REVIEW OF DIFFERENT TREATMENTS USED FOR DISPERSE DYE EFFLUENT

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ABSTRACT: Disperse dyes are largest group of dye used for dyeing of polyester, nylon and cellulose triacetate. The waste water generated during dyeing process contains dyes and other chemical auxiliaries which are major environment concern due to their toxic and carcinogenic impact. These paper reviewed different technique available for disperse dye removal from textile effluent.

KEY WORDS: Disperse Dye, Treatment for textile effluent

INTRODUCTION:

According to Aragao et al, Disperse dyes are characterized by low molecular weight and low solubility. Disperse dye is aromatic compound insoluble in water while soluble in organic solvent. It contains mainly azo and anthraquinon based chromophore. Szpyrkowicz at al. investigated that Azo group is mostly widely used among all disperse dye for commercial purpose. Christie has observed that Anthraquinone dyes are second most important group after Azo dye and it contain wide range of colours in visible spectrum. Disperse dye have high degree of fixation on fibre (about 90-100%) still some of its portion served as residue goes under effluent during dyeing and printing process (up to 100%),(Reife. A.1996). Major source of release of disperse dye in effluent is manufacturing process and dyeing process of polyester fibres. Lixuan Wang et al (2014) said that disperse dyes containing wastewater contain refractory organics. Disperse dye waste water contain toxic substances like benzene, nepthelene series, azo, anthraquinone, Halide, nitrocellulose, aniline and phenol substances. Only 2% product during the dyeing is drain away. Disperse dye contains $-NO_2$, $-NH_2$, -COOH and other functional group which characterized as alkali and acid group consequently. Disperse dye waste water containing mainly two parts of organic matter. One part is disperse dye and the other part is intermediates produced during dye production process. These organic molecules are so small that is partially dissolved in water. Disperse dye can disperse in water with the help of dispersant.

Disperse dye are hard to degrade and due to stability and their reductive toxic by-product survive longer time in the effluent. Anthraquinone dye are more resistant to degrade than azo and nitro compound because of stabilized aromatic ring structure while some azo dyes are hazardous to human health as toxic amines are released by their reduction. Some disperse dye have tendency to serve as bioaccmulate (Banat, 1996).

Removal of disperse dye from effluent is important and challenging job. Formation of toxic aromatic amine is another major threat cause by disperse dye.

Possible impact of dye effluent to aquatic life when released in to aquatic ecosystem without appropriate treatment.

1. Dye can block penetration of sunlight and hamper the growth of photoautotrophic organisms.
2. Suspended solids and oily substances of effluent interfere with oxygen transfer mechanism of aquatic life.
3. Some Inorganic chemicals used in dyeing process are toxic to aquatic life.
4. Organic compounds are undergo chemical and biological changes and depleted oxygen level of receiving stream.

DIFFERENT AVAILABLE TREATMENT TECHNOLOGIES FOR DISPERSE DYE LIKE PHYSICAL, CHEMICAL AND BIOLOGICAL ARE REVIEWED IN THIS LITERATURE.

PHYSICAL TREATMENT TECHNOLOGIES:

NUMBER OF TECHNIQUES ARE AVAILABLE FOR DISPERSE DYE REMOVAL. ADSORPTION IS WIDELY USED PHYSICAL TREATMENT. ACCORDING TO MARKANDEYA ET AL. (2018), ADSORPTION IS THE TECHNIQUE TO REMOVE DYE MOLECULE FROM EFFLUENT WITH BINDING ON THE SURFACE OF ADSORBENT BY PHYSICAL OR CHEMICAL INTERACTIONS. HALBUS ET AL. 2013 FOUND THAT ADSORPTION IS CHEAP AND EFFICIENT METHOD FOR COLOUR REMOVAL FROM WASTE WATER BUT IT CAN GENERATE HUGE AMOUNT OF SLUDGE. THEY USED IRAQI DATES PALM SEEDS ACTIVATED CARBON TO TREAT DISPERSE DYE 26 FROM EFFLUENT. EFFECT OF DIFFERENT PARAMETERS SUCH AS PH, CONTACT TIME AND DOSES WERE STUDIED FOR CHECKING BEHAVIOUR OF ADSORPTION PROCESS IN REMOVAL OF DISPERSE DYE. 66.47% DISPERSE BLUE DYE CAN BE REMOVED BY IRAQI DATES PALM SEEDS ACTIVATED CARBON WHILE 54.33% REDUCTION IN DYE CAN BE ACHIEVED BY COMMERCIAL ACTIVATED CARBON.

ADSORPTION OF DISPERSE RED-11, DISPERSE BLUE-26 AND DISPERSE RED-156 WERE INVESTIGATED WITH UNTREATED ALUMINA AND SURFACE TREATED ALUMINA. SURFACE TREATED ALUMINA FOUND MORE EFFECTIVE THAN UNTREATED ALUMINA. ADSORPTION OF DISPERSE DYE INCREASES WITH INCREASES PH IN THE RANGE OF 2-8. ABOVE PH8 ADSORPTION WAS DECREASED. SEQUENCE OF ADSORPTION OF DYES ARE DISPERSE RED -11>DISPERSE BLUE-26>DISPERSE RED-156 ACCORDING TO THEIR POLARITY. NON POLAR COMPOUNDS ARE MORE EASILY ATTACHED TO ALUMINA SURFACE THAN POLAR COMPOUND WAS OBSERVED BY GAWADE ET AL. IN 2005.

MODIFIED MAGNATITE NANO PARTICLES IS COATED WITH TYLTRIMETHYL AMMONIUM BROMIDE USEFUL FOR TREATMENT OF DISPERSE RED 167 AND DISPERSE BLUE 183 FROM WASTE WATER OF TEXTILE INDUSTRY. RAJABI ET AL (2016) OBSERVED THAT ADSORPTION PROCESS DEPENDED ON PH, SURFACTANT CONCENTRATION AND INTIAL DYE CONCENTRATION. THEY GOT HIGHER THAN 95% REMOVAL EFFICIENCY ACHIEVED IN 10 MIN. EVEN AT 500 MG/L DYE CONCENTRATION.

TIWARI ET AL. (2017) HAD PREPARED ZEOLITE FROM CENOSPHERETO TREAT DISPERSE ORANGE 25 AND DISPERSE BLUE 75:1 FROM WASTE WATER. THEY ACHIEVED 93% AND 88% REDUCTION AT OPTIMIZED CONDITION AND 0.6 AND 0.8 MG/L ADSORBENT DOSAGE. AFTER TREATMENT WITH DYE, ZEOLITE CAN BE REGENERATED BY RECOVERING OF DISPERSE DYE. MONOLAYER ADSORPTION WAS BEST FITTED IN THESE STUDIES. THEY ALSO WORKED (2015) WITH CENOSPHERE FOR REMOVAL OF DISPERSE BLUE 79:1 AND DISPERSE ORANGE 25 (DYE) FROM WASTE WATER BY BATCH ADSORPTION PROCESS UNDER DIFFERENT CONDITION AND GOT REDUCTION UP TO 78% OF DISPERSE BLUE AND 81% DISPERSE ORANGE.

HEMSAS ET AL. (2014) HAD INVESTIGATED POTENTIAL OF OLIVE STONES WHICH WAS EARLIER CONSIDERED AS A WASTE FOR REMOVAL OF DISPERSE DYE IN BATCH ADSORPTION PROCESS. THEY HAD PREPARED ACTIVATED CARBON FROM OLIVE STONE AND CHECKED EFFECT OF DIFFERENT PARAMETERS LIKE PH, TEMPERATURE, COLOR, AGITATION SPEED, TEMPERATURE, AND INTIAL DYE CONCENTRATION. THEY HAVE OBSERVED THAT WHOLE PROCESS IS HIGHLY DEPENDENT ON PH. THEY GOT 95% REDUCTION IN DYE BLUE PALANIL AND YELLOW TERAZIL AT PH 3, 50 RPM, 20^{O}C AND WHOLE PROCESS REQUIRE 30 MIN TIME FOR COLOR RAMOVAL.

COLUMN MADE UP OF FLY ASH AND SAND COMBINATION (1:1, 1:2 AND 1:3) FOR ADSORPTION STUDIES FOR REMOVAL OF DISPERSE 354 DYE OF 1-20 PPM SOLUTION HAD BEEN CARRIED OUT BY JAMDAKAR ET AL. (2015). THE PRESENCE OF SiO_2 AND OTHER OXIDES HELP IN REMOVAL OF COLOUR. THE WHOLE PROCESS IS DEPENDENT ON INITIAL CONCENTRATION OF DYE SOLUTION. DYE REMOVAL EFFICIENCY IS DECREASES WITH INCREASING CONCENTRATION OF DYE. THEY GOT 82% REDUCTION AT LOWER CONCENTRATION OF DYE SOLUTION WHILE 69% REDUCTION ACHIEVED AT HIGHER CONCENTRATION OF DYE.

ADSORPTION BY SAW DUST FOR REMOVAL OF DISPERSE YELLOW 22 CONTAIN EFFLUENT HAD BEEN STUDIED BY DESHANNAVAR (2015), OPTIMUM CONDITION FOR ADSORPTION HAD BEEN CONCLUDED BY THEM. COLOUR REMOVED AT INITIAL CONCENTRATION OF 201 MG/L DYE, 2.1PH, 40 MIN. AGITATION TIME AND 3 G/L DOSAGE. DYE REMOVAL RATE DECREASE WITH INCREASE CONCENTRATION OF DYE.

DISPERSE BLUE 79 ADSORPTION WAS CARRIED OUT WITH THE HELP OF FLY ASH AND SOIL IN BATCH AND COLUMN TECHNIQUE BY ALBANIS ET AL. (2000). HE GOT AVERAGE 60.3% REDUCTION BY USING COLUMN OF SOIL MIXTURE WITH 20% FLY ASH CONTENT IN

CONCENTRATION OF 50MG/L DYE SOLUTION.

SHENG H. LIN (1993) HAS OBSERVED THAT DISPERSE DYE C. I. DISPERSE DYE RED 60 WAS REMOVED BY ACTIVATED ALUMINA AND MOLECULAR SIEVE GREATLY IN COMPARE TO GRANUAL ACTIVATED CARBON, DIATOMITE AND SAW DUST IN 2 HOUR REACTION TIME.

ADAM ET AL. (2012) HAD INVESTIGATED POTENTIAL OF FRUIT WASTE (DURIO ZIBETHINUS HUSK), DZH FOR REMOVAL OF DISPERSE DYE UNDER DIFFERENT CONDITION OF PH, TEMPERATURE, AND CONTACT TIME. THEY FOUND THAT DURIO ZIBETHINUS HUSK, DZH IS CHEAPER ADSORBENT COMPARE TO ACTIVATED CARBON FOR REMOVAL OF DB 60 IN AQUEOUS SOLUTION. THEY COMPLETELY REMOVE DB60 5 GM/L DOSAGE BY USING DZH UNDER CONTROL CONDITION OF PH 9 AND 30^{O}C IN 1 HOUR RETENTION TIME.

DISPERSE YELLOW 22 REMOVAL USING WOOD DUST WAS CARRIED OUT BY DESHANNAVAR ET AL (2014). THEY HAVE STUDIED BATCH ADSORPTION STUDY OF COLOUR REMOVAL AND IMPACT OF DIFFERENT PARAMETERS LIKE PH, TEMPERATURE, ADSORBATE DOSAGE, INTIAL CONCENTRATION AND CONTACT TIME FOR DYE REMOVAL. THEY FOUND THAT MAXIMUM REMOVAL OCCURS AT 21 MG/L DYE CONCENTRATION AND 3 G/L ADSORBATE DOSAGE IN 40 MINUTES TIME.

REMOVAL OF DISPERSE DYE ORANGE 30 BY BAMBOO BASED ACTIVATED CARBON FIX BED COLUMN EXPERIMENT CARRIED OUT BY AHMADA ET AL. (2014). VARIOUS PARAMETERS LIKE BED DEPTH, FLOW RATE AND DYE CONCENTRATION. 39.97 MG/GM BED CONCENTRATION BED GIVES HIGHEST RESULT.

DISPERSE RED 170 WAS TREATED WITH CARBON DERIVED FROM BAMBOO WASTE BY LIANGGUI WANG (2012) UNDER CONTROL PH, TEMPERATURE, DYE CONCENTRATION AND CONTACT TIME.

DISPERSE OF YELLOW 42 ADSORPTION BY BENTONITE AND ORGANO MODIFIED BENTONITE WAS STUDIED UNDER DIFFERENT CONDITION IN BATCH PROCESS BY HASHEMIAN ET AL (2013). HE FOUND THAT DYE REMOVAL RATE IS INCREASING WITH ADSORBENT DOSE. ORGANO MODIFIED BENTONITE IS MORE EFFECTIVE THAN UNTREATED BENTONITE. IT IS COST EFFECTIVE ADSORBENT.

EL-SAYED ET AL. (2011) HAD PREPARED ACTIVATED CARBON FROM SUGAR CAN STALKS BY TREATED WITH PHOSPHORIC ACID WAS USED FOR DISPERSE 2BLN DYE AT PH NEAR 1.5 AND 27.1MG/G ACTIVATED CARBON DOSE. THEY ALSO FOUND THAT PROCESS IS EXOTHERMIC AND SPONTANEOUS.

CHEMICAL TREATMENT:

COAGULATION AND FLOCCULATION EFFICIENCY FOR DISPERSE DYE REMOVAL CAN BE MEASURED BY WONG ET AL (2007), THEY USED THREE DIFFERENT COAGULANT NAMED ALUM, POLYALUMINIUM CHLORIDE AND $MGCL_2$ FOR COMPARISON OF EFFICIENCY. IMPACT OF COAGULANT AID AND SETTLING TIME OF FLOC WAS ALSO CONSIDERED. THEY OBSERVED THAT PACI IS MORE EFFECTIVE THAN ALUM AND $MGCL_2$FOR REMOVING COLOUR AND COD IN TEXTILE WASTE WATER CONTAINING DISPERSE AND REACTIVE DYE.

NOUREDDINE ET AL (2008) HAD OBSERVED THAT CRYSTALLINE HYDROXYAPATITE FORMED BY REACTION OF $CA(NO_3)_2$ AND $(NH_4)_2HPO_4$ REAGENT TIN AQUEOUS SOLUTION IS USED AS ADSORBENT FOR REMOVAL OF DISPERSE DYE IN BATCH MODE. COLOUR REMOVAL EFFICIENCY INCREASES WITH INCREASING ADSORBENT DOSE. POORLY CRYSTALLINE HYDROXYAPATITE WAS USED TO REMOVE DISPERSE BLUE SBL DYE FROM AQEOUS SOLUTION. THEY OBSERVED THAT INTIAL ADSORPTION RATE DURING PROCESS IS HIGHER AND WHOLE PROCESS IS HIGHLY DEPENDENT ON PH. HIGH DYE UPTAKE AT LOW PH. ELECTROSTATIC NATURE OF DYE AND CALCIUM HYDROXYAPATITE FOUND.

YEAP ET AL. (2014) HAD PREPARED NOVEL HYBRID POLYMER FROM POLYALUMINUM CHLORIDE- POLY (3- ACRYLAMIDE- ISOPROPANOL CHLORIDE) MADE UP OF ORGANIC AND INORGANIC POLYMER. IT SHOWS 92% CHEMICAL OXYGEN DEMAND AND 95% REDUCTION IN COLOR AT PH 7.5 50 MG/L SOLUTION OF RCB DYE. IT GIVES 93% FOR COD AND 96% FOR COLOR AT PH 3 USING 20 MG/L DTY DYE CONCENTRATION.

Arslan-Alaton and S. Dogruel (2004), had investigated photo (U.V)-degradation of disperse dye effluent with the help of silicadodecatungstate (SiW12O404–/5–) nanoparticles. Decolourization efficiency depend up on the heteropoly acid (photocatalyst) loading, nature of the organic solvent, i.e. the electron donor, and the presence of various dye assisting chemicals. They also observed that colour removal efficiency was hinder by dye auxillry chemicals. Decolorizing efficiency of disperse dye bath recovers is 55%.

Phalakornkule et al. Investigated efficiency of electro coagulation of blue reactive, red disperses and mixed dye decolourization in 2010. Reactive blue 140 and disperse red 1 were selected for individual and mixture was taken for treatment. They got satisfactory result for individual as well as mixture. For 100 mg/L dye concentration they got >95% reduction for decolourization. They found that iron is superior coagulant compare to aluminium in their study.

ADVANCED OXIDATION TREATMENT:

Oxidation is one of most potential alternative treatment against conventional treatment. Ozone is treated with disperse dark blue 148 at 0.1 g/l investigated by S Eren et al. Ozone is efficient in removing COD, pH, temperature and conductivity.

Farouk KM Wail (2015) has selected three commercial disperse dye named disperse yellow 23, disperse red 167, disperse blue 2BLN for study fenton process for textile pollutant removal. He used 3g/l H_2O_2 and 120 mg/l ferrous sulphate hepta hydarated dosage for treatment of wastewater containing above dye. He got 84.66%, 77.19% and 79.63% color reduction in 160min retention time and Chemical oxygen demand reduction up to 75.81%, 78.03% and 78.14% of above dye.

Nano-iron modified goldmine waste as a catalyst in fenton reaction for treatment of disperse orange 288 was investigated by Mei Huang (2011). He observed that nano-iron modified goldmine waste gives better performance than the fenton process

Electrochemical oxidation for removal of pollutant was carried out by (Szpyrkowicz et al, 2000.) undivided cell reactor using different anode and 0.1M NaCl as a supporting electrolyte solution. Treatment effectiveness depend up on supporting electrolyte.in the reactor, pH of medium and anode material used. Ti/Pt-Ir anode and 0.05M Na_2SO_4 as supporting electrolyte in acidic medium. OH redical in water is generated by chlorine hypochloride species gain during electro-oxidation of chloride at anode. The control of increase three fold time reaction rate. Electochemical oxidation of disperse orange 1, disperse red 1 and disperse red 13 was carried out using Ti/TiO_2 Thin film electrode with NaCl and Na_2SO_4 medium. 100% Colour removal can be achieved after one hour treatment. They also observed that faster colour removal can be achieved by using 0.1mol/L NaCl under U.V light and +1.0V which also reduces TOC level up to 60%.

Fehiman Ciner, Omur Gokkus¸ (2013) had studied Disperse Yellow 119 and Disperse Red 167 removal by Fenton and solar light effect on Fenton reaction. Process is dependent on pH, Fe^{++} concentration, H_2O_2 Concentration and oxidation time. In fenton dark reaction 98% SAC and 90% COD removal were achieved at pH 3, Fe^{+2}(50 mg/l), H_2O_2 (75 mg/l) and 15 min oxidation time. Solar fenton reaction gives 99% SAC reduction for DY199 and DR 167. COD removed 98.3% and 98.4% respectively. Fenton assisted with solar is more efficient than fenton performed in dark.

Sonolytic degradation of disperse dye had been investigated by Verma et al (2015). Potential of chemical additive in combination with ultrasonication was checked for decolorization of mixture of Reactive Black 5 (RB5), Congo Red (CR), and Disperse Blue 3 (DB3).The PS and SS was producing scavenging effect of sulfate redicals to enhance the decolorization efficiency. Maximum 93% reduction is achieved in 8 hour sonication time in waste water containing RB5 dye.

Balla et al., in 2010 investigated potential of electrocoagulation and electrofoltation for removing colour containing reactive, disperse and mixture of dyes in external air-lift reactor. They used yellow terasil 4G, Red terasil 343 150%, Blue terasil 3R02 dye for treatment. They observed that aluminium electrode gives better dye removal efficiency than other metal electrode.

COMPARISON OF DIFFERENT TREATMENT OF ADVANCE OXIDATION:

Comparison of Fenton, Ozone, hypochlorite and electrochemical oxidation are commonly used method for removal of pollution load. Among this best result for disperse dye removal and COD obtain by Fenton Process under the optimum condition of pH and dosage of coagulant.

Ozonation is best treatment for color removal. It gives maximum reduction in apparent color removal in 1 minute at dosage of 50 mg/dm^3 but not sufficient for COD removal while electrochemical oxidation gives 90% of colour removal and 39% of COD removal.

BIOLOGICAL TREATMENT:

Disperse dye effluent is treated with activated sludge in the reactor by Ting-Chi Hsu and Chih-Sheng Chiang (1997). They found that BOD removal rate coefficient k = 0.00063 L/mg BOD/hr, sludge yield coefficient y=0.26 Kg MLVSS yield/Kg BOD removed, and sludge endogenous decay coefficient $K_{D=}$ 0.003 L/day.

Kurade et al. (2015) had observed that bervibacillus laterosporous are effective tool for bioremediation of disperse red 54 concentration of 50 mg/l solution within 48 hours with the help of yeast extract, peptone and supplemented medium. 100% reduction in dye removal is achieved by this method. Whole process is based on enzyme activity of bacteria. Tryosinase, veratyl alcohol oxidase and NADH-DCIP reductase enzymes are responsible for the color removal.

Rukhsana Satar and Qayyum Husain (2009) had used Salt-fractionated bitter gourd (Momordica charantia) proteins and H_2O_2 for removal of disperse dye. Various physical parameters wrer tested by them. Disperse red 17 in presence of 0.4mM phenol remove dye up to 60% and 40% reduction in disperse brown 1 dye achieved. Gouard peroxidase is act as catalyst to recalcitrant dye.

Yuzhu Fu and T Viraraghavan in 2004 prepared polysulphone solid matix made up of immobilized Aspergillus Niger dead fungal biomass in column study. Fungal biomass was immobilized on in form of spherical beads for improvement of adsorption capacity and strength. They used this matrix for acid, basic and disperse dye. Bead adsorbed 0.1 mg/gm disperse red dye.

Anthraquinone dye CI disperse red 15 (DR 15) was treated with yeast P. anomala by Itoh et al (1996).Disappearance of dye was measured by spectrophotometer. He investigated possible pathway for biodegradation of DR 15. Displacement of hydroxyl group result in the PV12 and further reduction in to LQ and 1-HAQ respectively.

Kulkarni et al (2014), had studied Solvent Red 24for degradation. 99±0.8% degradation of Lichen Permelia perlata found. Optimum pH is 8 and temperature is 50^{o}C.

Biosludge generated from water treatment plant containing abilities to adsorb disperse dye and organic matter investigated by sirianuntapiboon et al (2006). They also found that disperse red 60 is more easily adsorbed on bio sludge than disperse blue 60 and this bio sludge can be reused by after being wash with 0.1N NaOH. Disperse dye adsorption is more effective on resting bio sludge than autoclave sludge because disperse dye adsorbed on both living and dead bio sludge. Dye adsorption efficiency can be improved by adding glucose in to the system.

Kadam et al. in 2013 was conducted studied on decolourization and degradation of disperse red 73 adsorbed on sugercan baggases using rhizophoric plant growth promoting bacteria. They used 4 different strains of bacteria like Rhodobacter erthropholis, Azotobacter vinelanddi, Rhizobium meliloti, bacillus magaterium. Among various constrodia rhizobium RARB showed complete decolorization in 48 hours under the condition of 90% moisture content, 30^oC temperature and 6 pH.

Watharkar et al. has carried out studied of potential of ornamental plant for degradation of disperse, disulphonated triphenyl methane textile dye. They used petunia grandiflora Juss for remediation of brilliant blue G dye. Wild and tissue culture species show reduction up to 86%. They also conducted studied on phytotoxicity. No harmful metabolites were found during phyto remediation study.

Disperse dye effluent was studied to remove colour with the help of upflow anaerobic sludge blanket reactor by goncalves et al (2000), reactor was fed by glucose, dye and biodegradable organic matter. They found that USAB is unsuccessful treatment for disperse dye removal even at low concentration.

MEMBRANE TECHNOLOGY:

Nano filter made up of polyamide spiral wound membrane for removal of anthraquinone dye was investigated by askari et al. (2015). pH and dye concentration has most significant effect on disperse 56 removal. 90% reduction is achieved in disperse blue 56.

Disperse dye 73 removal from synthetic textile water by using photocatalytic process combined with micro filtration had been studied by buscio et al. (2015). They choose titanium dioxide and aeroxide P25 were selected as catalyst. They found that using that method good quality permeate can be achieved at pH 4, dye concentration 50mg/l and 2 gm/L TiO_2 loading. By this method 60% and 90% colour reduction and 98% Chemical Oxygen Demand (COD) reduction achieved.Oxidant Species generated during photocatalytic process are key factor for Colour and COD reduction. Major defect of this process is recovery of photocatalyst.

Biotransformation of azo disperse blue 79 was studied by A. cruz and G. Buitron (2000). An anaerobic decolorization using sequential batch biofilter gives 95% dye reduction at 48mg/l concentration in presence of co-substrate in 24 hour and 120 mg/l solution require 72 hours. They found that disperse blue 79 was bio transformed in to amines, was possible reason of decolorization. The amine produced in the first stage was degraded in the aerobic filter in 24 hours.

ACKNOWLEDGMENT: We are thanks to V.P.Science College and Man Made Textile Research Association (MANTRA) for providing detail information about dyes.

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