**International Journal of Advanced Chemistry Research**
www.chemistryjournals.net
Online ISSN: 2664-679X; Print ISSN: 2664-6781; Impact Factor: RJIF 5.22
Received: 15-9-2020; Accepted: 20-10-2020; Published: 25-10-2020
Volume 2; Issue 2; 2020; Page No. 53-55

# Photo catalytic degradation of copper surfactant

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**DOI:** https://doi.org/10.33545/26646781.2020.v2.i2a.63

**Abstract**
A large number of surfactant containing waste water are discharged into the environment, resulting in harming aquatic life, polluting the water and endangering human health. Therefore, it is important to monitor and control emissions of surfactants in environmental water. Photo catalytic degradation of copper (II) mustard thiourea complex has been carried out in the presence of light and observed spectrophotometric ally. The propose of this study was to assess the efficiency of photo degradation of copper (II) mustard thiourea complex with various concentration of complex in non-aqueous and non-polar solvent benzene. The synthesized complex was characterized by IR, NMR, ESR spectroscopy. Reaction rate is chosen as the photo catalytic activity, which has been controlled by several factors such as catalyst dose, initial concentration of complex, light exposure, polarity of solvent etc. Rate of reaction has been increases with increase in initial concentration and further decreases which was observed by decolourization of complex solution. An original experimental work, the photo catalytic degradation of the CMT using ZnO and benzene as non-polar solvent, is comprehensively described as a case study, in order to provide sufficient guidelines to deal with this subject, in a rational and integrated way. The degradation process of copper surfactant was examined by UV-IR spectroscopy. This photo degradation system may be practical for treatment of wastewater containing surfactants.

**Keywords:** Photocatalytic degradation, copper (II) mustard thiourea complex, decolourization

## Introduction

A Surfactant development to promote the home washing detergents and prosperity, and the development of household detergents also stimulates the surfactant growth. Surfactants are widespread in several human activities because of a series of excellent performances like wetting and emulsifying. Therefore, it is important to monitor and control emissions of surfactants in environmental water. Photo catalytic processes are well recognized due to its scientific and technological implications. Without the concourse of elevated temperatures and pressures and using light as the energy input this process can allow the possibility of performing chemical reactions aimed at the elimination of pollutant, the production of fuels, the inactivation of bacteria etc.. Heterogeneous photo catalysis on semiconductor surfaces has attracted a lot of attention due to its vast and important applications as degradation and complete mineralization of organic contaminants, air purification etc. [1-3] structure of the surfactant Bio-surfactants are widely applied in the petrochemical industry, and are extensively used for emulsification, emulsion breaking, wetting, foaming and anti-static. They also have important applications in the textile, cosmetics, pharmaceutical, food and other fields.

Recently, in photo degradation of dyes many transition metals play an important role. Amido black -10 B and Bismarck brown - R were bleached by photo-fen ton reagent [4]. Azure B dye can be successfully degrade using copper hexacyanoferrate (II) as semiconductor which effectively photo degrade different dye molecule to colourless less toxic products [5]. Photo catalytic degradation of dyes (methylene blue) using $TiO_2$ was studied [6]. Copper (II) pyridyl complex has been synthesized for adsorption as well as photo catalytic degradation of methylene blue (MB) and Rhoda mine B (RhB) dyes and characterized through FT-IR, LC–MS, FE-SEM, TEM and EPR studies [7]. The effects of surfactants on aquatic animals A certain toxicity of surfactants will pass into the animal through animal feeding and skin penetration way. When the surfactant concentration in water is too high, surfactants can enter the gills, blood, kidney, pancreas, gallbladder and liver, and produce aquatic toxicity effect spectroscopic studies and physico- chemical studies of CMT complex was studied earlier [8].

In the present work we have focused on the optimization of degradation of copper (II) smustard thiourea complex in the presence of zinc oxide and in various parameters and its bioactivity.

## Experimental

Copper (II) mustard thiourea complex was prepared by refluxing copper mustard soap with thiourea ligand in 1:1 ratio using benzene as solvent for one hour. For this copper mustard soap was prepared by refluxing (direct metathesis) mustard oil in pure form with alcohol and 1N KOH solution for 3 hour.[9] After that neutralization of excess KOH was done by 1N HCl. Saturated solution of copper sulphate was then used for conversion of neutralized soap into copper soap.

The photo catalytic degradation was studied in the presence of semiconducting zinc oxide and light source (200 W tungsten lamp) for irradiating the complex solution in visible range. The intensity of light was measured with the help of a solarimeter (Suryamapi model CEL India Model SM 201). The optical density of the solution was recorded at regular time interval by using U.V. visible spectrophotometer (SYSTRONIC MODEL 106).

## Results and Discussion

Copper soap and their complex are abbreviated as follows:
Copper- mustard soap (CM)
Copper-mustard -thiourea complex (CMT)
Different rate affecting parameters for % degradation were varied to obtain the maximum rate of degradation for photo catalytic degradation of CMT complex. The results for a typical run are presented in Table: 1 and graphically represented in Figure: 1.

**Table 1:** A Typical Run

| Time hrs | 2+log O.D. | Optical density O.D. |
|---|---|---|
| 0 | 1.47 | 0.298 |
| 4 | 1.26 | 0.186 |
| 8 | 0.908 | 0.081 |
| 12 | 0.939 | 0.087 |
| 16 | 0.897 | 0.079 |
| 20 | 0.929 | 0.085 |
| 24 | 0.88 | 0.076 |

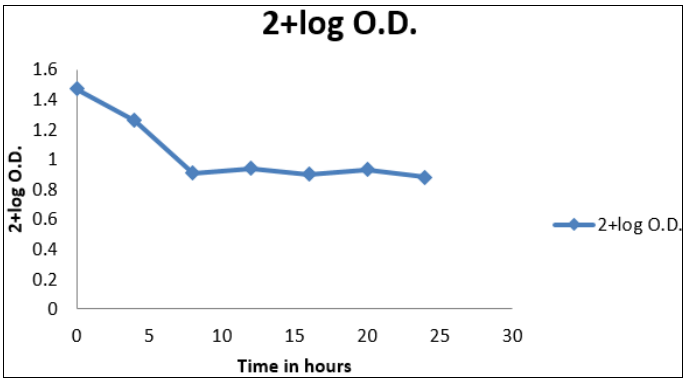


**Fig 1:** A Typical run

## Percent- degradation of CMT complex

Photo catalytic degradation of CMT complex was carried out by using ZnO as semiconductor under light of 34 $mWcm^{-2}$. Complex degradation was initially identified by colour change. Initially the colour of complex was dark green- blue which was gradually fades to light green after 2 hours. Further light green colour of solution was disappears slowly and solution becomes almost colour less after completion 18 hour light exposure.

Percentage degradation of CMT complex was estimated by the following equation [10].

% degradation = $A_o$-$A_t$ / $A_o$ *100.

Different rate affecting parameters for % degradation were varied to obtain the maximum rate of degradation for photo catalytic degradation of CMT complex.

## Percent degradation

As the initial concentration of CMT increases, more molecules are available for excitation and energy transfer [11].

This dependence is perhaps related to the formation of several monolayers of CMT complex on the ZnO surface, which is favored at high concentrations till the critical level is reached, the surface is not completely covered leading to constant reaction rates [12].

On the other hand, the decrease in degradation efficiency with the increase in concentration occurs due to several reasons. As the initial concentrations of the complex increase more and more, complex molecules have been adsorbed on the surface of the catalyst and significant amount of UV absorption has been hindered by CMT molecules. Hence, the penetration of light to the surface of the catalyst decreases. Results are represented in Table – 2, and graphically shown in figure-2

**Table 2:** Percent degradation and Concentration Effect

| Concentration | A0-At / A0*100 |
|---|---|
| 0.0005 | 76.69863 |
| 0.0007 | 74.24242 |
| 0.0009 | 54.71698 |
| 0.0011 | 53.00353 |
| 0.0012 | 44.79 |

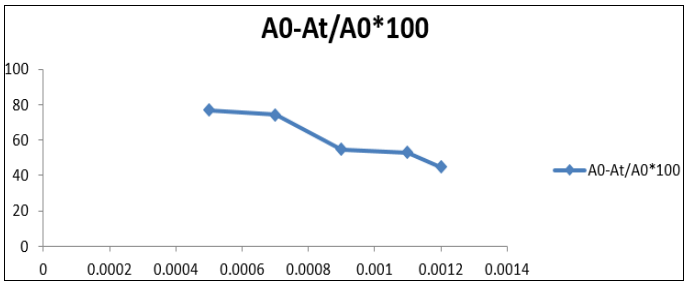


**Fig 2:** Percent degradation and Concentration Effect

## Conclusion

The decolouration of the copper soap complexes also suggests that some of $Cu^{+2}$ ion of the complex may reduced to $Cu^{+}$ or $Cu^{0}$ to some extent during the process of degradation by trapping photo generated electron in the system. The literature survey reveals that the presence of oxygen may also affect the photo degradation of complex molecules as the main oxidation products of the esters are keto or hydroxy compounds.

Series of experiments were conducted for analysis the photo catalytic degradation of CMT in various conditions. The rate of photo catalytic degradation of CMT increases by increase in concentration but after a certain limit it decreases. Percent degradation of CMT complex also affected by different parameters and shows variation in rate of degradation. These investigations may conclude that the CMT complex derived from natural oil had an inhibitory effect on the growth of some bacteria.

## Acknowledgements

The authors pay their sincere gratitude to Principal, S. D. Govt. College Beawar and Principal, S.P.C Govt College Ajmer for laboratory facilities.

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