International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Email:editorijoer@gmail.com http://www.ijoer.in ISSN: 2321-7758
Vol.4., S2., 2016

EPSDIC-2016

ISSN: 2321-7758

# GLOBAL CHANGE AND ENVIRONMENTAL POLLUTION- IMPACT ASSESSMENT FOR MINIMIZING THE POLLUTION

**VISSA MANIKYALA RAO**

Asst. Professor, Swarnandhra College of Engineering and Technology

**ABSTRACT**

Today every aspect of modern living poses potential health risks. The air we breathe, the water we drink ,and the places where we live and work in may be contaminated with toxic substances or chemical additives this is in addition to U.V. light present in sunshine some of our habits such as cigarette smoking ,is clearly related to an increased occurrence of lung cancer. The adverse effects of chemical pollutants in the mutations, birth defects, inherited diseases, and so on.All industrial operations produce some wastewaters which must be returned to the environment. Textile industries produce wastewater, otherwise known as effluent, as a by-product of their production. Effluent from the textile industry is a major source of environmental pollution, especially water pollution. Among the various stages of textile production, the operations in the dyeing plant, which include pre-treatments, dyeing and finishing, produce the most pollution. The textile dyeing wastes contain unused or partially used organic compounds, and high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). They are often of strong colour and may also be of high temperature. When disposed into water bodies or onto land these effluents will result in the deterioration of ecology and damage to aquatic life. Furthermore they may cause damage to fisheries and economic loss to fishermen and farmer, there may be impacts on human health. It is a positive sign that many industries are also making progress in establishing and operating their own ETPs to comply with national and international requirements, and also because of increased personal awareness of the negative impacts of industrial effluent.

**Keywords:** Effluent, Ecology, Pigments, Cellulose Fibers, Photo Catalytic, Absorbent, Deionized, SyzygiumCimin

## INTRODUCTION

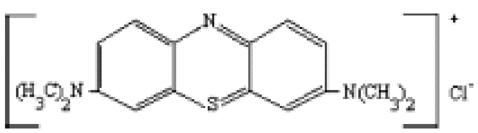
Removal of dyes from polluted effluent is an essential task for environmental protection. Considering both volume and composition, effluent from textile industry was declared as one of the major sources in waste water in ASEAN countries.About 700,000 tonnes and 10,000 different types of dyes and pigments are being produced annually across the world**.**Most of the synthetic dyes are extensively used in several fields such as textile industries, leather tanning, pare production, food technology, agricultural research, light harvesting arrays, petrochemical cells and in hair colorings.Color is a visible pollutant and presence of even minute amount of coloring substance makes it undesirable due to its appearance. Even small quantities of dyes can color large water bodies, which not only affects aesthetic merit but also reduces light penetration and photosynthesis. Dyes may be problematic and produce into toxic amines if they are broken down anaerobically in the sediment due to incomplete degradation by bacteria.[1]Waste water containing dyes not only produce toxic amines by the reductive cleavage of azo (N=N) linkages which causes severe effects on human beings through damaging the vital organs such as the brain, liver, kidneys, central nervous system and reproductive systems.Among these dyes basic azo dyes have the favourable characteristics of bright color, water-fast, simple application and are used extensively in textile industries, but nearly 50 % of the dyes are lost to the effluent after dyeing of cellulose fibres. These dyes cannot be easily removed by conventional waste water treatment systems since they are stable to light, heat, and oxidizing agents and are biologically non-degradable. So they have been identified as problematic compounds in textile effluents.

**MATERIALS**

Commonly used traditional methods to eliminate dyestuffs from textile and dye containing effluents are those of activated carbon adsorption, reverse osmosis, oxidation, ultra filtration, flocculation, color irradiation, coagulation, sedimentation and precipitation.[2]But the above mentioned techniques are ineffective for the removal of brightly colored, water soluble reactive and acid dyes because they show resistence to many chemicals, oxidiging agents and light.[3,4]The **a**ctivated carbon adsorption is choice because of its high adsorption capacity and surface area as well as having micro porous structure ,but its large scale application is restricted due to its high operating costs, problems with regeneration and relatively high price[5]. Chemically treatment process such as photocatalytic degradation process may produce concentrated sludge such as Fentons reagent. Membrane filtration are incapable of treating large volumes**.** Consequently, many researchers have studied the feasibility of using low cost substances as alternative to activated carbon. Materials like zeolite,[6] kaolinite,[7] bentonite,[8]alunite,[9] coal fly ash,[10] baggase fly ash,[11] fertilizer waste,[12] blast furnance slag,[13] agricultural waste residues,[14] red mud [15] and some of the live and dead microbial masses of *Lentinus sajor caju* ,[16]*Rhizopusarrhizus* ,[17]*Aspergillusniger* ,[18]*Funalia trogii,*[19]*Caulerpascalpellformis*[20]etc used in the biosorption of many dyes. Since 1980s, the adaption of agro wastes, live or dead microbial species, including bacteria, algae, fungi are capable of removing the different textile dyes by biosorption, biodegradation, and mineralization. The term biosorption refers to the removal of unwanted organic and inorganic species, which include dyes, metals and odour causing substances by using various agro waste products and microbial biomass through a combination of active and passive transport mechanisms including ion exchange and complexation**.** The literature indicated that the adsorption behaviour of dyes on different adsorbents like zeolite, alunite, baggase fly ash, chemically treated guava leaves had been investigated by using especially batch method [21]**.**

Methylene blue was used as a biosorbent in the following study because of its known strong adsorption onto solids. Methylene blue has a molecular weight of 373.9 g mol, which corresponds to methylene blue hydrochloride with three groups of water. The structure of the dye and its related information is given below.

| | |
|---|---|
| C.I number | 52015 |
| C.I name | Basic blue 9 |
| Emperical formula | $C_{16}H_{18}N_3SCl$ |
| Formula weight | 319.9 |
| Absorption maximum | 665 nm |
| Structure | |



Methylene blue applications:

1. Used in coloring paper
2. Used in coloring leather products
3. Dyeing cottons, wools
4. Used as a temporary hair colorant

**5.** Used in paper stock.

**Biosorbent characteristics:**

| | |
|---|---|
| **Scientific name** | ***Syzygium cumini.L*** |
| **Family** | **Myrtaceae** |
| **English name** | **Java plum** |
| **Hindi name** | **Jamun** |

**Chemical composition of Syzygiumcumini (%) :**

Leaves :cellulose (75%), hemicellulose (15%) Resins (25%), tannins ( 7.5%), Mucilage and other structural Proteins.

Seeds:Fatty oils includes lauric acid (2.8%), Myristic acid (31.7%), palmitic acid (4.7%), stearic acid (6.5%), oleic Acid(32.2%), phenolic compounds like quercetin, ferulic acid,caffeic acid, veratrole. Phytosterols such as B-sitosterol, tannins (6%), like allergic acid, ellagic tannins, corilagin etc.

Advantages of bio-adsorbents:

- Cheap and renewable i.e., Unlimited resources.
- Neutral carbon dioxide balance.
- Easy disposal after use by composting.
- No pollution problems.
- The oil distillated from the leaves is used to scent soap and is blended with other materials in making inexpensive perfumes.
- Medicinal uses of *Syzygum cumini.L* seeds are traditionally used for the treatment of diabeties(daily dose 30 seeds-1.9 gms of the powder).

*Syzygium cumini*.leaves are used to Strengthen the teeth and gums, to treat leucorrhoea, fever, stomachalgia, constipation and to inhibit blood discharge in the faeces.

**METHODS AND MATERIALS**

**Preparation of *syzygium cumini* L. for biosorbents**

The green colored java plum leaves (*syzygium cumini*L.) used in the present study were collected from the college of engineering, Andhra University, Visakhapatnam. The collected leaves were washed with deionised water several times to remove dirt particles. The washing process was continued till the wash water contains no dirt. The washed leaves were then completely dried in sunlight for 20 days. The resulting product was directly used as biosorbent. The dried leaves were then cut into small pieces and powdered using domestic mixie. In the present study the powdered materials in the range of 75-300µm. average particle size were then directly used as biosorbent without any pretreatment.

**Preparation of dye solution:**

The Methylene Blue dye (82% dye content) was obtained from Ranbaxy laboratories limited (India) and used without further purification. A stock solution of 1000mg $L^{-1}$ was prepared by dissolving 1.219 g of dye in 1000 ml of double distilled water which was later diluted to required concentrations. All the solutions were prepared in double distilled water. Solution pH was adjusted by adding HCl and NaoH as required. Concentrations of the dye solutions were determined from the absorbance of the solution at the characteristic wavelength ($\lambda_{max}$ =665nm )of MB using double beam UV-Visible spectrophotometer. Samples were diluted if absorbance exceeds 0.8. Final concentrations were determined from calibration curve.

Percentage dye removal was calculated using the following formula.

$$\% \text{ Removal} = (C_0-C_t)\times 100/C_0$$

Where $C_0$ is the initial dye concentration.

$C_t$ is the dye concentration at any time t.

Specific dye uptake was calculated by

$Q_t = (C_0\text{-}C_t)V/m$ where V is the volume of the dye solution taken in L
m is the mass of the biosorbent in gms.

**Experimental Parameters**:

Batch biosorption equilibrium experiments were carried out by varying pH, initial concentration, temperature, adsorbent dosage and particle size. In each experiment accurately weighed java plum leaf powder was added to 30 mL of dye solution in a 250 mL conical flask and the mixture was agitated at 200 rpm in a shaker. Samples were withdrawn at regular time intervals and centrifuged. The dye concentration in the supernatant was determined using UV spectrophotometer (GBC Avanta Ver 1.32, Australia).

**Effect of solution pH:**

The effect of initial solution pH was determined by agitating 0.1 g of biosorbent and 30 ml of synthetic dye solutions of initial dye concentration 20 mg $L^{-1}$ at different pH values of the solution ranging from 1 to 10 by adding 0.1 N HCl or 0.1 N NaOH. Shaking was provided for optimum time which was obtained in the above experiment at constant agitation speed and at room temperature .The concentration of dye is determined for each case.

**Effect of initial dye concentration:**

To study the effect of initial dye concentration, 0.1 g of biosorbent of 75 $\mu$m average size is taken and 30 ml of synthetic solution of initial dye concentration of 20 mg $L^{-1}$ maintaining optimum pH is mixed with it and it is kept for shaking for 1, 2, 4, 8, 10, 12, 15, 20-60 minutes. Then the same procedure is repeated with 30 ml of stock solution, but with different initial concentrations like 40mg $L^{-1}$, 60mg $L^{-1}$, 80mg $L^{-1}$ and 100 mg $L^{-1}$ keeping the remaining conditions like agitation speed and room temperature constant . Samples are centrifuged and supernatant was analyzed for end concentration.

**Effect of Temperature:**

The effect of temperature was determined by agitating 0.1 g of biosorbent and 30 ml of synthetic dye solution of concentration ranging from 20 mg/L to 100 mg/L at different temperatures of the solution ranging from 303K to 333K. Shaking was provided for optimum contact time at constant agitation speed. The concentration of Methylene blue is determined for each case.

**Analysis of the sample:**

The total dye concentration in solution was analyzed with UV spectrophotometer (GBC Avanta Ver 1.32, Australia) at a wavelength of 665 nm for MB solution.

**RESULTS AND DISCUSSION**

The experimental data on biosorption were obtained batch wise to study the effect of various parameters on the removal of Methylene Blue from the aqueous solutions prepared in the laboratory by using java plum leaves powder (S*yzygium cumini.L*.) The effect of various parameters on the biosorption of Methylene blue were first analyzed graphically and then attempted theoretically to justify the observation made from graphical analysis. All together about 180 experimental runs were made. The parameters studied include:

- Time of contact (t)
- Solution pH
- Initial concentration of dye ($C_i$)
- Size of biosorbent ($D_p$)
- Biosorbent dosage (W)
- Temperature (K)

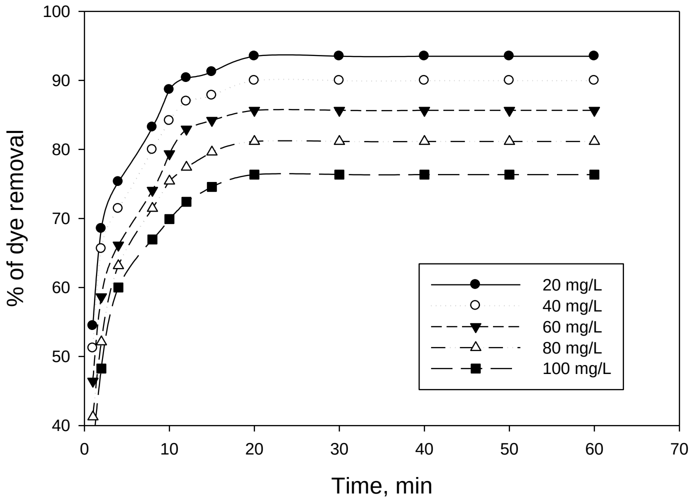



**Fig 1: Effect of contact time on % dye removal of methylene blue dye by *Syzygium Cumini.L.*for various dye concentrations at 0.1 g/30 ml biosorbent concentration.**

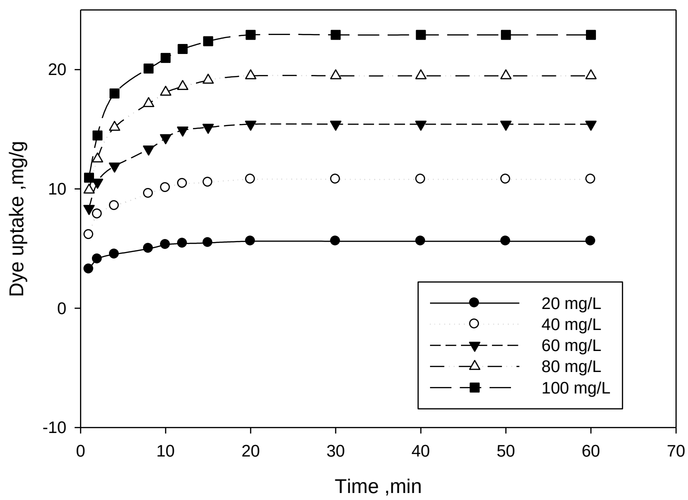



**Fig-2: Effect of contact time on uptake of methylene blue dye by Syzygium cumini.L for various concentrations at 0.1g/ 30 ml of biosorbent concentration.**

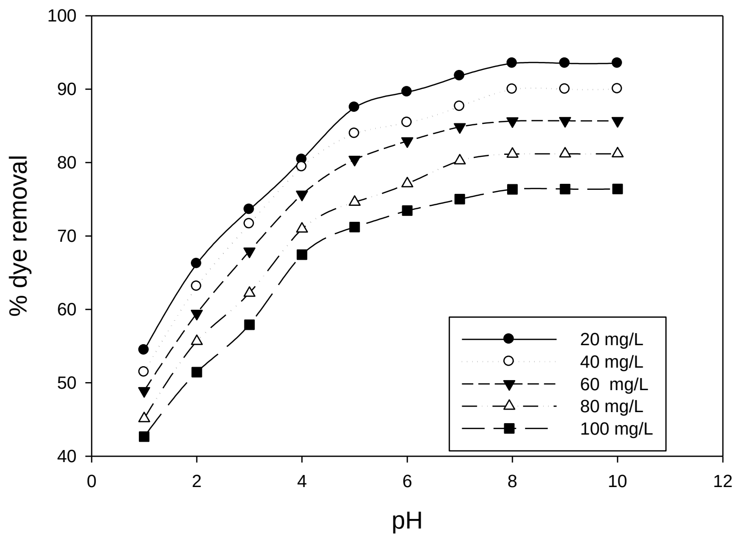



**Fig 3: Effect of pH on % of Methylene Blue dye removal by *Syzygium Cumini L*. for various concentrations of dye at 0.1 g/ 30 ml of biosorbent concentration.**

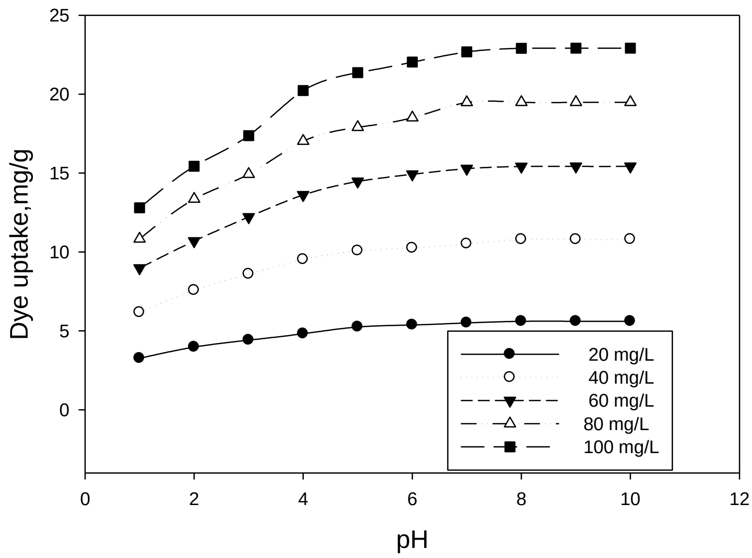



**Fig 4: Effect of pH on amount of Methylene Blue dye uptake by *Syzygium cumini.L* for various concentrations of dye at 0.1 g/30 ml of biosorbent concentration.**

**Comparison of Maximum capacity of *Syzygium Cumini.L* for Methylene Blue dye with other adsorbents**.

| Adsorbent | Methylene Blue q max (mg/g) | pH | Reference |
|---|---|---|---|
| Guava Leaf Powder | 295 | 7.5 | 35 |
| Paspalum notatum | 31 | 8 | 40 |
| Posidonia oceanica | 4.64 | 6-9 | 41 |

| | | | |
|---|---|---|---|
| Caulerpa racemosa | 5.23 | 6.6 | 42 |
| algae(Geledium) | 104 | 6.0 | 43 |
| Activated carbon | 39.7 | 7.2 | 48 |
| Rattan saw dust | 294.14 | 7.0 | 49 |
| Rose wood sawdust | 56.4 | 7.0 | 50 |
| Rice Husk Carbon | 9.4 | 7.2 | 48 |
| Oil Palm Wood | 90.0 | - | 57 |
| Sepiolite | | 6.6 | 58 |
| Neem leaf powder | 8.76 | - | 34 |
| Perlite | 94 | 7 | 67 |
| Coconut Shell carbon | 9.2 | 7.2 | 48 |
| Groundnut Shell carbon | 12.0 | 7.2 | 48 |
| Jute Fibre Carbon | 74 | 8 | 68 |
| Banana Peel | 15.9 | 6-7 | 69 |
| Orange Peel | 13.9 | >7 | 69 |
| Syzygium Cimini (Java Plum) | 24.956 | 8 | Present study |

**CONCLUSIONS**

Experimental data were obtained for removal of Methylene Blue ions using *syzygium cumini*L. as biosorbent. Analyses of results were made for about 180 experimental runs taken. Based on the analysis the following conclusions were made.

1. The biosorption performances are strongly affected by parameters such as initial concentration, pH, biosorbent dosage , biosorbent particle size and temperature.
2. The percentage biosorption of methylene blue increases with increase in contact time.
3. The equilibrium uptake was increased and percentage biosorption was decreased with increase in the initial concentration.
4. The plot of pH versus percentage biosorption shows that the significant biosorption takes place at 8.
5. The percentage biosorption of Methylene blue increases with increase in the biosorbent dosage and dye uptake decreases substantially.

The percentage biosorption of Methylene blue decreases with increase in average particle size of biosorbent.

6. The dye removal data of methylene blue follows the Langmuir model with the best fit.
7. The kinetics of the biosorption of Methylene Blue on *syzygium cumini* L.can be better described with second-order kinetics.
8. The thermodynamic parameters such as free energy change, enthalpy change and entropy changes are calculated and the biosorption process is endothermic in nature.

**REFERENCES**

1. E.Weber, N.L.Wolfe, "Kinetics studies of reduction of aromatic azo compounds in anaerobic sediment/ water system", Environ. Toxi Col. Chem. **6** [911-20]1987.
2. Z.Aksu, "Application of biosorption for the removal of organic pollutants; a review", Process Biochemistry. **40** [997-1026]2005.
3. A.S.Ozaan, A.Ozcan, "Adsorption of acid dyes from aqueous solutions onto acid activated bentonite", J.Colloid Interf.Sci **276** [39-46]2004.
4. Zumriye Aksu, Seyda Sen Cagatey, Ferda Gonen; "Contiuous fixed bed biosorption of reactive dyes by dried *Rhizopus arrizus*: Determination of column capacity". Journal of Hazardous Materials **143** [362-371]2007.

5. Z.Aksu, S.Tezer, “Biosorption of reactive dyes on the green algae *ChlorellaVulgari*”, Process Biochemistry **40** [1347-1361]2005.
6. S.A.Ong, E.Toorisaka, M.Hirata, T.Hano, “Treatment of azo dye orange II in arebic and anaerobic SBR system”. Process Biochemistry **40** [2097-2914]2005.
7. T.Robinson, G.McMullan, R.Marchant, P.Nigam, “Remediation of dyes in textile effluent . A critical review on current treatment technologies with proposed alternative”, Bioresource Technology **77** [247-355]2001.
8. F.Kargi, S.Ozmihci, “Biosorption performance of powdered activated sludge for removal of different dye stuffs”, Enzyme Microbial Technology.**34** [267-271]2004.
9. R.M.Liversidge, G.J.Llyod, A.J.Wase, C.F.Forster,"Removal of basic blue 4from aqueous solution by linseed cake” Process Biochemistry.**32** [473-477]1997.
10. B.Armagan, M. Suresh, M.S.Celik ,"Equlibrium studies on the adsorption of azo dyes onto zeolite",Desalination **170** [33-39]2004.
11. R.G.Haris, J.D.Wells, B.B.Jhonson,"Selective adsorption of dyes and other organic molecules to kaolinite and oxide surfaces",Colloid Surfa. A: Phisiochem. Eng.Aspects**180 [1-2]**[131-140]2001.
12. A.S.Ozcan, A.Ozcan,"Adsorption of acid dyes from aqueous solution onto acid activated bentonite",Journal of Colloid Interface Science. **276 [1]** [39-46]2004.
13. S.Tunali, A.S.Ozcan, T.Gedikbey,"Kinetics and equilibrium studies for the adsorption of acid red 57 from aqueous solution onto calcinated- alunite",Journal of Hazardous Materials, 2006, in press.
14. P.Janos, H.Buchtova, M.Ryznarova,"Sorption of dyes from aqueous solution onto fly ash",Water Resource. **37** [4938-4944]2003.
15. V.K.Gupta, D.Mohan, S.Sharma, M.Sharma,"Removal of basic dyes (Rhodamine B and Methylene Blue) from aqueous solution using baggase fly ash" Sep.Sci. Technol. **35** [2097-2113]2005.
16. A.K.Jain, V.K.Gupta, A.Bhatnagar, Suhas,"Utilisation of industrial waste products as adsorbents for the removal of dyes” Journal of Hazardous Materials **B101**[31-42]2003.
17. K.R.Ramakrishna, T.Viraraghavan,"Use of slag for dye removal",Waste Manage. **17** [483-488]1998.
18. A.Mittal, L.krishnan(Kurup), V.K.Gupta,"Use of waste materials – bottom ash and de-oiled soya, as potential adsorbents for the removal of Amaranth from aqueous solutions",Journal of Hazardous Materials. **B117**[171-178]2005.
19. V.K.Gupta, S.Suhas, I.Ali, V.K.Saini,"Removal of Rhodamine B , fast green, and Methylene blue from waste water using red mud an aluminium industry waste",Ind. Eng. Chem. Res.**43**[1740-1747]2004.
20. M.Yakup Arica, G.Bayramoglu,"Biosorption of Reactive red – 120 dye from aqueous solution by native and modified fungus biomass preparations of Lentinus –Sajor – Caju",Jounal of Hazardous Materials. [2007] in press.
21. Z.Aksu, Seyda.S.Cagatay,"Investigation of biosorption of GemezolTurquise Blue- G Reactive dye by dried Rhizopus Arrhizus in batch and column systems",Seperation and purification Technology. **48** [24-35]2006.