necessity of time to remove such dyes from water bodies for natural working ofecosystem.

Cango red dye [6] is one of the major dyes that are being used in many industries. It belongs to class of Azo dyes also known to metabolize to benzedene named as (1- Naphthalenesulfonic acid, 3, 3'-(4, 4' biphenylenebis (azo) bis 4-amino) di sodium salt)[7]



For the removal of cango red dye from industrial effluents researchers find out handsome number of methods [8] including nano filtration, coagulation, ultra- filtration, flocculation, photoxidation etc. These methods are costly, corrosive, and hazardous for environment in contrast to removal of cango red dye by process of adsorption [9]. Plenty of work is available on

removal of cango red dye via adsorption processby using different adsorbents natural or synthetic such as hydroxyapatite/chitosan composite [10] magnetite /zeolite composite [11] mesoporous carbon material[12] acid-activated bentonite [13] Silica Gel Immobilized ChlorophytaHydrodictyonAfricanum [14]Sulphate-Crosslinked Chitosan [15] terephthaloylthiourea cross-linked chitosan hydrogels [16] Citric Acid Modified Bentonite [17] shiitake mushroom[18] Jujuba seeds [19] biomass of Zea mays [20] Aloe vera leaves [21] Neem Leaves [22] . But in this research study reported the removal of cango red dye on garlic peel (bioadsorbent)[23] using process of adsorption[24] which is cost effective noncorrosive and green.[25]

1.1- Research methodology

Congo red dye was procured from market and calibrated prior to its use in experimental work as adsorbate. It was a red crystalline powder. It is also an azo dye. Its molecular weight is 696.665g/mol. When it is dissolved in water it produces colloidal solution red in color. In typical experimental work 1mg cango red dye was dissolved in 1000 ml of methanol (1000mg/dm^3) to prepare stock solution. Then by the implementation of dilution formula ($C_1V_1=C_2V_2$)solutions with different concentration were produced from the stock solution of cango red dye.

To prepare adsorbent for this research workfresh garlic that was obtained from the vegetable market of Punjab,Pakistan. After the collection of garlic, garlic was peeled off. After peeling, garlic peel was washed out with distilled water to remove the impurities, also boiled the garlic peel for 30 minutes with distilled water. Then garlic peel was filtered out. In next step garlic peel was dried or soaked at 60°C for 24 hours in an oven. To collect a very small sized garlic peel powder with particle size range between 0-177µm, 210-297µm, and 345-500µm it was crushed and then sieved. For further use the prepared sample of garlic peel was saved in a sealed container.

This research study was conducted to investigate adsorption ofcango red dye (adsorbate) onpowder of garlic peel (adsorbent) monitored by UV-Visible spectrophotometer. Different factors which affect the adsorption of cango red dye on powder of garlic peel were also analyzed under different conditions. These factorswere included pH, initial concentration of dye, contact time, adsorbent dose and temperature.

Effect of pH on the adsorption of cango red dye was examined by U.V-Visible spectroscopy. During experimentation pH was maintained in the range of 3-12 using 0.1M HCl and 0.1M NaOH reagents. 10 solutions were used with concentration 20mg/L adsorbate having 0.2 mg of adsorbent in them.

Keeping pH and temperature constant as 7 and 26^{o}C respectively, effect of initial concentration of dye was also studied. For this, 10 solutions of different concentrations from 10, 20, 30,40,50,60,70,80,90 and 100 ppm congo red dye were prepared and 0.2gm of adsorbent (powder of garlic peel) was added in each solution carefully.Every solution containing adsorbent filtered and studied with the help of U.V-visible spectrophotometer.

Moreover Effect of contact time on the adsorption of cango red dye was determined by taking 10 sample solutions with same concentration 20mg/L and 0.2gm adsorbate and adsorbent respectively,every sample solution was provided different contact time from 3-30 minutes and other factors pH = 7 and temperature = 25°C were kept constant and then λmax was measured by U.V-Visible spectrophotometer and thus investigated the percentage of congo red dye adsorbed on the selected adsorbent.

Further prepared 10 sample solutions with volume of 20 ml each and put different dose of adsorbent from 0.1mg to 1mg separately.Each sample solution was shaked by using an orbital shaker KJ-201BD for some time and then filtrate was used to measure effect of adsorbent dose on adsorption of dye by U.V-visible spectrophotometer. In the last, adsorption of cango red dye on the adsorbent was also studied by changing the temperature of same concentration of sample solutions.

1.2- Results and Discussion

Adsorption Study Of Congo red Dye

Working with cango red dye it was conclusive to determine the calibration of selected dye.Fig. 1 shows clearly the calibration of cango red dye to relay on it.Adsorption of congo red dye deviated from 10mg/dm^3 to 100mg/dm^3 at 480nm. It is disclosed from the data: when the concentration of adsorbent (Cango red dye) increases in the solution absorption of UV-Vis light also increases. In other sense dye is ready to use.

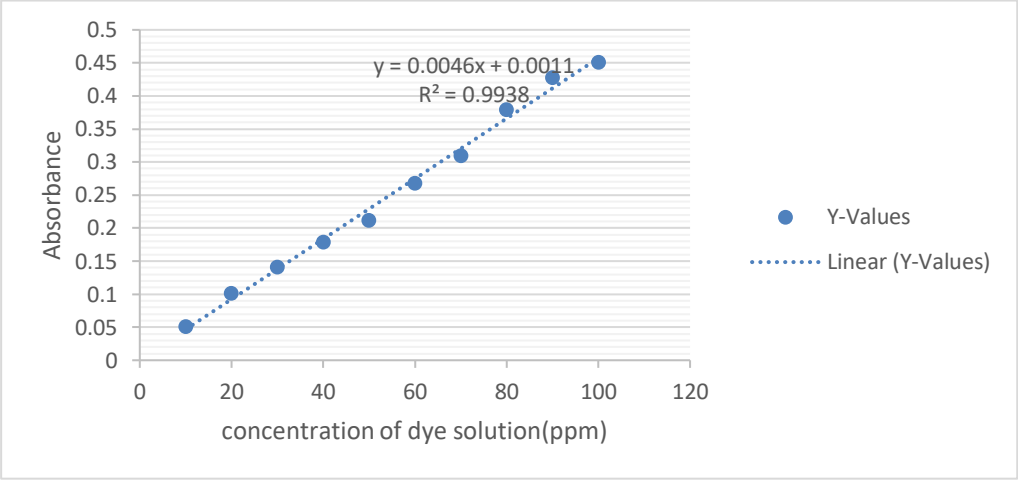


Fig. 1Calibration curve of congo red dye

Factors Affecting on the rate of Adsorption of Congo Red Dye

Effect of pH on solutionof dye

The pH is the utmost significant factor supervisory the dye adsorption onto suspended elements dye adsorption reduced by rasing the solution pH. We prepared 10 solutions of cango red dye and adjusted the pH from 3-12 by adding 0.1 M HCL and 0.1 M NaOH in the solution and were monitored via high quality pH meter. It was investigated that at low pH the activated carbon surface charged with H+ ions and it was led to expressively stout electrostatic attraction among the positively charged surface of Garlic peel and molecule of anionic dye (congo red dye) thereby raised in adsorption of dye.Increase in pH of solution (cango red dye) resulted toincrease in number of negatively charged sites on the surface of Garlic peel.Garlic peel with negatively charged places due to electrostatic repulsion didn't adsorb an anionic dye so;by raising the pH

removal of dye was decreased. Data of this part of research as shown in fig. 2 is in agreement with above discussion.

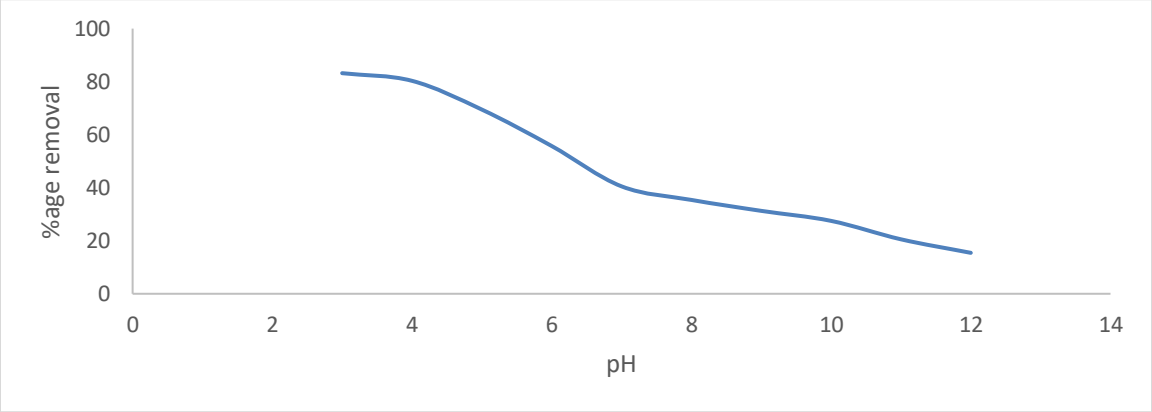


Fig.2Graph between pH of a solution and %age removal

Effect of initial concentration of dye

The preliminary concentration offers a significant powerful energy to overwhelm all mass transfer confrontations of all molecules between liquid and solid stages.The preliminary concentration of congo red dye solution was altered and time intervals were evaluated till no adsorption of adsorbate on Garlic peel under diverse initial congo red dye solutions.Fig.3 displays that decrease in adsorption by raising preliminary concentration of congo red dye.At lower concentration there was inspected an increased in removal of color due to higher preliminary concentration of congo red dye. Thus, it was found that at higher concentration of congo red dye removal of percentage decreased due to saturation of surface of an adsorbent.

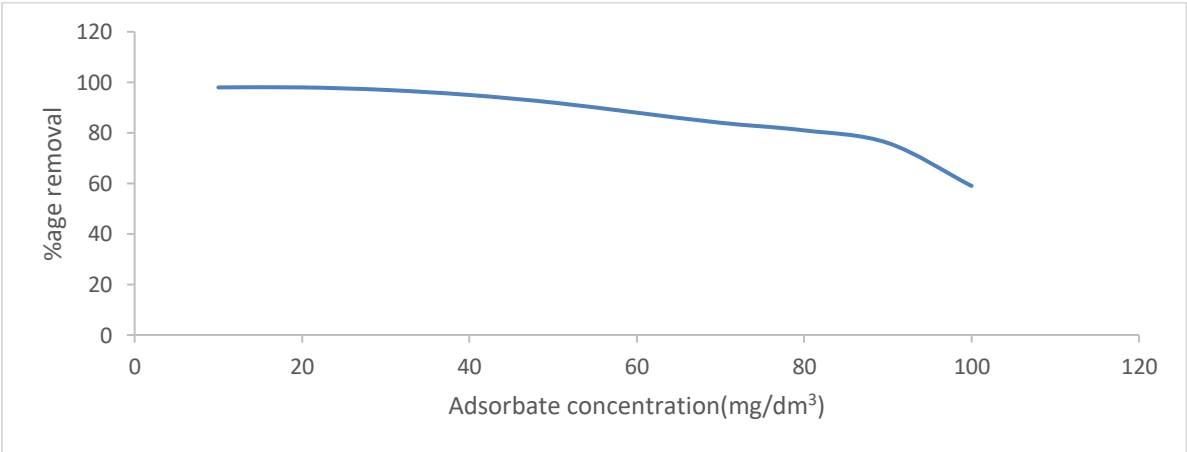


Fig. 3Graph between adsorbate concentration and %age removal

Effect of contact time on solution of dye

The adsorption of congo red dye on to garlic peel was studied as a purpose of contact time. We used 0.2 g of an adsorbent of garlic peel in 20mg/dm^3 solution of dye. The quick adsorption at the preliminary contact time could recognized to the obtainability of the definite charged surface of Garlic peel and slow rate of an adsorption of a dye is perhaps owing to the slow hole

dispersion of the solute ion into bulk of adsorbent. During research study it was investigated that contact time needed forcongo red dye to reach stability was determine 30 minutes as data indicates in fig. 4.

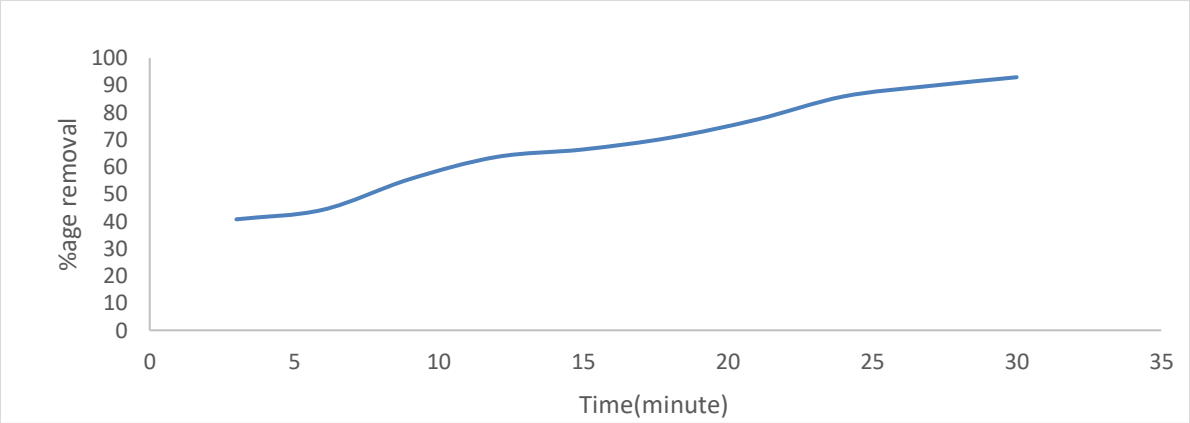


Fig. 4 Graph between contact time and %age removal

Effect of an adsorbent dose

The effect of an adsorbent dose was inspected by the rate exclusion of congo red dye color by changing by the use of Garlic peel powder from 0.1-0.10g. Alternate parameters like contact time=5 minutes, pH=7 and the temperature = 26^0C were kept constant precisely. This relationship was found that percentage removal of dye increases with increase an adsorbent dosage up to a certain limit. Data in fig. 5 confesses the statement. As dose of an adsorbent increased the sites for adsorption were also increased due to enhancement of surface area.

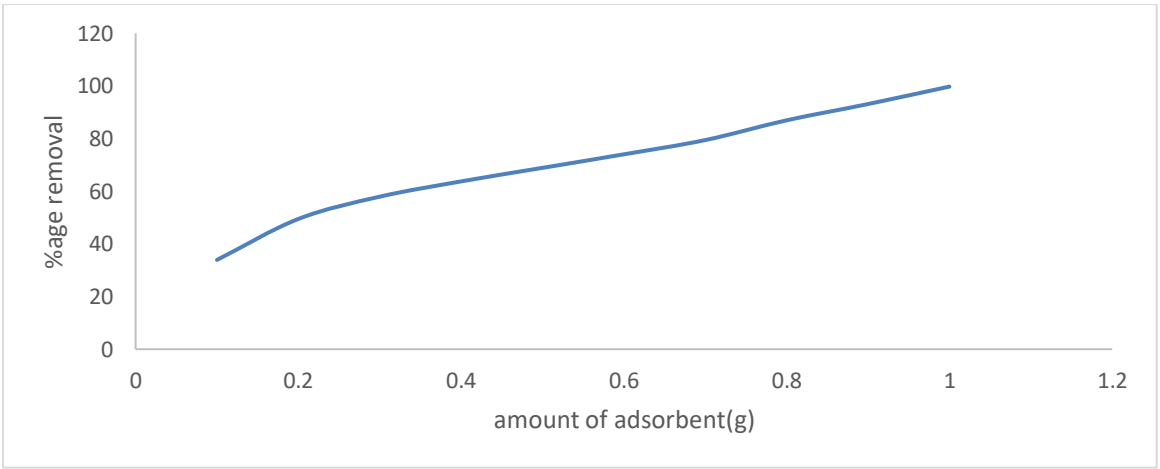


Fig. 5Graph between amount of an adsorbent (Garlic peel) and %age removal

Effect of Temperature

During this research study it was examined that temperature impacts on interaction of adsorbent and adsorbate.In two ways temperature affected the adsorption procedure. One by raising the temperature raised the rate of dispersion of the adsorbate (cango red dye) molecules crossways the outside boundary film. Second change in temperature changed the equilibrium capability of the garlic peel (adsorbent) on cango red dye (adsorbate). When there was used 20ml cango red

dye solution with 0.2g of Garlic peel as adsorbent in it at variable temperature range from 299.16, 309.16, 319.16, and 329.16K. Above mentioned discussion is supported by data in fig. 6.

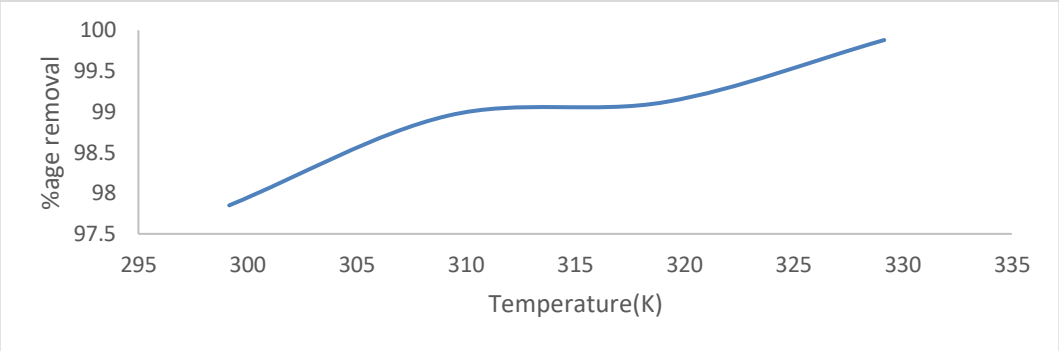


Fig. 6 Graph between temperature and %age removal

1.3- Conclusion

Congo red dye is removed from a solution by using Garlic peel as an adsorbent.Garlic peel is an excellent adsorbent.The sorption of congo red dye on Garlic Peel was find to lined over the full concentration ranges studies with the higher correlation coefficients (R2 > 0.99) utilizing Langmuir isotherm Later, it could be decided that the Langmuir isotherm is best isotherm to calculate the sorption of congo red dye over Garlic Peel sorbent.Kinetic study of pseudo first order and pseudo second order is also used for the removal of congo red dye by using Garlic peel as an adsorbent.this study reveals that pseudo second order of kinetics was best for study the removal of congo red dye by usin Garlic peel as an adsorbent.correlation coefficient of pseudo second order is 0.94,that is heigher than the pseudo first order of kinetics.There is found raise in sorption rate with raise in concentration of dye in the starting because of large driving force available for mass to transfer at maximum dye concentration at starting phase.when temperature is raised adsorption ability was also found to be raised because of movement of large ions of congo red dye raises when temperature raised and molecules gain enough energy to make interaction with surface sites for adsorption.it Is observed that peel of garlic is found in large quantity in the country,so it is low cost biosorbent that is used to remove the congo red dye.

1.4- References

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