Print ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Removal of Azo carmine G dye from aqueous solutions by employing Aluminum oxide

Hazim Y. Al gubury*, Zainab H. Khudheyer
Department of Chemistry, College of Science for Women, Babylon University, Babylon, Iraq
***Corresponding author: E-Mail: h.yahya40@yahoo.com**

ABSTRACT

This project include study, removal of Azo carmine G dye from wastewater using aluminum oxide as catalyst and UV irradiation. Different parameters has been investigated such as the effect of catalyst loading, the influence of initial dye concentration, and the effect of intensity of light in order to reach to the optimum operational conditions in which the best removal of dye. The highest removal efficiency of Azo carmine G dye was indicated at 0.09 gm/100cm^3 mass of aluminum oxide and 15 ppm of Azo carmine G dye. photocatalytic degradation of Azo carmine G dye was favorable in the 8.22 mW/cm^2 light intensity. The percentage efficiency of removal Azo carmine G dye equals 92.86%.

KEY WORDS: Photoefficiency, aluminum oxide, Azo carmine G, Removal.

1. INTRODUCTION

In the last decay, dyes has been represent essential source for pollution in the world. The scientists working hard to removal the environmental pollution and human health hazards, by using different methods for treatment the dyes (Matira, 2015). Now day, interest has been shifted toward the advanced oxidation processes (AOPs) for removal many pollutants such as Azo caramine dye. AOPs beginning with generation of hydroxyl radical to oxidize organic pollutants (Carlos, 2015; Hazim, 2016). In this project heterogeneous has been employed for the removal a wide range of environmental contaminants .In this work when the aluminum oxide particle irradiated with energy equal or greater than band gap the electrons promote from the valance band to conduction band to created photo electrons leaving positive holes in valance band. The dyes and other pollutants react with high active species super oxide and hydroxyl radicals on the surface of the aluminum oxide. Photoelectrons in the conduction band react with adsorbed oxygen producing the highly reactive superoxide radical ion (Abdullah, 2016). The positive hole in the valance band reacts with adsorbed water to producing hydroxyl radical then react with pollutants (Sin-Li, 2016).

2. MATERIALS & METHODS

Experimental Section:

Materials: The aluminum oxide was obtained from sigma-Aldrich. Azo carmine G dye was purchased from sigma – Aldrich .All chemicals were used without further purification.

Photocatalytic experiments: The photocatalytic degradation of Azo carmine G dye has been investigated in glass photoreactor, which consists of the cylindrical annular – type reactor consisted of two parts. The first part was an outside thimble, running water was passed through the thimble to cool the reaction solution. Owing to the continued cooling, the temperature of the reaction solution was maintained at room temperature. The second part was an inside thimble and the reaction solution (100 cm^3) was put in the reaction chamber. The removal of dye was conducted under 125W low-mercury lamp. All experiments of removal processes of dye have been performed by mixing 0.09 gm/100 cm^3 of the catalyst with 15 ppm of the dye solution. In order to ensure adsorption equilibrium between surface of catalyst and dye, the suspension solution was kept under stirring in the dark for 30 min. The solution of dye was bubbled with air (10cm^3/min) during the irradiation. 2 cm^3 of suspension reaction mixture was withdrawn every 10 min, then centrifuged at 4000rps to remove any residual aluminum oxide particles. All samples taken was analysed at maximum absorption band by UV-vis spectrophotometer.

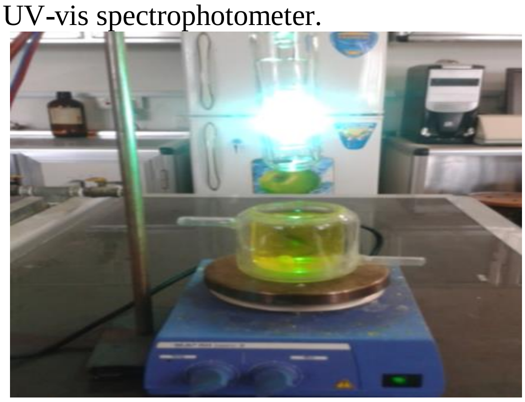

Figure.1. Main parts of the photocatalytic cell used in removal of Azo carmine G dye

3. RESULTS AND DISCUSSION

The effect of Aluminum oxide loaded masses on the photocatalytic degradation of Azo carmine G dye: Loaded masses of aluminum oxide was first parameter has been investigated at range (0.02- 0.35 gm/100 cm^3), to reach optimum degradation efficiency .The optimum conditions in which these experiments has been done include 15 ppm Azo carmine G dye, 10cm^3/min flow rate of an air bubble ,at room temperature 298 K . The results has been noted in Figure 2. When the amount of loaded masses of aluminum oxide increases the number of active sites available for the generation of highly reactive radicals increased, there for the removal of dye increased until reach to 0.09 gm/ 100 cm^3 which represent optimum value in which the best removal of dye. Above the optimum value of catalyst the removal of Azo carmine G dye decreases due to the decrease of light penetration and increase of light scattering. The interception of the light by the suspension solution, in such case a part of catalyst surface area decreased slightly or approach constantly (Junwei, 2010; Molly, 2016; Ruwaida, 2016; Pardeep, 2016; Hazim, 2016; Madhusudhana, 2016).

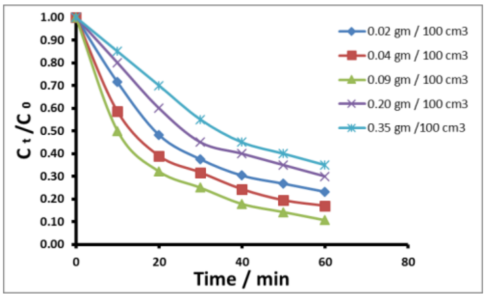

Figure.2. Effect of loading mass on removal of Azo carmine G dye using UV radiation, initial condition: 15 ppm Azo carmine G dye

The Effect of initial concentration of Azo carmine G dye on removal processes: The removal of Azo carmine G dye has been conducted by using different initial Azo carmine G dye concentration in the range (15- 50 ppm). These experiments was carried out at range (0.09gm/100 cm^3), the suspension solution was irradiated with 8.22 mW/cm^2 intensity of light, flow rate of air bubble 10 cm^3/ min, at room temperature and 0.09 gm/100 cm^3 of aluminum oxide as a catalyst. As illustrated in Figure.3, the removal of Azo carmine G dye decreases with increased the initial concentration of Azo carmine G dye because the active site of aluminum oxide catalyst doesn't change, so when the concentration of dye increases and cover all active sites that can cause reduced generation of an electron-hole pair which subsequently reduces the removal of dye. The optimum concentration of dye was 15 ppm the greatest removal of dye because the Azo carmine G dye was cover the largest area of the aluminum oxide particles, therefore absorbed maximum exciting photons to generate higher concentration of the activated catalyst (Alyaa, 2016; Hazim, 2015; Mohammed, 2016) .

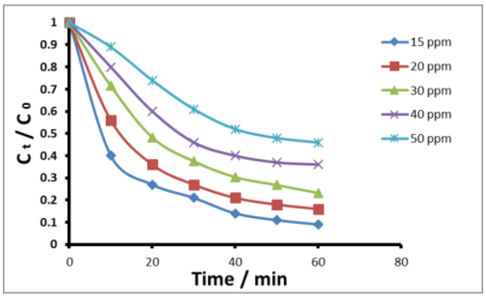

Figure.3. Effect of Azo carmine G dye concentration on removal process under UV irradiation, initial condition: amount of Aluminum oxide = 0.09 gm / 100 cm^3

The effect of light intensity on removal of Azo carmine G dye using Aluminum oxide: Light intensity was last parameter investigated in this project, include performed series experiments for study the removal of Azo carmine G dye at range (2.22– 8.22) mW/cm^2. The rate of removal Azo carmine G dye, was conducted at 0.09 gm/cm^3 loaded mass of aluminum oxide with 15 ppm of Azo carmine G dye, 10cm^3/min flow rate of an air bubble at room temperature as shown in Figure.4. The increasing of light intensity lead to increase the removal Azo carmine G dye from wastewater because increased electron–hole formation which was required for the electron transfer from the valence band to the conduction band of catalyst (Maria, 2015; Hazim, 2015; Zaied, 2016; Hazim, 2016). The optimum value of light intensity 8.22 mW/cm^2 in which the high removal of dye and the removal efficiency equal to 92.86 % as shown in Figure.5.

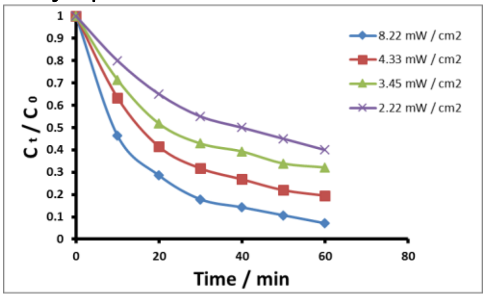

Figure.4. The change of (C_t / C_0) with irradiation time at the different light intensity with 0.09 gm/100cm^3 of Aluminum oxide, on removal of Azo carmine G dye

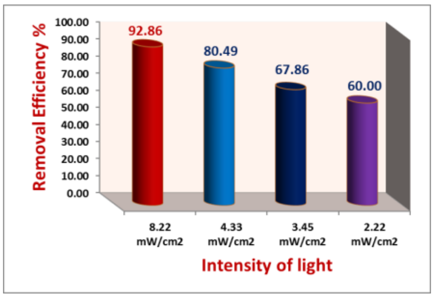

Figure.5. The change percentage of removal Efficiency with irradiation time at different light intensity, initial Azo carmine G dye concentrations = 15 ppm, the amount of loaded mass of Aluminum oxide = 0.09 gm / 100 cm^3

4. CONCLUSION

The experiments has been carried out in the absence of light and aluminum oxide no reaction occurs. The photocatalytic degradation of Azo carmine G dye depended on the amount of catalyst dosage and the optimum value equal 0.09 gm/100 cm^3 of aluminum oxide with 15 ppm concentration of Azo carmine G dye as optimum value and light intensity 8.22mW/cm^2 and 10 cm^3/min bubble of air. Removal processes decrease with increase concentration of Azo carmine G dye due to the decrease of the concentration OH^- adsorbed on the catalyst surface. Removal process of Azo carmine G dye increases with the increase of light intensity. The percentage efficiency of removal Azo carmine dye equals 92.86 %.

5. ACKNOWLEDGMENT

I sincerely thank for the University of Babylon, College of Science for Women, for providing the necessary infrastructural facilities during my research.

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