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RESEARCH ARTICLE

COMPARISON OF EFFECT OF VARIOUS PHOTOCATALYSTS ON WASTE WATER TREATMENT

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ABSTRACT

Photocatalytic waste water treatment process has potential as a low cost environment friendly treatment technique which has an additional advantage of sustainability and zero waste scheme. This advanced oxidation technology removes persistent organic compounds and microorganisms in water / waste water. I have performed experiments by using Titanium dioxide and Zinc oxide photocatalysts to compare their effect on waste water of reactive turquoise blue dye industry with UV-C light 66W and discussed results.

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INTRODUCTION

New regulations for toxics and priority pollutants frequently cannot be met by conventional technology. Other physical chemical technologies must therefore be applied. Chemical oxidation can be applied in industrial waste-water pretreatment for reduction of toxicity, to oxidize metal complexes or as a post treatment for toxicity reduction or priority pollution removal. Attempt to extend UV-C light 66W absorption of various photocatalysts to eliminate COD, TOC, Color from 50 ppm reactive turquoise blue dye (RB-21-H_2GP) waste water. Thus, experiments were carried out using various photocatalysts.

Literature review

Heterogeneous photocatalysis: Heterogeneous Photocatalysis is a technology based on the irradiation of a semiconductor photocatalyst e.g. Titanium Dioxide (TiO_2), Zinc Oxide (ZnO), Cadmium Sulfide (CdS), Photo catalyst have electrical conductivity between those of metals and insulators and have narrow energy gaps (bond gap) between the filled valence band and the conduction band. A number of photochemical processes occur this band gap excitation of a photocatalyst. When illuminated with light of sufficient energy the photocatalyst particle becomes part of a particulate system capable of mimicking a microphoto electrochemical cell at which efficient oxidative processes may take place. The efficiency of these process is largely determined by following five factors.

1. Efficient absorption of light with minimal entropy production.
2. Fast charge separation after light absorpyion.
3. Separation of products in order to prevent reverse reactions.
4. Adjustment of redox potentials of the exited states to the redox reactions which store the energy.
5. Long term stability.

The primary photochemical act, subsequent to near- UV light (wave lengths <400nm) absorption by TiO_2 particles, is generation of electron-hole pair. Chemically the hole associated with valence bond levels is constrained at:

$$TiO_2 + h\upsilon \rightarrow TiO_2(e^- .....h^+) \rightarrow e^-cB + h^+vB$$

The surface or sub surface site of photocatalyst in the region where light is adsorbed.

Objective of study

Study of effect of comparision of photocatalysis ZnO & TiO_2 is carried out for reactive turquoise blue dye industry waste water by using UV-C light of 66W. Comparison of these and other photocatalysts can be carried out for any water / waste water by this or other light sources to find out suitable photocatalyst for the best economical treatment.

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Equipments/Instruments used

COD analyzer, TOC analyzer, UV-C germination lamp, UV-visible spectrophotometer, photocatalytic reactor 450 watt

Experimental Conditions

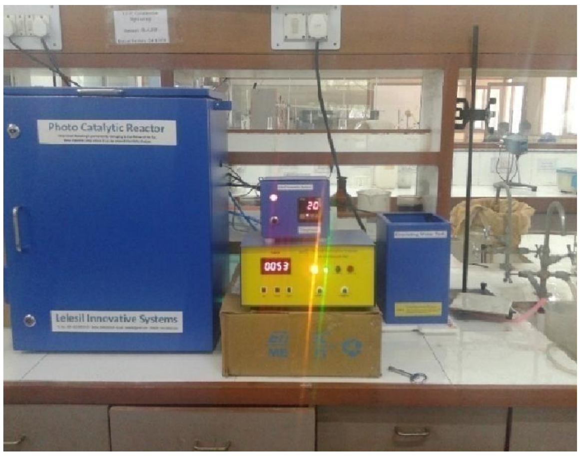
For my study I had selected conditions given below.

- Catalyst: ZnO and TiO2 separately for comparison, other conditions are kept constant.
- Dosage of catalyst: 800mg
- Room temperature (around 40`C)
- Continuous stirring
- pH neutral
- source: UV-C light 66W
- Sampling time: 30 min in dark for equilibrium and 2 hr experiment.
- Dye solution: Initial stock solution 1g/l of reactive turquoise blue dye (RB-21- H_2GP) 50 ppm solution, 500ml.
- After experiment sampling 15 min.
- UV-C germination lamp.

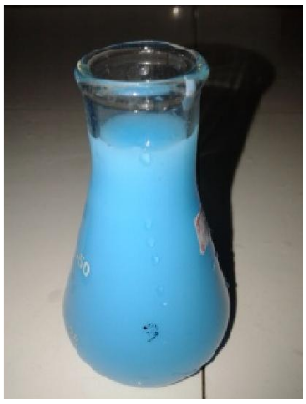
Procedure and Photographs of Experimental Setup

2 hrs run time set in UV-Visible photocatalytic reactor of 450 Watt. After that COD, TOC and color was measured.

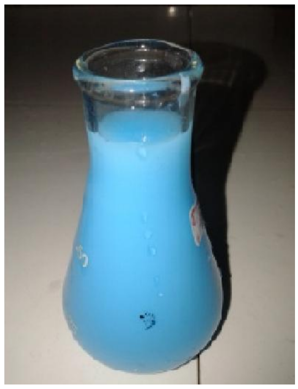
Addition of TiO_2semiconductor 800 mg



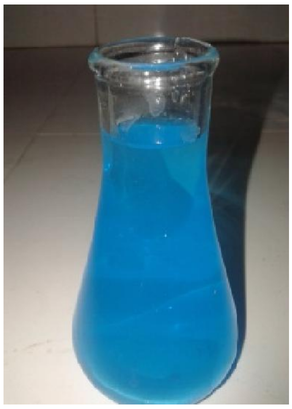
2 hrs run time set in UV-Visible photocatalytic reactor of 450 Watt



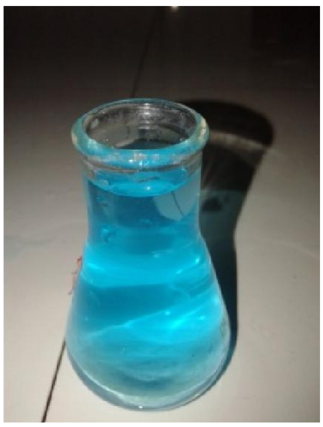
After experiment sampling 15 min



1 h



1h and 30min



2h

RESULTS AND DISCUSSION

Results of experimental study is shown in the table.
Initial Data for 50 ppm dye : COD-352 mg/L
TOC-8.844 ppm
COLOR-0.298 Absorbances

Experimental results with ZnO and TiO_2

S.No.	Catalyst	%COD	%TOC	%color removal
1	TiO_2	80	89	98.22, in 15 min
2	ZnO	48	56.49	96 in 15 min

I have found out reduction in %COD, %TOC & color for both catalysts TiO_2 & ZnO.

For my experimental study TiO_2 gives 32% more reduction in COD around 32% more reduction in TOC and 2% more reduction in color in 15 min.

Conclusion

By the same procedure, we can compare the effect of other photocatalysts as well. Here in these experiments cost of TiO_2 and ZnO are almost same but TiO_2 is more effective compared to ZnO. So we can select TiO_2 for the present waste water.

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