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DEGRADATION OF]MCIBV 14: USING HETEROCYCLIC DYE BASED PHOTOCATALYST METHYLENE BLUE IMMOBILIZED RESIN DOWEX 11 AND TIO_2 NANO PARTICLES MIXTURE 1:1

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Abstract
A solar energy based sustainable treatment of Megenta C.I. Basic Voilet 14 (MCIBV 14) dye using heterocyclic dye based catalyst MBIRD 11 - TiO_2 nano particle (1:1 ratio) based photocatalyst for degradation of MCIBV 14 present in water of textile effluent. We apply MBIRD 11 - TiO_2 catalyst for degradation of MCIBV 14 and we found that in 3 hours irradiation of sunlight we get more than 99.90 % transparent water. We also observed effects of different parameters on rate of degradation like sunlight, catalyst loading, pH etc. We observed that MBIRD 11 - TiO_2 catalyst is fully capable to remove MCIBV 14 by sunlight-catalytic action. We can reuse same catalyst many times. We also hypothesize the applicability of *MBIRD 11 - TiO_2* for treatment of polluted water of rivers like the Ganga, the Yamuna etc.

Key Words: Photocatalysts, Solar energy, MBIRD 11 - TiO2, Non-Biodegradable, Organic, Pollutants

1. **Introduction**

The complete degradation of MCIBV 14 is a crucial problem and a challenging task. These dye pollutants are non-biodegradable and can't eliminate completely by conventional treatment methods. Advance Oxidation Process (AOP) heterogeneous photo catalyst have shown its effectiveness to degrade MCIBV 14 including other dye pollutants. Effluent of all textile industries contain hazardous dyes which are non-bio degradable and harmful for flora and fauna. Common traditional techniques are requires huge amount of electrical energy and hazardous chemicals. The renewable energy based photocatalytic process have potential to degrade MCIBV 14 including azo dyes, pesticides etc. Scientists believes that in photo catalysis proc sensitization of photocatalyst through light energy, electrons migrates from balance band to conduction band. Holes are formed at balance band and these holes can generate $OH^{\cdot}$ (hydroxyl radicals). These $OH^{\cdot}$ radicals have high oxidation capacity. These Hydroxyl radicals react with organic molecule and process of oxidation starts.

. Heller[i] pointed out that, all the extensive knowledge that had gained during the study of semiconductors, photo electrochemistry during 1970s to1 980s have assisted the development of photo catalytic process. When Frank and bard[ii-iii] first successfully examined the possibilities of using ZnO 1:1 to decompose cyanide in water in 1977. Hsu Chin Cheng,[iv] Wu. L. carried out degradation of Methyl Orange under UV Light (300 nm) illumination using NnO as photo catalyst. Legrini et al [v] in 1993 suggested that the purification of water with TiO_2 photocatalyst in presence of UV radiation have many advantages; A. L. Ahmad and S. W. Puasa[vi] worked reactive dyes degradation from an aqueous solution by comb ined coagulation/micellar-enhanced ultrafiltration process. Guittonneau et al [vii] studied the oxidation of many volatile polychlorinated hydrocarbons, such as chloromethanes($CHCl_3$, CCb) and chloroethanes in different comb inations in diluted aqueous solutions. D. Mendez-Pazetet et al, [viii] is carried out many anaerobic treatments of azo dyes Acid orange 7 under Fed batch and continues condition. it has been noted that the removal rate of dye pollutant increases when some glucose is added to reaction mixture.X. Wang etal [icx] enhanced photocatalytic hydrogen evolution by prolonging the lifetime of carriers in ZnO/CdS heterostructure. I.Poulios and Tsachpinis[x] investigated the Photo catalytic degradation of Reactive Black 5, and used different semi conducting oxides, TiO_2, UV-100 TiO_2, ZnO, and TiO_2/WO_3. Four parallel black light blue fluorescent tubes were used as the UV-light source. It received much attention in the transformation and complete mineralization of environmental pollutants. Many more scientist also studies photo catalytic degradation and influencing factors.[xi-xxxvii]

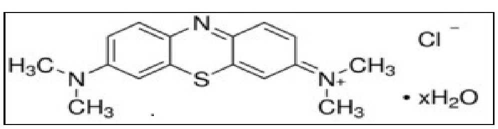
We observe the effect of different parameters on rate of removal of organic pollutants. These common parameters are amount of catalyst, pH, Light intensity; all the sets are observed for 4 hour.

2. **Materials and Methods:**

2.1 Methylene Blue Dye:: *Methylene Blue* Dye (Sigma-Aldrich)

Colour Index Number : 52016

Molecular Weight : 319.85



IUPAC Name: 3,7-bis(Dimethylamino)phenazathionium chloride,Basic Blue 9,Tetramethylthionine chloride

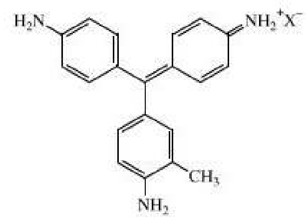
CAS Number : 122965-43-9

Molecular Formula : $C_{16}H_{18}ClN_3S \cdot xH_2O$

2.2 TiO_2 nano particles Anatas form

2.3 Dye name : Megenta C.I. Basic Voilet 14

Structure



Magenta C.I. Basic Voilet 14

IUPAC Name: 2-methyl-4,4'-[(4-imino-2,5-cyclohexadien-1-ylidene)methylene]dianiline hydrochloride; rosaniline chloride; rosaniline hydrochlorid

Molecular Formula: C20H19N3.HCl

Analytical methods:

The change in dye concentration observed by UV-Visible spectrophotometer at 30 minute time interval. A Continues treatment process- solar energy based treatment in sunny day time. We Recover 99.9% transparent water.

A. Observation 1: Bio degradability of pollutants (without catalyst): No biodegradability

B. Observation 2 : Dark test to find out the action of catalyst in dark: No action

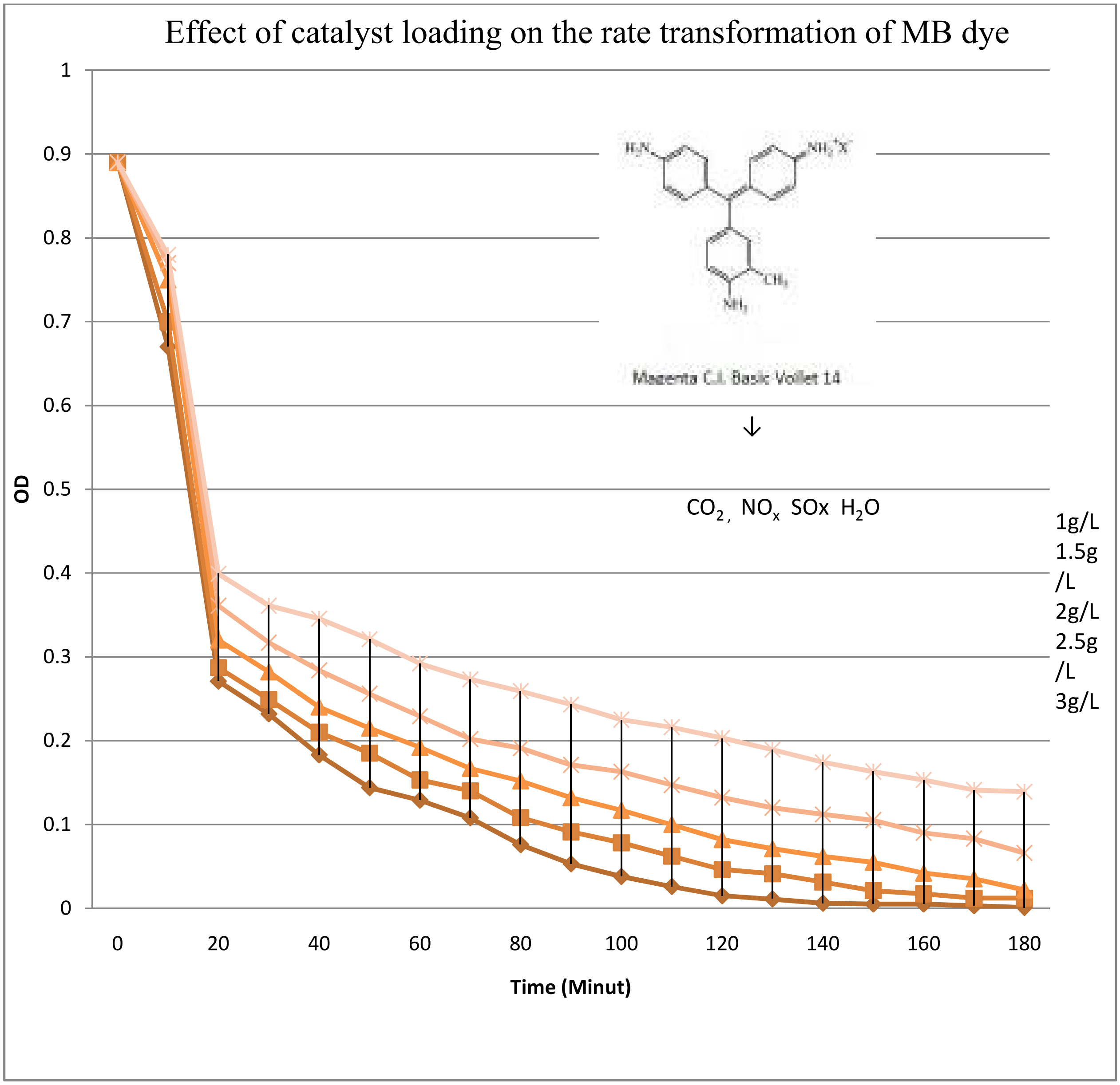
C. Observation 3: Heterogeneous photo catalyst: Transform in to 99 percent transparent water.

We reuse same catalyst again and again and found that it works well every time.

3. **Result and discussion**

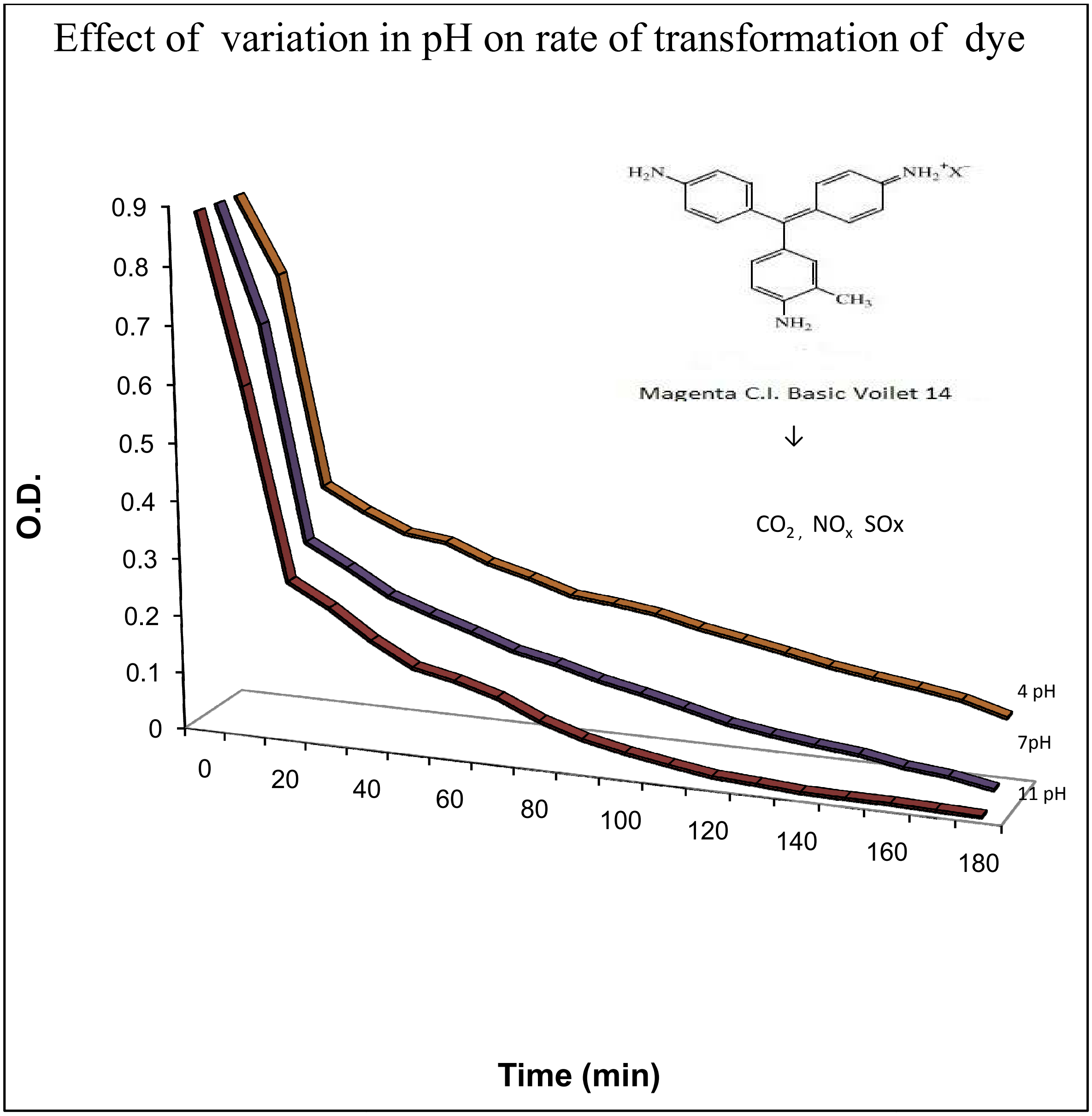
3.1 Probable Chemical Reaction of This Degradation:

Probably electronic transitions VB to CB and through ISC. Intermolecular electronic transition between organic pollutants, catalysts, hydroxyl radicals etc, Intermediate oxidants (IMO) like holes, hydroxyl radicals and supra oxide ions (o^-) are produced. These IMO d*3.2 Effect of catalyst:* Degradation process enhances as we increase amount of catalyst.



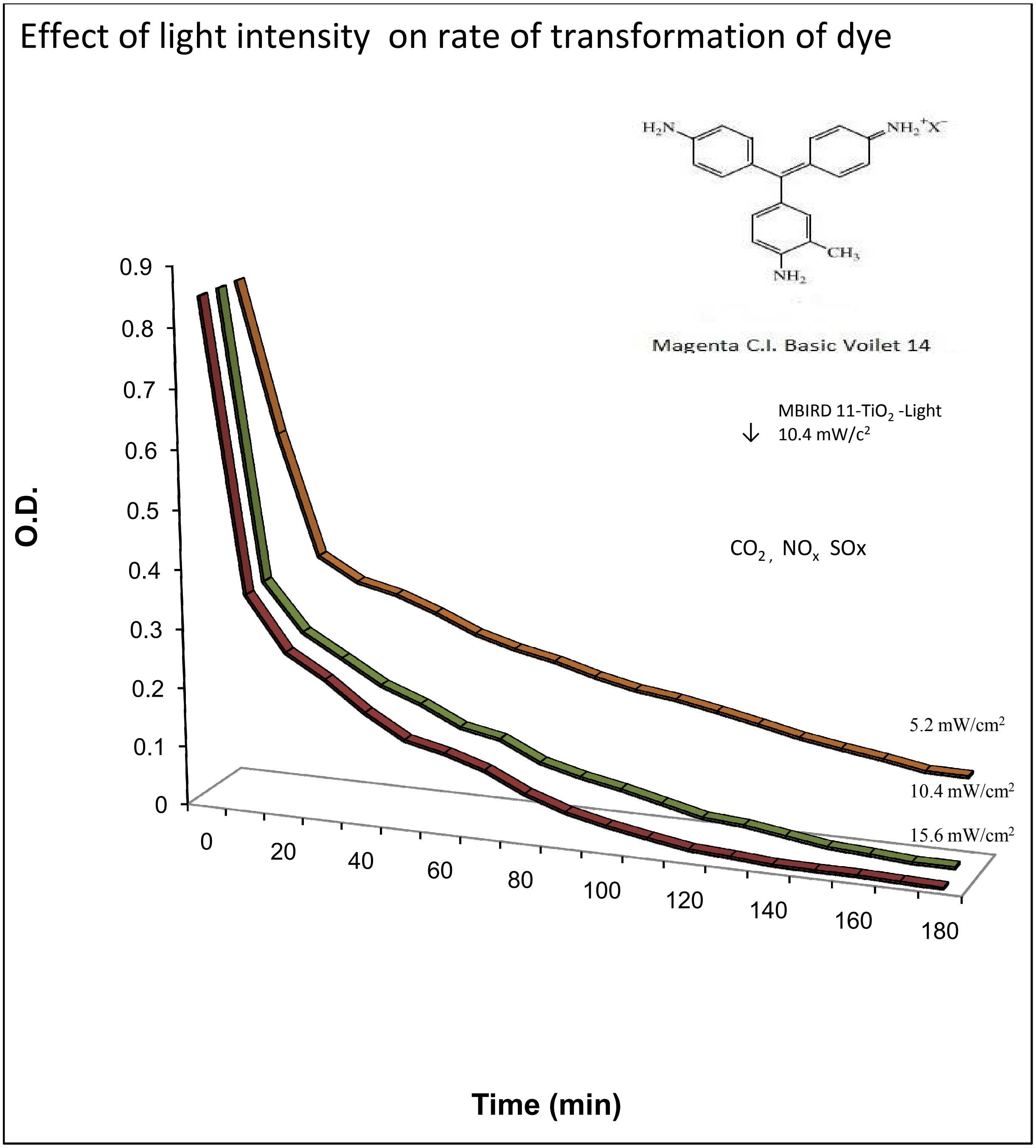
Graph -i Effect of catalyst loading on the rate of transformation (Solution volume: 1L, Light intensity UV-Visible lamp 10.4 mW/cm^2 , pH 7, Aeration from bottom 3L/Minute, Temperature 303K)

*3.3 Effect of pH :*The rate of degradation increases fast, in pH range 7.5 to 11



Graph - ii Effect of pH on rate of transformation (Solution volume: 1 L ,Catalyst 2 g/L, Light intensity 10.4 mW/cm^2, Aeration from bottom 3L/Minute, Temperature 303K)

3.4 Effect of light Intensity : We found, as light intensity increases rate of degradation also increase.



Graph-iii Effect of variation of light intensity on transformation (Solution volume: 1L, Amount of Catalyst 2 g/L, pH 7, Aeration from bottom 3L/Minute, Temperature 303K)

Effect of dissolved oxygen: Degradation process increases with increase dissolve O_2.

4. **Conclusion**

After long observation we conclude that

1. Technique is based on renewable and non-polluting source energy sunlight
2. Cost efficient because we can reuse same catalyst many times and technique is based on renewable source of energy.
3. Effect of catalyst: Increase with increase catalyst loading.
4. Effect of pH : Faster in pH range 7 to 11
5. Effect of light Intensity : Increase with increase light intensity
6. Effect of dissolved oxygen: Increase with increase dissolve oxygen.
7. This photocatalytic technology has vast potential to control water. After long observations we hypothesize its applicability at large scale.

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