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Methods for Removing Dyes from Polluted Water; A Review

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ABSTRACT

Most of the water pollutants with dyes are leftovers from industries, including textiles, wool and others. There are many ways to remove dyes such as sorption, oxidation, coagulation, filtration, and biodegradation, Chlorination, ozonation, chemical precipitation, adsorption, electrochemical processes, membrane approaches, and biological treatment are among the most widely used technologies for removing colors from wastewater. Dyes are divided into two types: natural dyes and synthetic dyes.

Keywords: Dyes, polluted, removing, water, color

طرق ازالة الاصباغ من الماء الملوث ؛ عرض

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الخلاصة

تنقسم الأصباغ إلى نوعين: الأصباغ الطبيعية والأصباغ الاصطناعية. معظم ملوثات المياه مع الأصباغ هي بقايا من الصناعات ، بما في ذلك المنسوجات والصوف وغيرها. هناك العديد من الطرق لإزالة الأصباغ مثل الامتصاص ، والأكسدة ، والتخثر ، والترشيح ، والتحلل البيولوجي ، والكلور ، والأوزون ، والترسيب الكيميائي ، والامتزاز ، والعمليات الكهروكيميائية ، ونهج الأغشية ، والمعالجة البيولوجية من بين التقنيات الأكثر استخدامًا لإزالة الألوان من مياه الصرف الصحي .

الكلمات الرئيسية : اصباغ ، تلوث ، ازالة ، الماء ، الوان

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INTRODUCTION

The dyestuff-carrying wastewater is the result of industrial waste from the dyeing and printing industries and the wool and spinning factories, among others. The increase in the industry's production capacity led to an increase in dyes in sewage water. One of the characteristics of the chemical substance of the dye is that it is highly concentrated, bright in color, and challenging to analyze and disintegrate. Dyes are separated into eight classes based on their chemical makeup, such as azo dyes, and 14 categories based on their application. Reactive dyes, acid dyes, and other dyes are examples. Because of the chromophore in the partial structure of the pigments, the color carrier appears. There are technologies for treating wastewater that is physical, chemical, and biological, with the biological option being the most cost-effective and viable **(ECS, 2021).**

Dyes are divided into two categories based on their origin: natural and synthetic dyes. Natural dyes are made from naturally existing substances, primarily plant parts, and do not require chemicals. Natural dyes are mainly utilized to increase the nonharmful qualities of all types of natural textiles. Textiles, food, cosmetics, pharmaceuticals, handicraft products, and toys are all colored with these dyes and the leathering process. Dyes are made from renewable materials that are environmentally benign and biodegradable. Synthetic dyes are organic colors made mostly from petroleum, coal tar equivalents, and occasionally a mix of mineral components derived from benzene and its derivatives. Mauveine, the first human-made dye, was discovered by W. H. Perkin in 1956. Synthetic dyes can be used anywhere; however, they should be used cautiously due to their high toxicity. Synthetic dyes are becoming increasingly popular due to their inexpensive cost and superior quality compared to natural dye sources. Diphenylmethane derivatives, triphenylmethane, oxazine compounds, xanthine compounds, and azo dyes are examples of synthetic dyes **(Bharagava,2019).**

Treatment of dye wastewater in cloud technical overview, Physical principle, Chemical methods and biological law, depending on Classification, Technical essential, Superiority, Scope of application, and Problems **(ECS, 2021).**

1. Dyes concept

Dyes are temporary substance that causes discoloration of any crystalline substance caused by materials used in textiles, medicine, food, cosmetics, plastic, paper, and others. It can adhere to surfaces by covalent bond formation or by physical adsorption. It consists of a group of atoms called chromium carriers responsible for the dye's color. The dyes are classified according to their applications and chemical composition **(Chequer, et al., 2013);** in other words, dyes are chemical substances that absorb and alter the energy of electromagnetic radiation in the near visible, ultraviolet, and near-infrared light bands intensely. It adheres to many materials, such as natural and synthetic fibers, paper, and others, and discolors them when they come into contact with them. One of the most common pollutants in the water environment is dyes. It has to do with their application in various industries, such as textiles, cosmetics, and food. Because of their toxicity, low biodegradability, and bright color, the color compounds found in industrial wastewater are hazardous. Their presence in surface waters substantially impacts the ecology, interfering with photosynthesis and having a direct, negative influence on living species, among other things. These chemicals are also toxic to humans, producing a variety of disorders. The characteristic of dyes is chemical compounds that can absorb and convert a large amount of electromagnetic radiation energy in the visible, near-ultraviolet, and near-infrared light spectrums. They are used to transmit the qualities listed above to other compounds. When they come into contact with various materials, such as natural and artificial fibers, paper, and others, they form a permanent bond, causing them to color. The practical application of dyes depends on the absorbed energy conversion. These chemicals should be resistant to sunshine, water, and other environmental conditions that may be present as a result of the use of colored products. (**Bożęcka et al.,2021).**

It is well known that the source of dyes is the primary cause of human beings due to wrong behavior in factories. Wastewater is formed and mixed with dyes without treating it and pouring it into the sources of water resources. Among the industries that cause dyes in wastewater are knitting, spinning, wool, silk, printing, and others. Common types of treatment are de-refining, bleaching, degreasing, and finishing. The pretreatment step (burning, brewing, boiling, blanching, bleaching, and so on) should be completed, but wastewater dyeing is the main source of wastewater printing and dyeing **(ECS, 2021).** Dyes, unlike most organic compounds, have color because they **(Abrahart, 1977):**

- absorb light in the visible spectrum (400–700 nm),
- have at least one chromophore (color-bearing group),
- have a conjugated system, i.e., a structure with alternating double and single bonds.
- have electron resonance, which is a stabilizing force in organic compounds.

Color is lost when one of these properties is missing from the chemical structure. Auxochromes (color helpers) are groups that are present in most dyes in addition to chromophores. Examples of auxochromes include carboxylic acid, sulfonic acid, amino, and hydroxyl groups. While they aren't responsible for color, their presence can cause a colorant's color to fluctuate, and they're most commonly utilized to impact dye solubility.

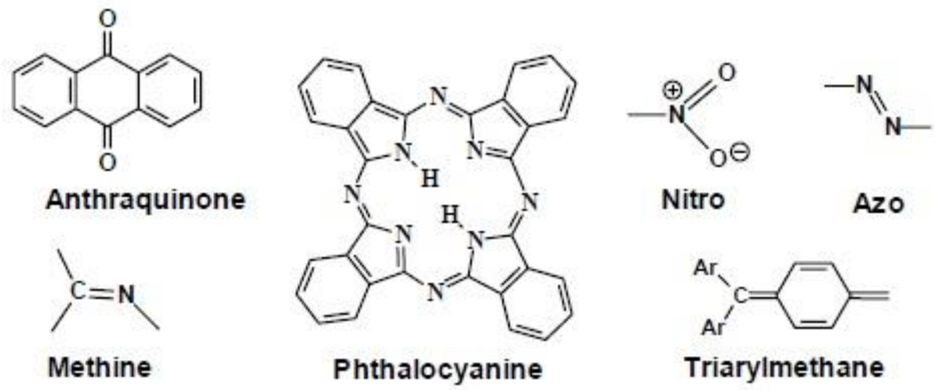

Figure (1) Chromophore groups found in organic dyes as examples **(Bharagava, 2019)**

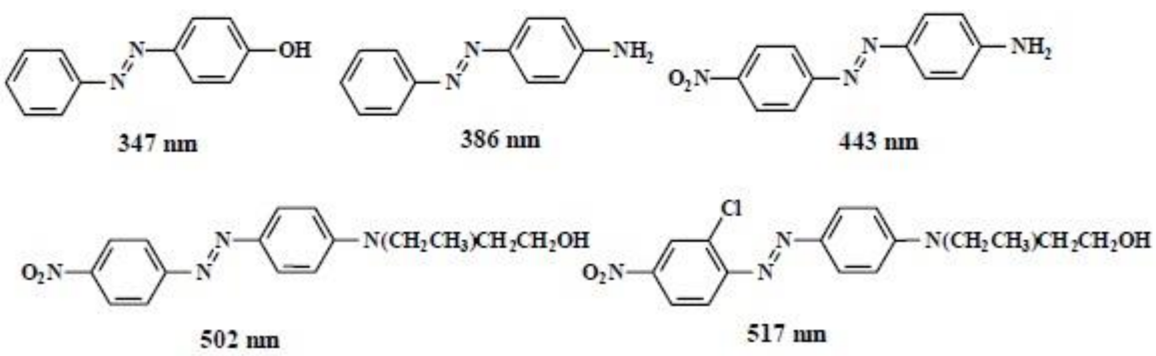

Figure (2) Within an azo-dye system, the effects of substituent groups**(Bharagava, 2019)**

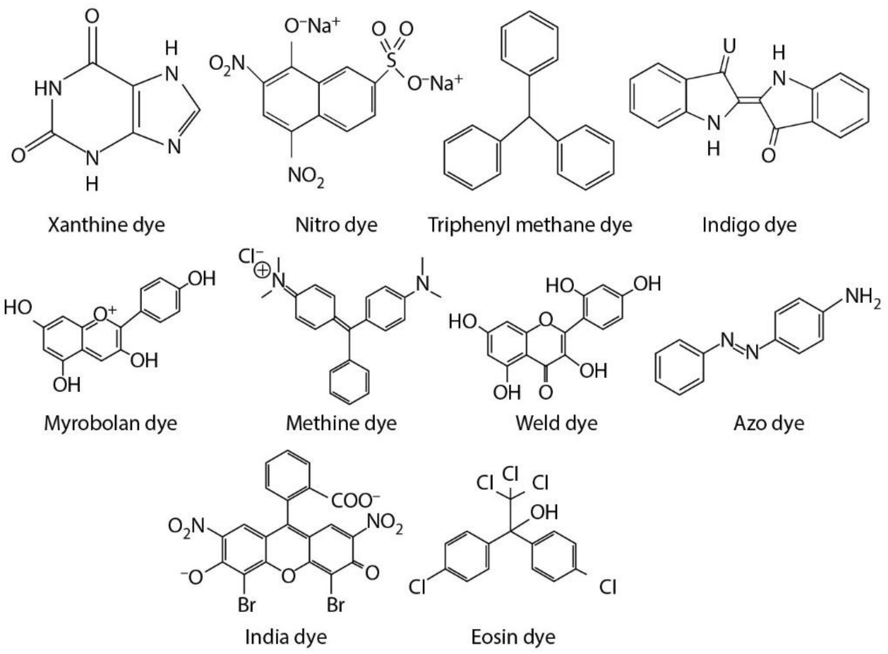

Figure (3) Description of some important dyes is provided **(Bharagava, 2019)**

2. Types of Dyes

Dyes have a complex and varied structure. There are more than 5,000 kinds of dyes with distinct chemical structures, according to the third edition of the Dye Index, of which more than 1,500 have been published. China produces around 500 different dyes **(ECS, 2021).**

Nature dyes are classified into two broad types: natural and synthetic. Natural dyes are extracted from natural materials, especially plants, and do not need chemicals. They are used to dye fibers to improve properties. They are used in the coloring of textiles, cosmetics, food, handicrafts, pharmaceuticals, toys, and leather treatment. Natural dyes are better than artificial ones because they are less toxic and less allergenic, while synthetic dyes are considered organic dyes obtained from petroleum and its derivatives and sometimes from mineral components such as benzene and its derivatives. It can be used anywhere but with caution because it is very toxic. Currently, industrial dyes are used because of their low cost and excellent quality compared to synthetic dyes, such as diphenylmethane derivatives, oxazine compounds, triphenylmethane, xanthine compounds, and azo dyes (**Bharagava, 2019**).

Depending on the application's features, dyes are classed based on application method and chemical structure. A wide range of dyes/colorants are categorized. Acid dyes, basic dyes, direct dyes, disperse dyes, reactive dyes for fibers, insoluble azo dyes, sink dyes, and mordant dyes are only a few examples (**Husain and Husain, 2012)**.

The names of commercial dyes are typically classified according to the use of dyes for ease of application. Still, the categorization by chemical structure directly expresses the qualities and commonness of dye structure. Dyes are categorized into eight categories based on their chemical structure: azo dyes, anthraquinone dyes, indigo dyes, phthalocyanine dyes, sulfur dyes, Jia CHUAN dyes, triaryl methane dyes, and heterocyclic dyes. Reactive dyes, cationic dyes, alkaline dyes, direct dyes, vector dyes, and neutral dyes; acid dyes, reactive dyes, cationic dyes, and basic dyes have the highest solubility in water, while direct dyes, vector dyes, and neutral dyes have a slightly lower solubility; ice dye, disperse dyes, vat dyes, and sulfur dyes are insoluble in water. **Table (1)** shows the types of dyes and Main contamination in wastewater (**ECS, 2021).**

Table (1) Components of wastewater from printing and dyeing

Types of dyes	Main contamination components in wastewater
Direct dye	Ming powder, dyes, salt, soda, and surfactant
Reactive dye	Some ingredients are dyes, caustic soda, sodium phosphate, baking soda, meta powder, urea, and surfactant.
Acid dye	Ammonium sulfate, acetic acid, sulfuric acid, surfactant, dyes, Ming powder
Acid mordant dye	Dyes, acetic acid, meta-powder, dichromate, and surfactant are all used in this project.
Metal complex dye	Surfactants, dyes, sulfuric acid, sodium acetate, ammonium sulfate, meta powder
Cationic dye	Surfactants, dyes, sodium acetate, soda, ammonium acetate
Primulin bases	Meta marine, Sulphur Alkali, Dyes, Soda,
Vat dye	caustic soda, meta powder, Dye, insurance powder, red oil
Navto dye	hydrochloric acid, Dyes, caustic soda, sodium nitrite, surfactants, sodium acetate,
Disperse dye	carriers, surfactants, powder, Dyes
Coating material	ammonia, Pigments, sodium alginate, resins, mineral oils

3. Methods Removing Dyes

The wide range of manufacturing techniques involves developing a uniform solution to the problem of dye-containing wastewater treatment. Various halogens and chromophore groups make up these compounds' characteristics. One of the most common dye removal methods is adsorption, a treatment method for wastewater from various businesses. It can also be used to get rid of organic contaminants like dyes. Based on the most recent literature data **(Bożęcka et al.,2021).** Adsorption, as a superior and environmentally safe approach, eliminates organic dyes due to the abundance of materials that may be used as adsorbents. Due to their unique features, cheap nanoparticles are a more appealing solution for dye remediation because they provide an acceptable avenue to absorb any organic dye from water and overcome its dangerous effects on human health. Results showed that adsorption technology provides an attractive pathway for further research and improvement in more efficient nanoparticles, with higher adsorption capacity for numerous dyes to eliminate the dyes discharged from various industries and thus reduce water contamination. As a result, nanocomposites may play a role in future water treatment processes **(Tara, et al., 2020).** The use of polymeric adsorbents based on polyaniline for dye adsorption has been evaluated, which has received great attention recently. Various modifications of polyaniline have been investigated so far to increase the adsorption capacities. It is characterized by its ability to absorb, and polyaniline provides better potential to effectively remove various dyes **(Nasar and Mashkoor, 2019).**

There are ways to remove dyes by nano. One of these methods is the use of silica nanoparticles, core, and polymeric shells to remove the dye. Where silica and hybrid silica nanoparticles are manufactured and used in the removal process **(Garud et al., 2020)** or by using nanoporous MnO absorbent materials in addition to the current developments. Where adsorption, pH, initial dye concentration, amount of adsorbent, and temperature were among the experimental factors, but their lack of use was due to cost in commercial use **(Islam, 2019).**

The method of photolysis of dyes from pollutants to wastewater is one of the removal methods in addition to the heterogeneous catalytic decomposition of dyes from an aqueous solution of different types and the use of various three-dimensional structures of porous networks such as graphene, carbon, titanium/silica, TiO_2, carbon, SnO_2, Fe_3O_4, ZnO, and others and interest in carbon-containing pneumatic machines (such as graphene and graphene oxide) because of their effectiveness in removing dye **(Hasanpour and Hatmi, 2020).** For the use Fe_3O_4, super magnetic graphene is easily fabricated from a single vessel prepared by chemical precipitation and showed high dye adsorption efficiency. The nano adsorption was examined by the organic dye pararosaniline as a dense substance, and the adsorption capacity of this substance was evaluated using equal results. The result was satisfactory because the separation process was easy **(Qiuhua et al., 2012).** A unique GO/PNIPAM complex system rationally designed to remove organic dyes from polluted water using a novel mechanism, i.e., an extraction-like process, was revealed. At temperatures above the lower critical solution temperature (LCST) of PNIPAM, the system produces a phase transition that produces a solution phase and a gel phase, during which the entire GO sheet is transferred to the gel phase **(Shen, et al., 2021).**

Another way to remove dyes from wastewater is using carbon tubes. The results showed that the chemical change improves the adsorption process, as the adsorbent affects the adsorption of dye in carbon nanotubes. Still, this method is limited due to the high cost **(Mashkoor, 2020)** or from the preparation of potato polyphenol oxidase, which proved to be more effective in removing the color of individual dye and complex dye mixtures for wastewater handlers of specifically polluted effluents **(Khan and Husain, 2006)**. Advanced electrochemical oxidation processes can be used to remove dyes from polluted water, and this technique has been indicated that it has a great capacity to treat dyestuff-contaminated effluents **(Nidheesh et al., 2018).** The methods of treating dyes wastewater can be summarized in **Table (2)**.

Table (2) methods of treating dyes wastewater **(ECS, 2021).**

No.	classification	Technical essential	superiority	Scope of application	problems
Physical Law	Adsorption method	-	Waste utilization, simple operation	Water soluble dyes, cationic dyes	Poor regeneration of adsorbent and small adsorption capacity
	Membrane technology	-	The decolorization effect is obvious	Disperse dyes	High cost of membrane clogging
Chemical methods	Electrochemical process	Electrochemical Oxidation and Electrochemical Reduction	The processing color, COD, BOD and TSS are effective, the process is flexible and adaptable	Dyes other than cationic dyes	High unit power consumption, high iron consumption and high cost
		Electric Coagulation	Low investment, large handling capacity,	Disperse dyes, vat dyes, Sulphur	Low decolorization ability for hydrophilic

		Electrical Floatation	hydrophobic dye, high decolorization efficiency	dyes	dyes, low COD removal efficiency, chemical sludge production, secondary pollution
	Advanced method	Photo-catalytic oxidation	The catalyst input is small, the treatment effect is good, the reaction time is short	-	High catalyst price and reuse problem, low utilization of light energy and complex reactor
	-	Fenton and Class Fenton Oxidation	Fenton reagents have both oxidation and coagulation effects	Direct dyes, acid dyes, basic dyes, reactive dyes	The process conditions is harsh, the running cost is high, the excess sludge is produced more

	-	O3 oxidation	Small area, easy automatic control, easy to adjust, no sludge, no secondary pollution		High cost, unsatisfactory COD removal rate
Bio analysis	Aerobic method	-	Economy		Long processing time, unstable effect, impact resistance
	Anaerobic process	-	Decolorization effect is good, residence time is short		Produce a large amount of aniline, the effluent biological toxicity increased
	Anaerobic /aerobic process	-	High COD removal rate, good economy		Poor impact resistance, poor adaptability, reaction time

Ziziphus mauritiana nuts were used to examine activated carbon's adsorption to remove methylene blue dye MB from a polluted water sample. Effects of removing dye such as pH (2-12), temperature (298-328 K), initial methyl bromide concentration (20-100 mg L-1), and contact time (5-70 minutes) were investigated, and four samples were taken. Balanced (Langmuir, Freundlich, Riedlich-Petersson, and Fritz-Schlender) and the calculation of the constants using models of nonlinear equations and one model appeared the best (Fritz-Schlunde), and the process was good and endothermic **(Regti et al., 2017).** To remove antimony dye from water, there are several methods, including ion exchange, coagulation, and electrochemical treatment. In the laboratory, orange peel treated with acetic acid was used to remove antimony dye ions from the solution. The results showed that 5 g of orange peel is suitable at a rate of 98.5% in treating water at pH 6 for a contact time of 150 minutes and a mixing speed of 450 revolutions per minute **(Hasan et al., 2021).** Orange peels were also used in the laboratory to remove Congo red dye from polluted water, which was implemented in experimental factors such as pH, contact time, temperature, initial concentration of the dye to be removed, absorbed dose, and representative conditions. The properties of the orange were examined, and an adsorption-balanced study was conducted. The results indicated that the orange peel could be used as an excellent alternative to remove the dye due to its low cost **(Sahu, 2015).**

Because of the high cost of current methods and the continuing growth in water usage, removing heavy metal ions and dissolved organic compounds from wastewater is difficult for many countries. Three natural materials, avocado peels, Hamammon, and dragon fruit, were chosen and employed as easy and renewable water purifiers in this study. Spectroscopic and electron microscopy techniques were used to determine the existence of surface functional groups, such as CO_2H and OH, as well as the morphologies of the crusts. All of the calves were successful at removing colors as well as harmful metal ions from the water. With increasing extraction time, scale extraction capacity rose, and equilibrium was established. The highest extraction efficiency for alky blue (71.85 mg/g) and methylene blue (62.58 mg/g) was found in dragon fruit peels. The Langmuir isotherm model proved effective in understanding the adsorption process, which is dominated by electrostatic interactions between adsorbents and adsorbents, showing monolayer adsorption at the binding sites on the crusts' surface. On the other hand, the adsorption model for methylene blue and neutral red is still speculation. The sorbents can be regenerated and reused at an acidic pH for several cycles **(Mallampati et al., 2015).** Pomelo peel was used in experiments to see if it could absorb methylene blue from an aqueous solution. Batch adsorption experiments were carried out under various settings, including contact time, dye concentration, adsorbent dosage, and pH. Methylene blue absorption had a maximum pH of 5.0. Methylene blue is removed at a rate of 95% with a retention duration of 90 minutes, according to adsorption experiments. For an initial dye concentration of 100 ppm, the best absorption dose was 1 g/150 mL. The Langmuir adsorption model was utilized to describe the adsorption equilibrium mathematically, and the experimental data was found to fit well with the Langmuir model **(Tanzim and Abedin, 2015).** Biosorbents made from banana and orange peels can be used to remove colors, metals, and organic contaminants from industrial water and wastewaters. Dispersive of energy, the surface of the biosorbent was characterized by atomic X-ray (EDAX), spectrometry, scanning electron microscopy (SEM), Fourier transformation infrared (FTIR), and thermogravimetric (TGA) analyses. Greater knowledge of chemistry that underpins these interactions could aid in developing commercial biosorbents made from discarded banana and orange peels. On the surface of the peels, EDAX revealed the presence of carbon, oxygen, sodium, aluminum, calcium, magnesium, potassium, sodium, silica, and other minor elements. The presence of aliphatic, carboxylic acid and other groups on the surface of peels is confirmed by FTIR spectrometric findings. The TG traces revealed moisture loss and the development of certain light molecules **(Kamsonlian, 2015).** A thorough investigation into the use of waste biomass for water remediation has led to the discovery of new sources of these materials. Litchi chinensis peels are one example. This paper discusses the utilization of Litchi peels biowaste for effectively removing Cadmium (II) ions and the effects of environmental variables such as pH, sorbent dosage, sorbate concentration, and physicochemical treatments on the adsorption capacity of Cd (II). The best experimental conditions for maximum metal uptake were the pH 5, particle size 43 m, and a contact period of 60 minutes. The pseudo-second-order kinetic model and Freundlich adsorption isotherms model fit the Cd (II) sorption data well. The qmax was determined to be 15.27 mg/g using the Freundlich adsorption isotherm. The presence of different alkane, alcohol, amines, and oxygen-bound groups was shown by Fourier-transforms infrared spectroscopy examination of waste biomass. According to the findings of this study, Litchi waste biomass is a potential, low-cost, and environmentally acceptable bio-material that may be utilized to remove high quantities of Cd ions from wastewater **(Ansari, 2020).** In Viet Nam, research concentrated on creating adsorbents to remove colors from aqueous solutions based on cheap, abundant, and locally available agricultural wastes. The effects of initial concentration (100-600 ppm), the initial dose of adsorbent (0.1-1.5 g), and contacting time on the adsorption behaviors of Rhodamine B onto various types of pretreated fruit peel wastes, such as orange peels, pomelo peels, and passion-fruit peels, were investigated in greater detail. These bio-peels are efficiently absorbed in less than an hour in a short amount of time.Orange and passion fruit peels had dye removal effectiveness of 82-92 percent, whereas pomelo peels had a quicker removal efficiency of 91-94 percent, depending on the original concentration (200 ppm). Adsorbent dosage greatly enhances color removal efficiency: passion-fruit peels 43-98 percent, pomelo peels 67-94 percent, and orange peels 57-93 percent. The equilibrium adsorption data well obeyed the Freundlich isotherm, and the adsorption capacity was established in the following order: passion-fruit peels > orange peels > pomelo peels **(Nhung, 2018).** In order to offer use for this by-product of the Brazilian fruit juice industry, the yellow passion fruit peel was employed for Eriochrome black adsorption investigations in an aqueous solution. To imitate pectin removal conditions and produce surface changes that improve adsorption, the passion fruit peel was treated with nitric acid and sodium hydroxide. Batch kinetics and equilibrium tests were carried out at room temperature with contact periods ranging from 15 to 240 minutes. The thermodynamic studies were carried out using a temperature range of 298–343 K. The adsorption capacities ranged from 196 to 303 mg/g, with the adsorption capacity of the NaOH-treated sample being the highest at all temperatures. In comparison to other low-cost adsorbents, this result indicates that the passion fruit peel is a promising adsorbent. Adsorption is an exothermic process that occurs as entropy decreases. Except for the sample treated with NaOH, the procedure has a low level of spontaneity. At room temperature, Gibb's free energies for the untreated sample were 1.70 kJ/mol, 2.55 kJ/mol for the HNO3-treated sample, and 6.03 kJ/mol for the NaOH-treated sample. Eriochrome black adsorption on passion fruit peel is a physical process, according to thermodynamic research. With diffusion constraints in the solution, the pseudo-second-order model can be used to characterize the process kinetics. The findings suggest that passion fruit peel treated with NaOH is a promising adsorbent for Eriochrome black and that it might be utilized to adsorb various acid dyes in an aqueous medium **(de Oliveira et al., 2019).** Fruit peels, ubiquitous agricultural leftovers, have been widely employed to remove heavy metals as abandoned or low-cost biosorbents. Cu (II) ions were removed from an aqueous solution using dragon fruit peel (DFP), rambutan peel (RP), and passion fruit peel (PFP). The atomic absorption spectroscopy technique was used to determine the concentrations of the adsorbed metal ions.

Different adsorbent doses, pH levels, contact periods, and starting concentration in the sample were used in adsorption tests. An adsorbent dosage of 0.25 g, a contact period of 180 min, an initial concentration of 100 mg/L, a pH value of 4 for RP and PFP, and a pH value of 5 for DFP was found to be the best conditions for biosorption of Cu(II) ions.The pseudo-second-order kinetic model predicted the adsorption. The Langmuir and Freundlich isotherm models suited the adsorption data well, but the Langmuir model provided the best fit. DFP, RP, and PFP's Langmuir monolayer adsorption capacities were calculated to be 92.593, 192.308, and 121.951 mg/g, respectively. For all parameters, RP had a higher adsorption capacity for Cu (II) ions than PFP and DFP. According to the findings, these biosorbents could be employed to successfully adsorb Cu (II) ions from wastewater treatment plants **(Phuengphai, 2021).** The effectiveness of Pitahaya (Hylocereus spp.) peel (PP) as a low-cost biosorbent for the removal of Co (II), Cd (II), Pb (II), and Ni (II) from single and multicomponent solutions was examined in this study. pHpzc, Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy/energy-dispersive X-ray spectroscopy (SEM/EDS) were used to characterize the samples. The effects of contact time, solution pH, initial metal ion concentration, and biosorbent dosage were investigated using a batch experimental approach.The biosorption of Pb(II), Cd(II), Co(II), and Ni(II) Pitahaya peels followed pseudo-second-order kinetics, and equilibrium adsorption followed the Langmuir model, according to the findings. For metallic species, the maximal sorption capabilities of PP were discovered to be as follows: Cd (17.95 mg g-1) > Co (6.013 mg g-1) > Ni (82.64 mg g-1) > Pb (82.64 mg g-1) (5.322 mg g-1). When metallic species are combined, however, the biosorption efficiency changes. The PP regeneration following the metallic species' adsorption was accomplished with a 0.1 M HNO3 solution, and biomass reusability was achieved with two adsorption and desorption cycles **(Abatal, 2022).**

4. DISCUSSION

According to the third version of the pigment index, it is reported that there are more than five thousand different pigments according to the complex and variable composition, such as anthraquinone dyes, azo dyes, phthalocyanine dyes, indigo dyes, sulfur dyes, methane ternary dyes, Jia CHUAN dyes, and heterocyclic dyes are the types The eight are dyes based on their chemical structure.

Dyes, unlike most organic compounds, have color because they absorb light in the visible spectrum (400–700 nm), have at least one chromophore (color-bearing group), have a conjugated system, i.e., a structure with alternating double and single bonds and have electron resonance, which is a stabilizing force in organic compounds.

5. CONCLUSIONS

- The dyes cause water pollution and become unfit for drinking because it causes poisoning and other problems
- Many treatment methods are either technological, using nanotechnology and adsorption, which is more common, or chemical and coagulation methods, chlorine, or biological methods that are either pneumatic or non-aerobic or both.

- For textile industries, different types of dyes and chemicals are used to complete the process. Therefore, wastewater is classified based on the presence of non-dissolving dyes and types of toxic substances.

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