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Review Article

ADSORPTION OF TEXTILE DYES IN THE PRESENCE EITHER CLAY OR ACTIVATED CARBON AS A TECHNOLOGICAL MODELS: A REVIEW

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Abstract
Global water pollution caused via dye and pollutants have been reported to need touched an alarming level. These hazardous pollutants pose important threats to ecosystem , humans , due to their carcinogenicity, mutagenicity and toxicity. Different method needed to removal of dyes from waste water, like chemical oxidation, extraction, physical adsorption, electrochemical treatments and zonation. Though, these methods conventional are constrained via little efficiency great cost ,stability, and harmful formation through-produces. Wastewater from production dyestuff is one of the main pollutants water. Different ways have been useful for the remediation of water contaminated. In the present study, the utilize of low-cost, abundantly available, greatly efficient and simply obtained ecofriendly adsorbents like clay and activated carbons have been reported as an alternative to the current expensive ways of dye removal from aqueous solution. .About of the methods depend of the several will yield from (AC). kind of AC is useful: (1) it acts as a dye adsorbent, not only in straight forward methods of the adsorption but too in AC-improved clotting and filtration membrane methods; (2) it strong produces of the oxidizing agents (typically, radicals (_OH)) in electro chemical oxidation dye; (3)it catalysis _OH production in (AOPs); (This reviews kind of clay and AC in dye de-colorization, assesses the possibility of each AC-altered de colorization method and discusses perspectives on future research.

Keyword : Adsorption , Removal , Clay , Activated carbon .

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INTRODUCTION

Color is the utmost obvious indicator of water contamination. The release of coloured wastewater of the streams not only moves their nature aesthetic but too interferes with the show of sunlight in to streams and thus decreases photo synthetic action. Wastes from the dye industrial industry ,pulp textile industry and paper manufacturing are greatly colored[1-3]. Synthetic dyes are extensively utilized in different textile dyes branches manufacturing, photography color, cosmetics, drug , plastic. The find of even so little conc. of dyes. in water decreases light penetration by the water surface, precluding photo synthesis of the flora aqueous. Various of the dyes, teratogenic , carcinogenic, mutagenic and too toxic to beings human, bacteria, and types fish. Therefore, the remove from water wastes becomes ecologically important[4-7].

Dyes

are colored organic complexes founded on functional groups similar chromophore group (RNH , NH2, R2N, OH and COOH) and auxo-chromes (NO ,$N_2$and NO2) [8]. There are Various kind of dyes utilized for the dyeing of varies appear in (Table 1) the acid dyes usually utilized for altered acrylics , silk, wool, dyeing nylon. Too utilized in cosmetics, food, paper and leather dyeing . The main kind of the dyes acid are anthraqueinone, nitroso, xanthene, azine, tri phenyl methane, azo and nitro dyes[9, 10] The kind of soluble dyes in water and give colored cations and are too named dyes cationic [11, 12] . The main kinds are oxazine, cyanine, thiazine, diazahemicyanine and hemicyanine acridine, i.e., methylene blue, yellow basic 28, basic brown, CV , basic red 46, and basic red9 are the basic dyes. Dyes disperse are working on acrylic fibers, nylon. Dyes nonionic in soluble in water from aqueous solutions, utilized for fibers acrylic too. major kind are styryl, , azo nitro, benzodifuranone, and anthraquinones group [13, 14]like disperse orange , disperse yellow, blue, and red. Direct dyes utilized for leather, rayon dyeing , cotton and in paper manufacturing. [15, 16] . Reactive dyes utilized on cotton fiber , nylon, and cellulose . The chromophores of the dyes are triaryl methane , phthalocyanine, azo and a covalent bond is formed among the fiber dye [17, 18]. Common like are reactive red, reactive black 5 ,reactive yellow 2, and remazol etc.

Table 1: Several kinds of textile dyes

Dye	Example
Dyes Acid	Acid red 57, Acid-blue 25, Congo-red, methylene orange
Dyes Basic	Basic yellow 28, basic red9 ,Basic red 46, Malachite green, basic brown, methylaene blue
Dyes Disperse	Disperse orange, disperse yellow, disperse red disperse blue
Dyes Reactive	Reactive red, remazol, ,reactive yellow 2, reactive black5
Vat	Vat blue, indigo ,Vat green 6,
Dyes Direct	Black direct, violet direct, orange 34 direct, direct blue.

Techniques Separation of Dye

Waste dye mix with wastewater might cause possible threat to environment .several physiochemical techniques has been advanced for the remediation of waste of eco-friendly concern . The chemical treatment that contains photocatalytic and photolysis processes, while biological way contain aerobic and anaerobic degradation and physiochemical ways contain kinetic electro coagulation, adsorption ion exchange, and filtration membrane. All systems need their own determine for basis of price, design and separation capacity of the dye . But the adsorption utmost suitable way in comparison with others in several respects [7, 19, 20]. abstract of disadvantages and advantages of these ways appear in Table 2.

Table2: Techniques of the Separation disadvantages and advantages

Techniques Separation	Disdvantages	Aisadvantages
Chemical methods		
Ozonation	Some photocatalyst degrades into toxic by-products	No sludge generation
Photocatalyst	Working cost is very great, half life is short (20 min) Some photocatalyst degrades into toxic by-products.	Working cost is little and economically feasible
Fenton reagent	Disposal issues and sludge production	Little-priced reagent and afficient process
Biological methods		
Degradation anaerobic	conditions aerobic require Large treatment and yield of hydrogen sulphide and methane	By-products may be utilized as energy resources
Aerobic degradation	Provide suitable environment for growth of microorganisms and very slow process	Operational cost is low and effective in removal of azo dyes
Physicochemical methods		
Adsorption/sorption	Low surface area for some adsorbents, high cost of adsorbents.	High adsorption capacity for all dyes.
Ion exchange Electro kinetic coagulation .	Need to dispose of adsorbents .Need further treatments by flocculation and filtration and production of sludge	No loss of sorbents Economically feasible
Membrane filtration .	Suitable for treating low volume and production of sludge	Effective for all dyes with high quality effluents

Clays

Clays are defined as fine minerals grained , that might plastic in kind clays may be hardened when fired or dried and they include suitable contents of water . Clays mostly include phyllosilicates, yet the other contents find might locate harden or either plasticity when dried or fried [21, 22] . Clays can be distinguish from other soil fine-grained via their several in size ,minerology [23, 24] reported montmorillonite- sematic, bentonite ,kaolinite, chlorite and Elite the major kinds of clays. Group of the Kaolinite clay contains the kaolinite mineral, , halloysite , dickie and nitrite. The group smectite contains pyrophyelite, vermiculite, talc, nontronite ,saponite, sauconite, and montmorillonite. The group of the IL lite clay contains the clay micas. elite is the only common mineral[22, 25] . Chlorites are not constantly considered clay; some -times they are classified as group separate inside the phyllosilicates. naturally Zeolites occurring minerals silicate, that container too be synthesized at commercial level. Possibly clinoptilolite is the utmost abundant of N40 natural species zeolite. The properties of the adsorption of zeolites clay depend upon their ion exchange capabilities [26, 27].

Bentonite

Bentonite, as a representative mineral clay, is mainly composed of montmorillonite, that contains of layers of two tetrahedral sheets silica inserting one octahedral sheet alumina [28, 29]. Deferent properties are obtainable like the great surface area, great capacity swelling and great capacity cation exchange [30] . Bentonite has a perpetual charge negative, caused via the isomorphs substitution of $Al3+$ for $Si4+$ in the tetrahedral layer and $Mg2+$ for $Al3+$ in the octahedral layer. The charge negative is balanced via the presence of cations exchangeable ($Na+$, $Ca2+$, etc.) in the lattice structure, that ensures its good performance in adsorbing cationic pollutants via exchange cationic [31] . These cations inorganic can be substituted for cationic surfactant or hydroxymetal, producing materials like organo bentonite and pillared bentonite . There are several kinds of bentonite which are named with respect to the find of dominant element in them likes potassium, calcium, sodium and aluminum. Bentonite is usually produced due to the weathering of ash volcanic commonly in the find of water[32, 33]. Two major kinds of bentonite are sodium or calcium bentonite, mostly utilized for manufacturing applications. Calcium bentonite is an affective adsorbent of ions not only in solution but too in fats and oils. Sodium bentonite when added in water; absorb several times as its dry mass find in water and expand when it is wetted, it is very important because of its wonderful colloidal properties. It is utilized for environmental and geotechnical study via drilling mud for gas wells and oil [33, 34]. According to the properties of the adsorption of bentonite, it has total neutral charge on its lattice excessive charge negative is find which is characterized via the structure a three layer with two silicate layers, enveloped via an aluminate layer as opposite charges attract, charge negative surfaces have affinity for dye cationic. A number of dyes cationic was absorbed through clay bentonite [35]. So far, clay could probably be utilized for the dyes removal due to its capacity , abundance , obtainability and economically beneficial.

Kaolinite

Contains this group minerals trioctahedral such as cronstedite, chrysotile, chamosite ,antigorite and minerals decahedral like halloysite, dickite ,kaolinite, and nitrite. It is white or plastic soft clay, composed of the hydrated aluminium silicate, kaolinite a mineral. Overall the structure of group of the kaolinite is composed the sheets of silicate ($Si2O5$) bonded to aluminium oxide/hydroxide layers $Al2(OH\ )4$ named layers gibbsite [36, 37] , Kaolinite covers heterogeneous charge surface is a famous fact. It is believed that its basal surface has a constant charge structural that accredited to isomorphs substitutions of $Si4+$ by $Al3+$. The charge onto edges is due to deprotonation or protonation of surface groups hydroxyl and thus it depends of the solution pH. Adsorption can happen on flat exposed planes of sheets alumina and . silica It is least clay reactive. Kaolin has no side affects, no health problems till the fine dust particle is controlled, so it is ecologically safe [37, 38]. Clay minerals chemical composition had been mentioned through several studies shows Table (3) .

Table 3:Chemical composition of several normal minerals clay [27, 39-41]

Natural clays	Elemental composition (% weight)								
	SiO_2	Fe_2O_3	Al_2O_3	TiO_2	Loss on Ign.	CaO	NaO	K_2O	MgO
Bentonite	54	4.88	14	0.52	-	4.77	0.65	1.54	0.65
clay Indigenous	46.22	0.68	38.40	–	13.47	0.86	–	–	0.37
clay Egyptian	50.65	4.61	30.31	1.65	–	0.27	0.16	–	0.20
Kaolinite	53.701	2.00	43.60	0.10	–	–	–	0.50	–
Illicit	62.72	5.58	14.34	0.82	–	7.27	1.01	3.59	1.82
BeetElite	58.08	2.96	29.92	0.22	–	0.63	1.85	0.22	5.48
Indian clay	48.12	2.48	34.54	0.40	12.44	0.83	–	–	0.50
Kaolin	46.701	0.75	37.33	<0.01	13.68	<0.10	<0.10	0.93	<0.10
clay Nigerian	48.62	2.88	34.82	0.01	11.54	0.10	0.06	0.94	0.23
Ball clay	53.70	1.99	31.31	1.91	10.03	0.41	0.44	Nil	Nil
clay Algerian	23.34	8.86	7.02	–	–	0.78	–	4.07	1.91
clay Tunisia	52.50	3.00	18.20	–	16.00	2.81	1.78	1.50	2.45
China clay	46.22	0.68	38.40	–	13.47	0.86	–	–	0.37
Chlorite	27.40	2.40	18.90	–	–	–	–	–	34.00
Clay Red	41.10	6.05	31.48	1.49	16.58	0.28	0.62	1.77	0.35
Bejoypur clay	72.090	1.01	18.69	1.02	–	0.10	0.11	0.61	0.14
Diatomite	72.00	5.80	11.40	–	–	1.500	7.20	–	–
Clay Caro	53.350	0.99	30.33	1.23	11.35	0.09	0.13	2.06	0.47
Brazilian clay	59.570	11.31	22.28	1.03	–	0.72	0.01	2.83	2.25
Brown clay	51.10	4.45	15.57	0.13	–	10.57	0.17	3.42	0.86
Red mud clay	2.150	7.15	51.07	1.77	33.90	1.07	2.84	–	–

Activated carbon

The term activated carbon (AC) is basically referred as a car-bonaceous material with high micropores volume, well developedsurface area, favorable pore size distribution, and high adsorptive capacity [42]. Activated carbon, a generally utilized adsorbent in manufacturing methods, is composed of a microporous, structure homogenous with great surface area and appear stability radiation [20, 43]. The method for producing great-capacity AC is not completely studied in emerging countries. Also, there are several problems with the regeneration of utilized AC. Now days, there is a countless interest in discovery cheap and alternatives affective to the existing AC commercial [1, 17, 44, 45] . Discovering affective and inexpensive AC might contribute to ecofriendly sustain ability and offer benefits for applications in the future commercial. The prices of AC prepared from biomaterials are very little compared to the cost of commercial activated carbon. Waste materials that has been successfully utilized to production AC in the recent past contain bagasse ,coir pith , orange peel , , sunflower seed hull , coffee shell , waste wood , pine cone , coconut tree, oil palm shell ,hazelnut husks, pine-fruit shell , corn cob, rice hulls, apricot stone and Coconut husk [14, 18, 46-52].

Table 4: Removal of several dyes using Activated Carbone(AC) .

Type dye	Sorbent	E%	q_{max} (mg/g)	C_o (mg/l)	Dose (g/l)	t(h)	Ref.
Maxilon blue GRL	Coconut husk	98	30	2-16	0.05	24	[48]
direct yellow DY 12	Coconut husk	72	30	2-16	0.05	24	[48]
crystal violet (CV, basic dye)	Coconut husk	88	20	5-30	0.3	1	[53]
crystal violet (CV, basic dye)	Fugas Sawdust Carton	89	64	5-100	0.5	1	[50]
Maxilon blue GRL	Fugas sawdust (beech wood)	88	18	30	0.025	2	[54]
methylene blue (MB)	corn-cob	99	15	5-30	0.03	24	[18]
crystal violet (CV, basic dye)	Coconut Shell	99.5	12	30	0.05	24	[51]
methylene blue (MB)	Apricot stone	99	49	30	0.05	24	[14]
methylene blue (MB)	corn-cob	90	55	50	0.1	24	[55]
crystal violet (CV, basic dye)	corn-cob	80	26	50	0.1	24	[55]
Maxilon blue GRL	corn-cob	99.5	90	50	0.1	24	[55]
basic yellow 28	apricot stone	55	11	16	0.1	1	[56]

Methods removal of dye

Few decades earlier, selection the dyes, application and utilize was not certain a main consideration with respect to their impact environmental. Even the chemical composition of half of the dyes utilized in the industry was determined to be anonymous. With the growing concern on health mainly of grounds aesthetic, Usually manufacturing treatment wastewater methods contain of following steps similar: Pretreatment – industrialized- sewerage streams prior to release to municipal wastewater methods or even to a central industrial wastewater method are pretreated doing equalization, neutralisation; then they undergo treatment of the primary and sewerage is directed toward removal of contaminants with the effort least. Suspended solids are removed via both chemical or physical separation techniques and handled as solids concentrated; then known treatment secondary commonly including microorganisms(treatment biological) chiefly bacteria that stabilize the waste components [57]. The step third is chemical- physical treatment or treatment tertiary and the methods involved the adsorption, stripping, ion exchange, oxidation of the chemical, and separations membrane [58, 59]. All costly than treatment biological but are utilized for the removal of contaminants that are not certainly removed through biological systems. commonly used in series with treatment, biological some times they utilized as stand-alone methods also. The step final being the sludge treating and disposal. wastewater of the Dye are too treated in large or less a alike method, yet, there is no single standard methodology/treatment procedure utilized for very kind of wastes. classifying the methodologies usually adopted to treat dye wastes in four categories: (1) chemical (2) physical (3(biological and (4) acoustical, radiation, and electrical methods. Exactly the lying methodologies in beyond mentioned categories are discussed in brief in subsequent paragraphs.

1-Sedimentation

The basic form of main treatment utilized at utmost municipal and industrialized-wastes treatment facilities .The number of method options obtainable to improve gravity settling of suspended particles, counting flocculants chemical, clarifiers and sedimentation basins [60, 61].

2-Filtration technology

is an integral component for water drink and wastewater applications that contains nanofiltration, ultrafiltration, microfiltration, and reverse osmosis. This have been studied for color removal microfiltration is of not much utilize for wastewater r treatment because of its big pore size, and by Nano filtration and ultrafiltration . techniques are affective for the removal of totally kind of dyestuffs, molecules of the dye cause frequent clogging of the membrane holes making the separation methods of determine utilize for textile waste treatment[62] .

3-Chemical treatment

is one of the robust methods to remove color. the method is economically feasible (but some times becomes costly due to the cost of chemicals) Though, the chief drawback of the method is that the last product is a concentrated sludge produced in great amounts too, further this, the removal dependent of pH . This method is no good for greatly soluble dyes and the result with reactive, azo, acid and especially the dyes basic are usually consider not good[63] .

4-Oxidation

Wastewater is treated via utilized oxidizing agents. Usually, two forms viz. UV assisted oxidation and chemical oxidation by means of chlorine, hydrogen peroxide, ozone, reagent fenton's, or potassium permanganate are utilized for treating the wastes, specifically those found from main treatment (sedimentation). They are among the most commonly used methods for decolourisation processes since they require low quantities and short reaction times . It is worth to note that pH and catalysts show an significant part in oxidation method [64, 65].

5-Electrochemical methodology

As a tertiary treatment is too utilized to removal the color. De-colorization can be attained both via electro oxidation with no soluble anodes or through electro-coagulation utilize materials consumable. Deferent materials anode, such as iron, conducting polymer a boron doped diamond electrode etc [66].

6-Advanced Oxidation Processes (AOPs)

The techniques including simultaneous utilize of large than one oxidation methods, since some times a single oxidation method is not sufficient for the overall decomposition of dyes. The reactions contain the accelerated production of the (OH) free radical, that is very reactive, are termed advanced oxidation processes (AOPs) and contain methods as reagent Fenton's oxidation, (UV) photolysis and sonolysis. They are capable of degrading dyes at ambient pressure , temperature and might too have an advantage above treatment of the biological for waste streams having toxic or bio inhibitory contaminants [67-70].

7-Biological treatment

The utmost common and widespread method utilized in dye waste- water treatment A great number of species has been utilized for de coloration and mineralization of many dyes. The methodology offers substantial advantages similar being relatively cheap, needing little running costs and the end products of complete mineralization not being toxic. The method can be aerobic (in find of O_2), anaerobic (without O_2) or combined aerobic–anaerobic[71] .

CONCLUSION

The literature reviewed revealed the fact that there have been a great increase in production and application of dyes in last few decades resulting in a big threat of contamination. It is worth while noting that the elimination of dyes may be done via several methods; yet, there exists no such methodology which can successfully removal all kinds of dyes at low cost. The clays is low-cost sorbents, which have been successfully utilized for the adsorption of dyes from wastes They have several kinds of clays was compared for the adsorption of dyes belong to several kinds based on experimental conditions counting temperature, pH, primary dye concentration and particle size. clays offered more capacity for the adsorption of dyes.

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