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Degradation Colors of *Congo Red* with Zno Catalyst Using Photosonolysis Method

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Abstract :

Research that has been carried out on the degradation of *Congo Red* dye by photosonolysis using a ZnO catalyst aims to determine the effect of degradation time and the effect of adding catalyst mass to Congo Red degradation. The range of degradation time used ranged from 30 minutes to 150 minutes while the catalyst mass used was 0.05 grams to 0.25 grams of ZnO. Uv-Vis spectrophotometer measurement results obtained the maximum wavelength (didapatkanmax) of *Congo Red* at 498nm with an absorbance of 0.191. In the variation of the degradation time, the optimum time was obtained at 60 minutes which was 82%, while the mass variation of ZnO carried out at the optimum time obtained the highest result at the addition of 0.25 grams of ZnO with a percent degradation (%D) of 87%. In this study, the presence of hydroxyl radicals produced in the photosonolysis process plays an important role in degrading methyl red dye.

Keywords: Degradation, *Congo Red*, ZnO Catalyst, Photosonolysis

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I. INTRODUCTION

The development of the textile industry in Indonesia is currently growing rapidly. Currently, a common industrial process uses textile dyes to color their products. Because this industry also uses large amounts of water in the process which can produce colored waste and has high toxicity so that it has harmful effects on our ecosystem, due to the presence of synthetic chemical dyestuffs. . At the time of dyeing synthetic dyes, not all of them can be absorbed by the clothes so that the rest of the waste juice is disposed of in landfills or loose waters. These dyes are at risk of causing health problems, such as skin irritation, eye irritation, and even worse, causing cancer [8].

dye *Congo Red* is one of the synthetic dyes that is widely used in the textile industry. Its presence in the aquatic environment can damage and affect various living things in it because of its high toxicity. Therefore, it is necessary to take serious handling of the waste so that it is safe with low toxicity to be discharged into open waters [9].

Many conventional methods and technologies are currently used in the removal of colored waste in water. Industry is classic and does not lead to the high total destruction of dyes we can do to deal with textile or artificial dye waste. Therefore, it is necessary to develop new treatment methods that are more effective in removing dyes from wastewater. The advanced oxidation process (AOP) is an alternative technique for destroying dyes in industrial water and this process is relatively new. They were developed to meet the increasing demand of effective wastewater treatment, among others the first physical methods such as adsorption, reverse osmosis deposition, the second chemical methods(ozonation,correlation,photosonolosis).Based on this method, a fairly effective method that we can use is the photosnolysis method because this method is one of the advanced oxidation processes (AOPs) methods, namely by combining one of the photolysis and sonolysis methods with the addition of a semiconductor catalyst in the photosonolysis process [6].

I. dyedegradation *Congo Red* uses a semiconductor catalyst, namely ZnO. ZnO is a semiconductor substance that is often used as a photocatalyst which has a band gap of 3.37 eV and ZnO can be used as a photocatalyst and applied to degrade waste produced by dyes which are very efficient in degrading a pollutant[3].The use of ZnO as a catalyst can function to remove or degrade dye waste faster. The advantage that can be obtained from the use of ZnO is that it can absorb a larger fraction of the light spectrum compared to other semiconductor catalysts such as TiO2 degradation [1]. process *Congo Red's* can be influenced by the percentage of the mass of ZnO catalyst and the variation of the time used.

The use of ZnO catalyst has proven to be effective in degrading a dye compound found in textile industry wastewater. And based on previous research, the maximum irradiation time to degrade one of the azo dyes, namely Methylene blue which has a concentration of 10 ppm with the help of a ZnO catalyst by photosonolysis carried out for 120 minutes is able to produce a degradation percentage of 94.55%. The maximum pH value obtained in this method is pH 7 with a degradation percentage of 96.83%) [7].This proves that the use of ZnO catalyst in photosonolysis is effective in degrading dyestuffs in industrial wastewater.

From the description above, I as a writer are interested in conducting research on "Degradation ofDyes *Congo Red* using the Photosonolysis Methodwith ZnO Catalyst". Degradationis Congo Red influenced by the length of time of degradation and the percentage of ZnO catalyst used. This research is expected to provide education and solutions to reduce the impact of dyestuff waste produced by the industry, especially for the textile industry itself so as not to dispose of waste in an inappropriate place which has a negative impact on the surrounding environment.

II. METHOD

A. Tools and Materials

The equipment used in this research is a series of tools in the form of a box in which there are 3 UV lamps with a wavelength of 254nm and a power of 15 watts from the Germicidal Yamano brand and ultrasonic (45 kHz) from the Ultrasonic cleaner Sunshine Csp 889, UV-Vis spectrophotometer from the Agilen 8543 brand. Other equipment: beakers, measuring flasks, erlenmeyer, and other standard equipment.

The materials used in this research areDyes *Congo Red*, ZnO Catalyst, and Aquades.

B. Research procedure

1. MakingDyes Solution The *Congo Red*

Waste model ofdye solution is *Congo Red* obtained by dissolving 0.2 grams ofpowder *Congo Red* in 1000 mL of distilled water. So that obtainedmother liquor *Congo Red* with a concentration of 200 ppm. 50 mL of the mother liquor was pipetted and diluted with distilled water to the limit of 1000 mL to obtain asolution *Congo Red* with a concentration of 10 ppm.

2. Degradation Congo Red by Photosonolysis Method

Prior to the degradation,dye samples were *Congo Red* measured for maximum wavelength (λmax) using UV-Vis spectrophotometry in the wavelength range of 400-800nm.

3. Degradation of *Congo Red* with Time Variations by Photosonolysis

A total of 80 mL of 10 ppm sample solution was put into a 250 mL beaker, then added 0.1 grams of ZnO, after that it was placed into a box that had been assembled with a 45 watt UV lamp and sonified with a ultrasonic frequency 45 KHz power 50 watts for 30 minutes. Followed by an interval of 60, 90, 120 and 150 minutes.

4. Degradation ofSolution *Congo Red* with Mass Variation by Photosonolysis

A total of 80 ml of sample solution was put into a 250 ml beaker then added 0.05 grams of catalyst after that it was placed into a box that had been assembled with a 45 watt UV lamp and sonified with ultrasonic frequency of 45 KHz 50 watts of power at the optimum time that has been obtained previously. The same treatment applies to the addition of 0.1 gram, 0.15 gram, 0.2 gram and 0.25 gram catalyst.

C. Data Analysis Techniques The data

Obtained in the study in the form of absorption of methyl red solution was measured using a UV-Vis instrument. The analysis was carried out by comparing the remaining test solution before and after degradation as well as the comparison of radiation time and addition of catalyst variation. The

Percentage of degradation (% D) was calculated by the equation:

$$\% \boldsymbol{D} = \frac{\boldsymbol{A_0} - \boldsymbol{A_t}}{\boldsymbol{A_0}} \boldsymbol{x}\ \mathbf{100}\ \%$$

Where , Ao (cm-1) is the initial absorbance, At (cm-1) is the absorbance at time.

III. RESULTS AND DISCUSSION

1. Degradation of *Congo Red* with variations in radiation time using the photosonolysis method

The results of measuring the absorbance of the Congo Red solution using a UV-Vis spectrophotometer obtained an initial absorbance (Ao) of 0.191 at a wavelength of 498nm. Furthermore, *Congo Red* which has been degraded by the addition of 0.1 gram ZnO with time variations by photosonolysis is measured for absorbance then the percent degradation (% D) of the *Congo Red* solution can be determined.

In the following figure, it can be seen the effect of the degradation time on Congo Red by photosynthesis:

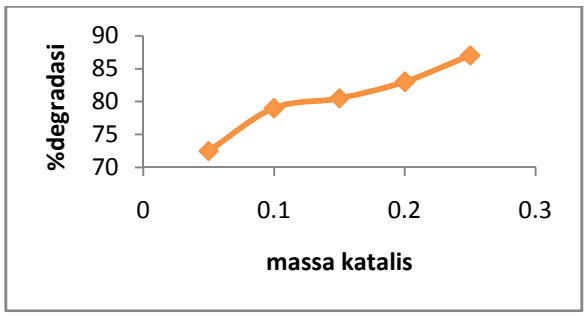

Figure 1. The curve of the effect of the degradation time on thedye solution Congo Red using a ZnO catalyst by photosonolysis

Figure 1 shows a radiation time of 30 to 150 minutes so that the percent degradation increases. Based on the results of the calculation of %Ddye solution, the *Congo Red* 10 ppmhighest was 93% at 150 minutes and the lowest %D was 73% at 30 minutes.

The optimum degradation time was obtained when the time at which thedye sample solution *Congo Red* experienced a stable percentage of degradation or did not experience too significant changes. optimization of radiation degradation time of *Congo Red* showed that the optimum time of degradation ofdye *Congo Red* occurred at 60 minutes. The percentage of degradation shows that the longer the photosonolysis process, the higher the percentage of degradation caused by the hydroxyl radicals produced in the process [4].

The high percentage of degradation obtained indicates that there has been intermolecular contact between *Congo Red* and the ZnO catalyst, resulting inmolecules *Congo Red* being degraded by hydroxyl radicals produced from the photosonolysis process. The fotosonoliss method is a combination of photolysis and sonolysis processes where in the photolysis process there is an interaction between water molecules and UV/Visible radiation, while in the process a mechanical wave is generated by influencing the cavitation effect on water [6].

2. Degradation *Congo Red* by variation of the catalyst mass using the photosonolysis method

The photosonolysis process with variations in catalyst mass was carried out as an effort to increase photocatalytic activity and see whether or not there was an effect of adding catalyst ondegradation *Congo Red.* The effect of variations in the catalyst mass on thedegradation process was *Congo Red* carried out by varying the catalyst mass, namely 50 mg, 100 mg, 150 mg, 200 mg, and 250 mg.

Based on the measurement results ofabsorbance, it *Congo Red* can be seen that the absorbance value of *Congo Red* after being degraded decreased in the mass of the catalyst with a mass variation of 50 mg to 250 mg. Decrease of absorbance makes% D of *Congo Red* increases, it is because the amount of H_2O_2 generated that react with OH radicals in the process of sonication which produce radical hidroperoksi [6]

Based on the calculation of% D solution of *Congo Red* 10 ppm which has been degraded using the photosonolysis method, the highest %D is 87% at a catalyst mass of 250 mg and the lowest %D is 72.5% with a catalyst mass of 50 mg. The curve of the influence of the catalyst mass on the percentage ofdegradation *Congo Red* can be seen in Figure (2).

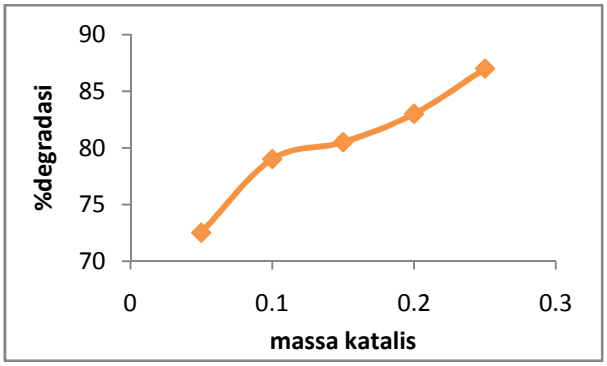

Figure 2.degradation curve *Congo Red* using ZnO catalyst by photosonolysis

The degradation curve shows that there is an increase in the % degradation from the addition of 0.05 grams of ZnO to the addition of 0.25 grams of ZnO. The highest percentage of degradation was found in the addition of 0.25 grams of catalyst, which was 87%. The photocatalytic activity of ZnO catalyst is caused by the movement of electrons from the

valence band to the conduction band under UV radiation and cavitation waves. The electrons in the conduction band can reduce oxygen molecules to produce oxide radicals and the holes produced in the conduction band can react with hydroxyl ions to form hydroxyl radicals[1].This is a strong oxidative radicals which can transform organic molecules into CO_2 and H_2O so that the increased percent degradation characterized by a decrease in absorbance.

The highest percentage of degradation obtained from thedegradation *Congo Red* 10 ppmusing the photosonolysis method with the help of a ZnO catalyst was 87% at the addition of a 0.25 gram catalyst mass, while the lowest degradation percentage of 72.5% was obtained at the addition of a 0.05 gram catalyst mass.

IV. CONCLUSION

Based on the research that has been done, it canbe concluded. Degradation*CongoRed* using the photosonolysis method obtained the Optimum time at 60 minutes with a degradation percentage of 82%. Degradation of *Congo Red* using the photosonolysis method obtained the best percentage of degradation at a catalyst mass of 250 mg, which is 87%.

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