

CERTIFICATION OF APPROVAL

**DEGRADATION OF ORGANIC EFFLUENT COMPOUND, DYE (MALACHITE GREEN OXALATE) BY USING HYDROGEN PEROXIDE (H<sub>2</sub>O<sub>2</sub>)**

by

Girisha Ganeson

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Approved by,



(AP Dr. Thanabalan Murugesan)

PROF. DR. T. MURUGESAN  
Chemical Engineering Department  
Universiti Teknologi PETRONAS

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

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## CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



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GIRISHA GANESON

## **ACKNOWLEDGEMENT**

I would like to show my highest gratitude and appreciation to my supervisor, AP Dr Thanabalan Murugesan for assisting me throughout my Final Year Project. He had helped me a lot and gave me a strong support. I would also like to thank my parents for their moral support. Not forgetting my friends who were there to support me. The lab technician also assisted me in my experiments and had been a big help for me. Once again, thank you all for making my project a success.

## ABSTRACT

This project is about degradation of organic compound in the waste water by using chemical. It is a method of oxidizing organic compounds in aqueous solution by using hydrogen peroxide ( $H_2O_2$ ). Concentrations of organic compounds are very high in the waste water. So oxidizing agent such as hydrogen peroxide which has a higher oxidizing potential is used in degradation of organic compounds in waste water. Hydrogen peroxide is used as the oxidizing agent because it is cheap and easy to handle. Oxidation removes harmful and toxic substances. These methods are very important because can degrade organic pollutants to non toxic substance such as carbon dioxide and water.

The degradation of dye is chosen as the organic compound to be tested on. Malachite Green Oxalate is the tested dye. Pollution of water by dyes is a serious problem in the developed countries. Many industries use dyes to color their products. These highly colored components when discharged with wastewater in the water bodies stop reoxygenation capacity if the receiving water and cut-off sunlight, thereby upsetting biological activity in aquatic life. Furthermore, the expanded use of dyes has shown that some of them and some of their reaction products, such aromatic amines, are highly carcinogenic. The removal of dyes (color) from wastewater is, therefore, a challenge to the related industries. The parameters that are tested on are: (i) The initial dye concentration (ii) The hydrogen peroxide concentration (iii) Stirring/ Speed (iv) Temperature

The manipulated variable is the concentration of hydrogen peroxide. The concentration is varied and the corresponding level of degradation is tested at constant time. The initial dye concentration and the temperature is also varied to investigate the effect on dye degradation. The concentration of dye at certain time is measured using UV Spectro

## TABLE OF CONTENTS

<b>ABSTRACT . . . . .</b>	<b>i</b>
<b>CHAPTER 1: INTRODUCTION . . . . .</b>	<b>1</b>
1.1 Problem Statement . . . . .	1
1.2 Objectives and Scope of Study . . . . .	1
<b>CHAPTER 2: THEORY . . . . .</b>	<b>2</b>
2.1 About dye and environmental effect . . . . .	2
2.2 About malachite green dye . . . . .	3
2.3 Oxidation of organic compounds . . . . .	5
using hydrogen peroxide (H <sub>2</sub> O <sub>2</sub> )	
<b>CHAPTER 3: METHODOLOGY . . . . .</b>	<b>7</b>
3.1 Effect of different H <sub>2</sub> O <sub>2</sub> concentration . . . . .	7
on dye degradation	
3.2 Stirring effect on dye degradation . . . . .	8
3.3 Temperature effect on dye degradation . . . . .	8
3.4 Dye concentration effect on dye degradation . . . . .	9
3.5 To use the UV spectrophotometer . . . . .	9
3.6 List of Equipment and Chemical used . . . . .	10
<b>CHAPTER 4: RESULTS AND DISCUSSION . . . . .</b>	<b>13</b>
4.1 Results . . . . .	13
4.1.1 Effect of different H <sub>2</sub> O <sub>2</sub> concentration . . . . .	14
on dye degradation	
4.1.2 Stirring effect on dye degradation . . . . .	21
4.1.3 Temperature effect on dye degradation . . . . .	25
4.1.4 Dye concentration effect on dye degradation . . . . .	29
4.2 Discussion . . . . .	33
4.2.1 Effect of different H <sub>2</sub> O <sub>2</sub> concentration . . . . .	33
on dye degradation	
4.2.2 Stirring effect on dye degradation . . . . .	34

	4.2.3	Temperature effect on dye degradation	35
	4.2.4	Dye concentration effect on dye degradation	36
<b>CHAPTER 5:</b>		<b>CONCLUSION AND RECOMMENDATION</b>	<b>37</b>
<b>REFERENCES</b>	.	.	<b>38</b>
<b>LIST OF FIGURES</b>	.	.	<b>39</b>
<b>LIST OF TABLES</b>	.	.	<b>40</b>
<b>LIST OF DIAGRAM</b>	.	.	<b>41</b>

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 PROBLEM STATEMENT**

At this time, there is a critical need for removing trace amounts of toxic organic compounds from industrial waste waters without transferring these compounds to the atmosphere or to burial sites. At present, oxidation by incineration or chemical means is the only method of accomplishing true detoxification. Incineration of dilute organic solution is expensive due to the energy required for evaporation of water. Moreover incineration causes formation of toxic by-products such as dioxin derivatives in the off-gases. So the chemical oxidation process is better in removing organic effluents. The chemical that can be used for degradation is hydrogen peroxide ( $H_2O_2$ ).

#### **1.2 OBJECTIVE AND SCOPE OF STUDY**

The objective of this experiment is to remove dye, an organic effluent by oxidization using chemical which is hydrogen peroxide. The dye that I am using in this research is malachite green oxalate. First the optimum hydrogen peroxide concentration is found. Then with that concentration, the dye is tested with other parameters: stirring speed temperature and different dye concentration. UV spectrophotometer is used to measure the absorbance of the solution after degradation and the percent of degradation is found by concentration of dye at every 10 minutes until the dye degrades.

## **CHAPTER 2**

### **LITERATURE REVIEW / THEORY**

#### **2.1 ABOUT DYE AND ENVIRONMENTAL EFFECT**

Dyes are usually highly structures organic substances rather difficult to degrade. These complex aromatic compounds are normally used to color fibers, utensils, plastics, food among others. Up to the first half of the XIX century, all of the dyes were derived from leaves, roots, fruits and flowers of different plants. The azo dyes are the largest class of dyes used in the textile industry, consisting of 60-70 % of all synthetic dyes produced. They are characterized by having one or more azo group ( $R_1-N=R_2$ ). They belong to numerous families of synthetic dyes, quite resistant to natural degradation and with a proven carcinogenic and mutagenic character. The presence of dyes in effluents if not adequately treated can cause serious problems to the environment, contaminating rivers and groundwater, particularly the azo dyes, due to resistance of microbiological degradation. The presence of dyes in effluents is easily perceptible even in low concentration.

Pollution of water by dyes is a serious problem in the developed countries. Many industries use dyes to color their products. These highly colored components when discharged with wastewater in the water bodies stop reoxgenation capacity if the receiving water and cut-off sunlight, thereby upsetting biological activity in aquatic life. Furthermore, the expanded use of dyes has shown that some of them and some of their reaction products, such aromatic amines, are highly carcinogenic. The removal of dyes (color) from wastewater is, therefore, a challenge to the related industries.

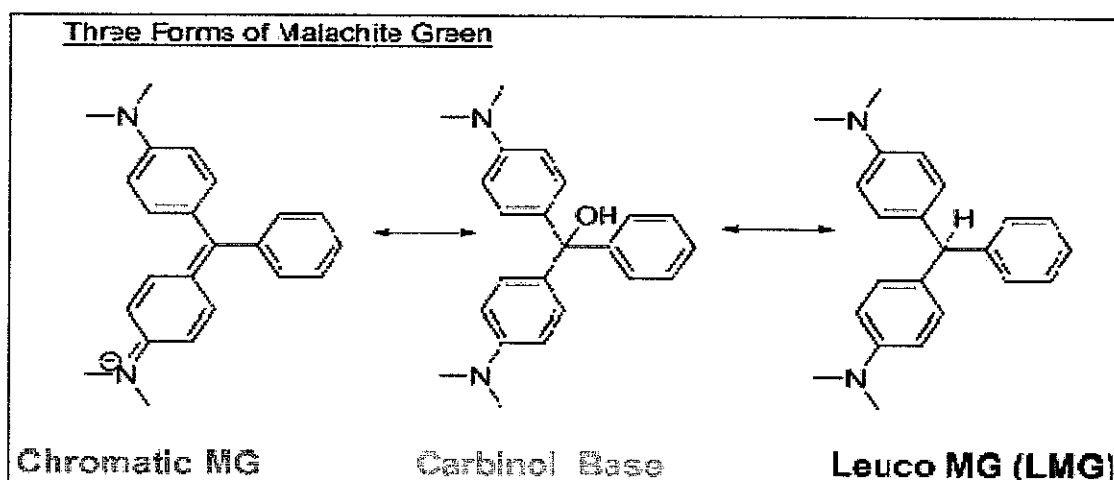


There are many kinds of dyes available in the market. In view of their chemical structure, dye can be characterized as azo dyes, anthraquinone dyes, heterocyclic dyes and etc. Dyes can also be characterized according to their application method into vat dyes, reactive dyes, direct dyes, acid dyes, basic dyes, disperse dyes, etc.

## 2.2 ABOUT MALACHITE GREEN DYE

Malachite green, also called basic green 4 or victoria green B, is a toxic chemical primarily used as a dye. When diluted, it can be used as a topical antiseptic or to treat parasites, fungal infections, and bacterial infections in fish and fish eggs. It is also used as a bacteriological stain. Malachite green can also be used as a saturable absorber in dye lasers, or as a pH indicator between pH 0.2 - 1.8. However this use is relatively rare. Leuco-malachite green (LMG) is used as a detection method for latent blood in criminalistics. Hemoglobin catalyzes the reaction between LMG and hydrogen peroxide, converting the colorless LMG to the chromatic form of malachite green. Therefore, the appearance of a green color indicates the presence of blood.

Figure 1 below shows three forms of malachite green oxalate structure.



**Figure 1: Three Forms of malachite green oxalate**

The structures of compounds explain their chemical and biological properties, such as how well they might be absorbed in the body and how reactive they are. Malachite green is commonly known in a form called the chromatic form in which it is a green dye. However, as it is absorbed into the body, it is converted by body mechanisms into other forms that are equally important for us to consider. The first form is called the carbinol form, which is important because it spreads across cell membranes faster. When it is inside the cell, it is then metabolized into a form called leuco-malachite green. This form is known by researchers to be toxic in addition to the fact that it is retained in the body for a longer period than the chromatic form of malachite green.

Malachite green is used to dye materials like silk, leather, and paper. The chemical known as malachite green does not actually contain the mineral malachite, the name comes from the similarity of color. The use of this substance has been banned in many countries as a suspected carcinogen. Lab tests revealed that rats fed malachite green at the concentration of 100 ppb for longer than 2 years showed signs of tumors.

Malachite green and its major metabolite, leuco-malachite green has been reported to have mutagenic and carcinogenic effects. Culp SJ in her recent article published in Mutation Research mentions that rats fed malachite green experience “a dose-related increase in liver DNA adducts” along with lung adenomas. Leuco-malachite green causes an “increase in the number and severity of changes”. As leuco-malachite green is the primary metabolite of malachite green and is retained in fish muscle much longer, most intake of malachite green would be in the leuco form. During the experiment, rats were fed up to 543 ppm of leuco-malachite green, an extreme amount compared to the average 5 ppb discovered in fish. After a period of two years, an increase in lung adenomas in male rats was discovered but no incidences of liver tumors. This shows that although adducts are formed, they have “little mutagenic or carcinogenic consequence.” Therefore it could be concluded that malachite green caused carcinogenic symptoms but a direct link between malachite green and liver tumor could not be proved.

## **2.3 OXIDATION OF ORGANIC COMPOUNDS USING HYDROGEN PEROXIDE (H<sub>2</sub>O<sub>2</sub>)**

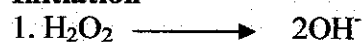
The organic compounds in the waste water treatment are removed by using hydrogen peroxide as the oxidizing agent. The organic compounds in the waste water are such as phenol, chlorobenzene, 1, 2-dichlorobenzene, 1, 4-dichlorobenzene, benzene, 1, 2 - dichloroethanes and various other organic compounds. Oxidation removes harmful and toxic substances. These methods are very important because they can degrade organic pollutants to non toxic substance such as carbon dioxide and water.

Oxidizing agent such as hydrogen peroxide which has a higher oxidizing potential is used in degradation of organic compounds in waste water. Addition of oxidant agents such as hydrogen peroxide increases the degradation of organic compounds. The hydrogen peroxide's concentration influences the degradation of organic compounds in waste water. It is a linear correlation between hydrogen peroxide concentration and degradation rate. When the concentration of the oxidizing agent is increased above the optimum value, the reaction rate deviates from the linear dependence. This is traced back to a significant increase of the OH-radical concentration. The increase promotes a reconversion of the OH-radicals and takes partly away the just formed OH-radicals which are needed for the oxidative degradation process. At higher concentrations of hydrogen peroxide the combination of the just formed OH-radicals proceeds faster than the desired oxidation of organic compounds. Increasing amounts of hydrogen peroxide causes two different effects, an increase of the degradation rate and therefore shorter treatment times as well as increasing cost for oxidizing agent.

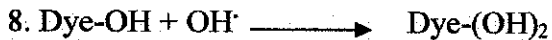
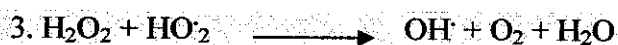
Figure 2 below shows mechanism for degradation of dye with hydrogen peroxide.

**Reaction Step**

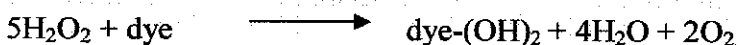
**Initiation**



**Hydroxyl radical propagation and termination**



**Overall reaction**



**Figure 2: Mechanism for degradation of dye with hydrogen peroxide**

## **CHAPTER3**

### **METHODOLOGY**

The experiment was done on the optimum concentration that is between the range of spectrophotometer as we use UV spectrophotometer to read the concentration of the dye that has degraded. The flow of the experiment is as follows:

#### **3.1 Effect of different H<sub>2</sub>O<sub>2</sub> concentration on dye degradation**

1. First prepare 25ppm of dye solution by diluting 25mg of dye in to 1 liter of deionized water.
2. Prepare the standards at 5 ppm, 10 ppm, 15 ppm, 20 ppm and 25 ppm. Use the formula  $M_1V_1=M_2V_2$  to get the volume of dye to be diluted with water.
3. To prepare 5 ppm:  $(5 \text{ ppm}) \times (100\text{ml}) = (25 \text{ ppm}) \times (V_2)$ , so  $V_2$  can be found. That is the amount of volume of dye to be diluted with deionized water. Make it up with water with a 100 ml volumetric flask.
4. Find the concentration in the graph using the standard curve. Choose appropriate concentration to run the experiment so that the absorbance is in-between the range.
5. Mix 1 ml of Hydrogen Peroxide with 50ml of dye and run the test.
6. Take reading at every 10 minutes for one hour and then for every half hour till the dye degrades.
7. Test for 2 ml, 3 ml, 4 ml, 5 ml, 6 ml and 7 ml of Hydrogen Peroxide.

### **3.2 Stirring effect on dye degradation**

1. First prepare 25ppm of dye solution by diluting 25mg of dye in to 1 liter of deionized water.
2. Prepare the standards at 5 ppm, 10 ppm, 15 ppm, 20 ppm and 25 ppm. Use the formula  $M_1V_1=M_2V_2$  to get the volume of dye to be diluted with water.
3. To prepare 5 ppm:  $(5 \text{ ppm}) \times (100\text{ml}) = (25 \text{ ppm}) \times (V_2)$ , so  $V_2$  can be found. That is the amount of volume of dye to be diluted with deionized water. Make it up with water with a 100 ml volumetric flask.
4. Find the concentration in the graph using the standard curve. Choose appropriate concentration to run the experiment so that the absorbance is in-between the range.
5. Mix 5 ml of Hydrogen Peroxide with 50ml of dye and run the test at speed 2.
6. Take reading at every 10 minutes for one hour and then for every half hour till the dye degrades.
7. Repeat the experiment at speed 3,4,5,and 7.

### **3.3 Temperature effect on dye degradation**

1. First prepare 25ppm of dye solution by diluting 25mg of dye in to 1 liter of deionized water.
2. Prepare the standards at 5 ppm, 10 ppm, 15 ppm, 20 ppm and 25 ppm. Use the formula  $M_1V_1=M_2V_2$  to get the volume of dye to be diluted with water.
3. To prepare 5 ppm:  $(5 \text{ ppm}) \times (100\text{ml}) = (25 \text{ ppm}) \times (V_2)$ , so  $V_2$  can be found. That is the amount of volume of dye to be diluted with deionized water. Make it up with water with a 100 ml volumetric flask.
4. Find the concentration in the graph using the standard curve. Choose appropriate concentration to run the experiment so that the absorbance is in-between the range.
5. Mix 5 ml of Hydrogen Peroxide with 50ml of dye and run the test at 35<sup>0</sup>C in water bath.

6. Take reading at every 2 minutes till the dye degrades.
7. Repeat the experiment at 50°C, 75°C, and 100°C.

### **3.4 Dye concentration effect on dye degradation**

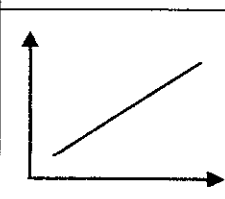
1. First prepare 100 ppm of dye solution by diluting 100mg of dye in to 1 liter of deionized water.
2. Prepare the standards at 5 ppm, 10 ppm, 15 ppm, 20 ppm and 25 ppm. Use the formula  $M_1V_1=M_2V_2$  to get the volume of dye to be diluted with water.
3. To prepare 5 ppm:  $(5 \text{ ppm}) \times (100\text{ml}) = (100 \text{ ppm}) \times (V_2)$ , so  $V_2$  can be found. That is the amount of volume of dye to be diluted with deionized water. Make it up with water with a 100 ml volumetric flask.
4. Find the concentration in the graph using the standard curve. Choose appropriate concentration to run the experiment so that the absorbance is in-between the range.
5. Mix 5 ml of Hydrogen Peroxide with 50ml of 100 ppm dye and run the test
6. Take reading at every 30 minutes for two hours.
7. Repeat the experiment at 25 ppm, 50 ppm and 75 ppm.

\* Use the dilution of the 100 ppm dye solution.

### **3.5 To use the UV spectrophotometer**

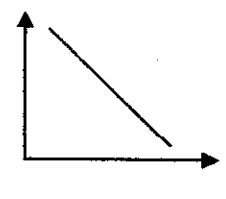
1. Turn on the computer and UV spectrophotometer. It will take 15 mins to warm up.
2. Then click on the UV ICON on desktop.
3. Set the wavelength range and clear everything in the spectrophotometer.
4. Set the baseline.
5. Then enter cuvette filled with deionized water and set Auto-Zero.
6. Clean the cuvette with acetone, dry and fill in the sample.
7. Run the standards and the sample.

Figure 3 below shows the standard table.

Standard	Absorbance	wavelength	concentration	graph curve
Std 1		617	5 ppm	
Std 2		617	10 ppm	
Std 3		617	20 ppm	
Std 4		617	30 ppm	

**Figure 3: Standard Table**

Then the sample is entered and the unknown concentration of the dye is read. Figure 4 below shows the sample concentration table.

Sample	Absorbance	wavelength	concentration	graph curve
At 10 min		617		
At 20 min		617		
At 30 min		617		
At 40 min		617		

**Figure 4: Sample Concentration Table**



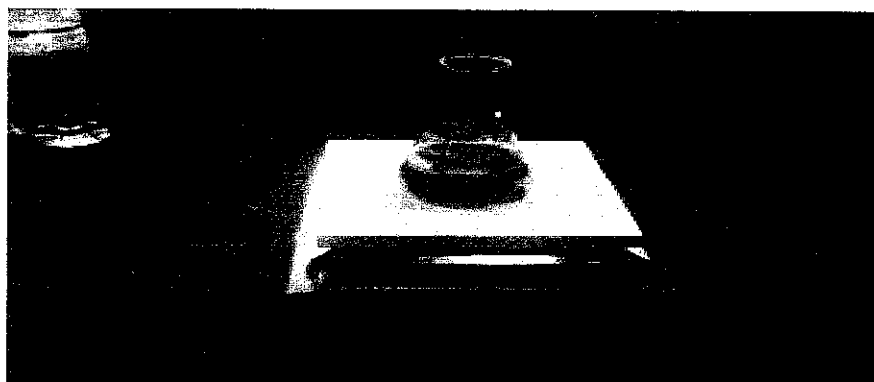
### 3.6 List of Equipments and Chemical used



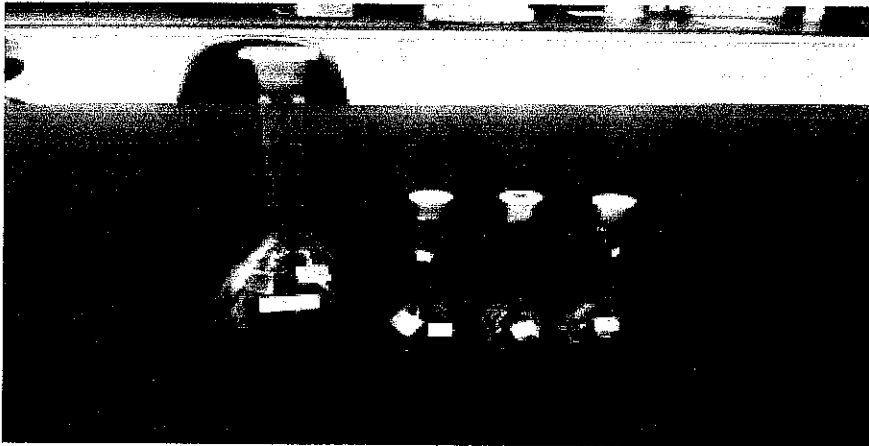
**Diagram 1: UV Spectrophotometer**



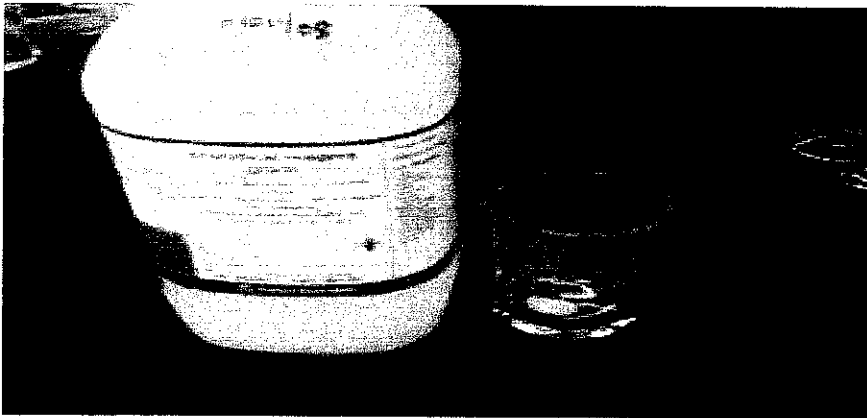
**Diagram 2: Glass apparatus**



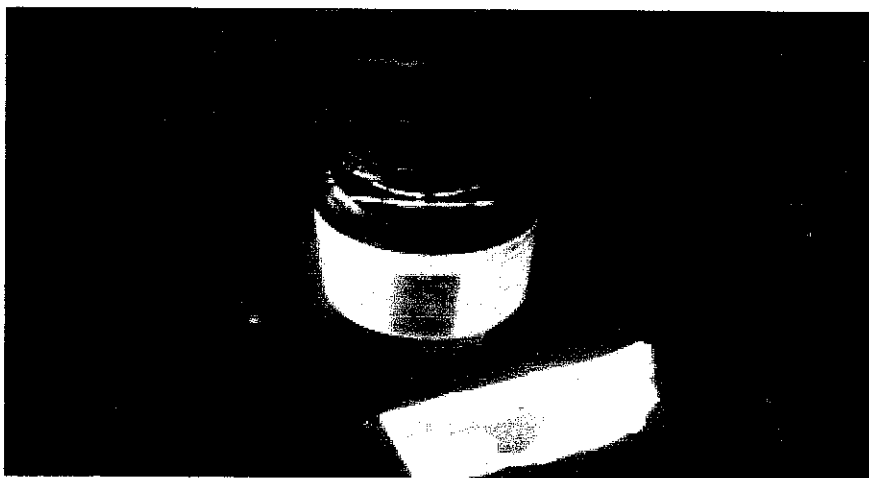
**Diagram 3: Beaker and agitator**



**Diagram 4: Conical Flask**



**Diagram 5: Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>)**



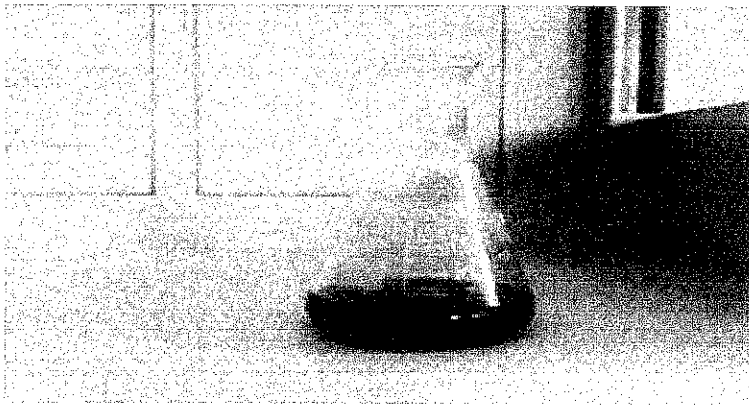
**Diagram 6: Malachite Green Oxalate, dye**

## CHAPTER 4

### RESULT AND DISCUSSION

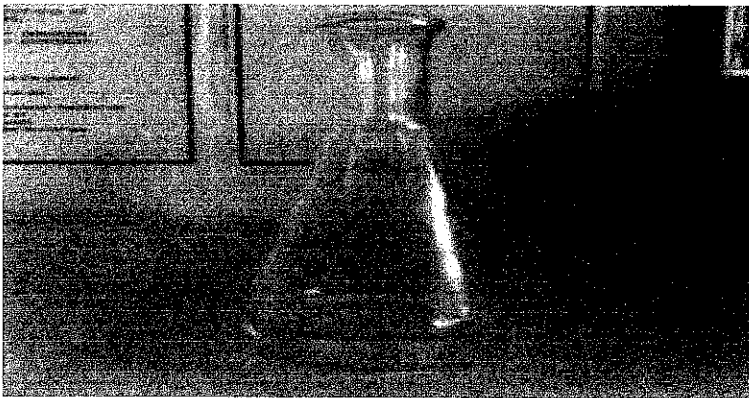
#### 4.1 RESULTS

##### Before Experiment



**Diagram 7: During Degradation**

##### After Experiment



**Diagram 8: After Degradation**

#### 4.1.1 Effect of hydrogen peroxide on degradation of dye

Figure 5 below shows the effect of one milliliter hydrogen peroxide in 50 ml Dye

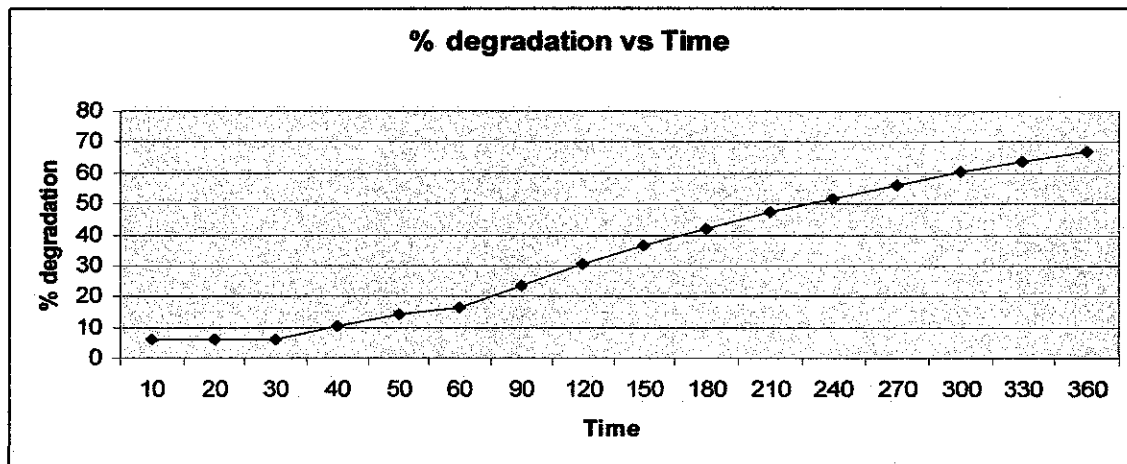


Figure 5 : 1 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration(ppm)	degradation	% degradation
10	23.557	0.05772	5.772
20	23.557	0.05772	5.772
30	23.557	0.05772	5.772
40	22.414	0.10344	10.344
50	21.428	0.14288	14.288
60	20.886	0.16456	16.456
90	19.124	0.23504	23.504
120	17.442	0.30232	30.232
150	15.878	0.36488	36.488
180	14.467	0.42132	42.132
210	13.221	0.47116	47.116
240	12.043	0.51828	51.828
270	10.972	0.56112	56.112
300	9.924	0.60304	60.304
330	9.028	0.63888	63.888
360	8.22	0.6712	67.12

Table 1 : 1 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Figure 6 below shows the effect of two milliliter hydrogen peroxide in 50 ml Dye

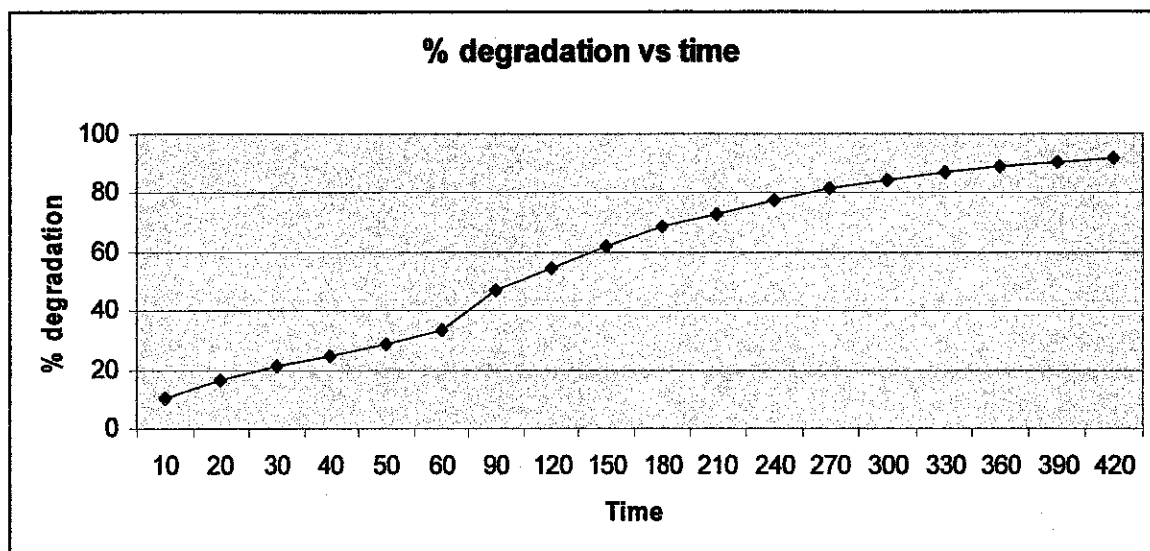


Figure 6 : 2 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration(ppm)	degradation	% degradation
10	22.414	0.10344	10.344
20	20.886	0.16456	16.456
30	19.745	0.2102	21.02
40	18.903	0.24388	24.388
50	17.821	0.28716	28.716
60	16.678	0.33288	33.288
90	13.306	0.46776	46.776
120	11.313	0.54748	54.748
150	9.477	0.62092	62.092
180	7.821	0.68716	68.716
210	6.739	0.73044	73.044
240	5.579	0.77684	77.684
270	4.593	0.81628	81.628
300	3.839	0.84644	84.644
330	3.264	0.86944	86.944
360	2.78	0.8888	88.88
390	2.361	0.90556	90.556
420	1.97	0.9212	92.12

Table 2 : 2 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Figure 7 below shows the effect of three milliliter hydrogen peroxide in 50 ml Dye

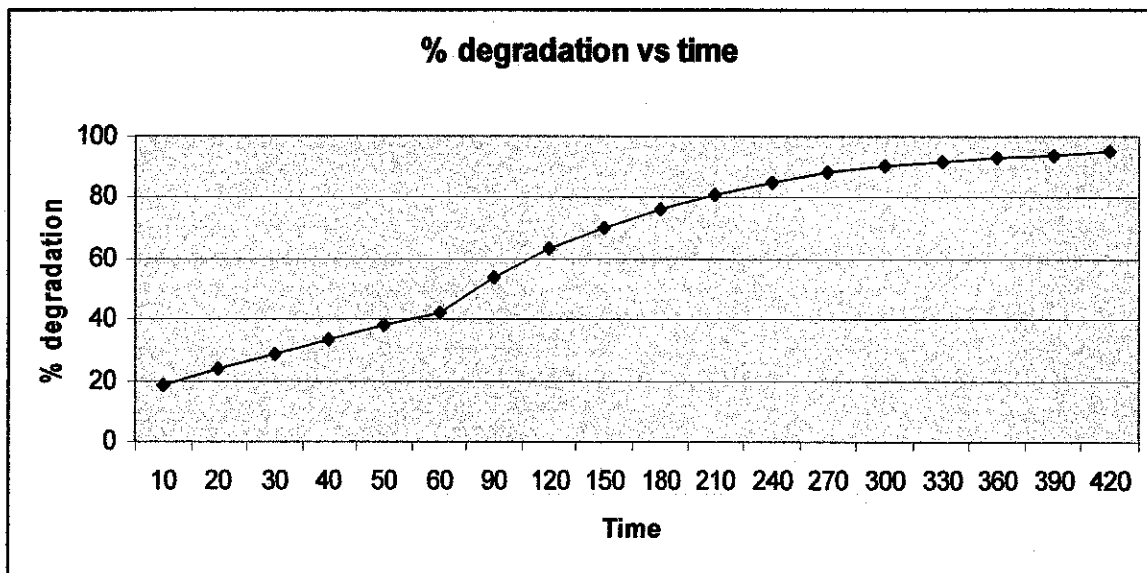


Figure 7 : 3 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration(ppm)	degradation	% degradation
10	20.448	0.18208	18.208
20	19.048	0.23808	23.808
30	17.775	0.289	28.9
40	16.707	0.33172	33.172
50	15.538	0.37848	37.848
60	14.502	0.41992	41.992
90	11.634	0.53464	53.464
120	9.244	0.63024	63.024
150	7.454	0.70184	70.184
180	5.921	0.76316	76.316
210	4.723	0.81108	81.108
240	3.703	0.85188	85.188
270	2.964	0.88144	88.144
300	2.424	0.90304	90.304
330	2.048	0.91808	91.808
360	1.707	0.93172	93.172
390	1.46	0.9416	94.16

Table 3 : 3 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Figure 8 below shows the effect of four milliliter hydrogen peroxide in 50 ml Dye

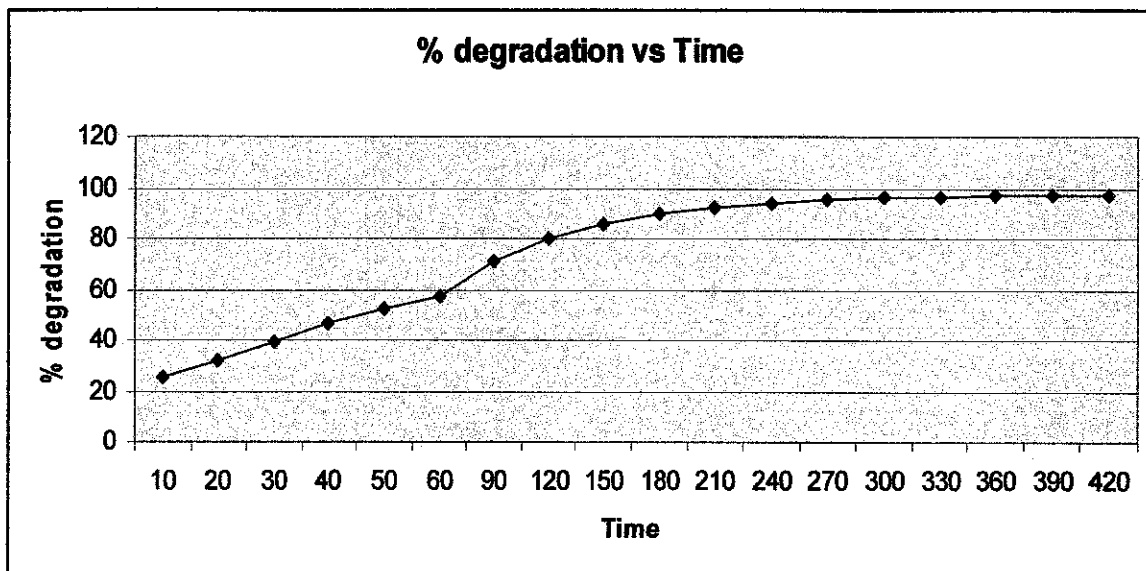
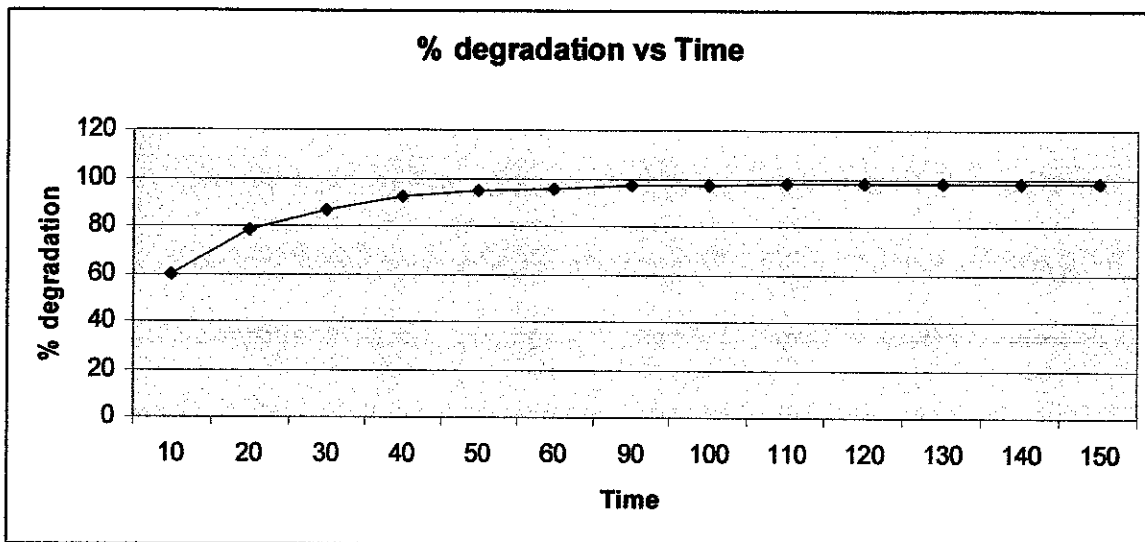


Figure 8 : 4 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration(ppm)	degradation	% degradation
10	18.634	0.25464	25.464
20	17.117	0.31532	31.532
30	15.175	0.393	39.3
40	13.431	0.46276	46.276
50	11.989	0.52044	52.044
60	10.704	0.57184	57.184
90	7.332	0.70672	70.672
120	5.075	0.797	79.7
150	3.522	0.85912	85.912
180	2.543	0.89828	89.828
210	1.91	0.9236	92.36
240	1.458	0.94168	94.168
270	1.153	0.95388	95.388
300	0.959	0.96164	96.164
330	0.882	0.96472	96.472
360	0.781	0.96876	96.876
390	0.687	0.97252	97.252
420	0.681	0.97276	97.276

Table 4 : 4 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Figure 9 below shows the effect of five milliliter hydrogen peroxide in 50 ml Dye



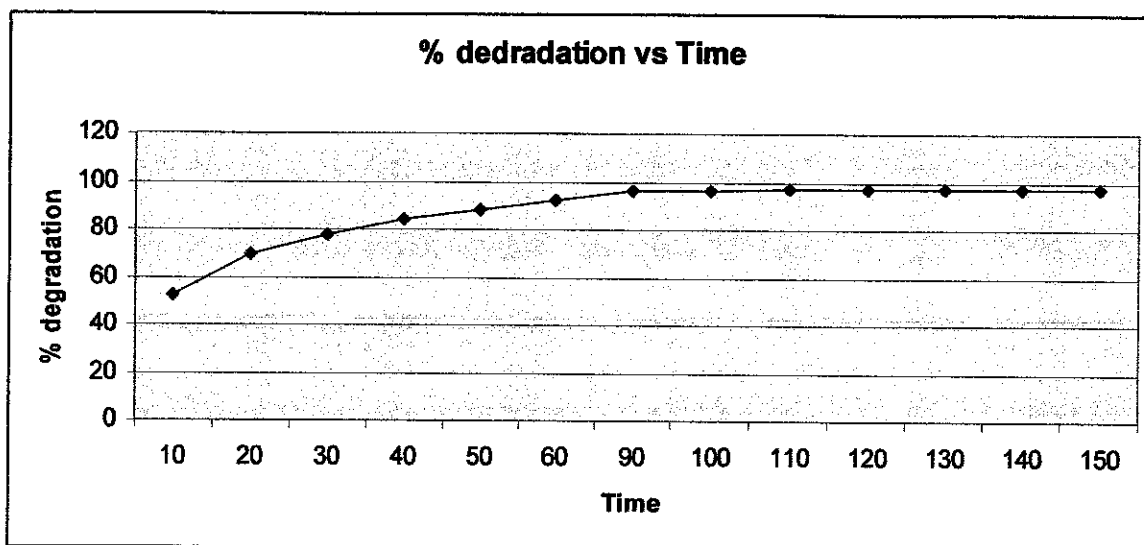
**Figure 9 : 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**

time(min)	concentration(ppm)	degradation	% degradation
10	10.06	0.5976	59.76
20	5.438	0.78248	78.248
30	3.297	0.86812	86.812
40	2.003	0.91988	91.988
50	1.414	0.94344	94.344
60	1.022	0.95912	95.912
90	0.662	0.97352	97.352
100	0.617	0.97532	97.532
110	0.598	0.97608	97.608
120	0.593	0.97628	97.628
130	0.586	0.97656	97.656
140	0.58	0.9768	97.68
150	0.577	0.97692	97.692

**Table 5: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**



Figure 10 below shows the effect of six milliliter hydrogen peroxide in 50 ml Dye



**Figure 10 : 6 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**

time(min)	concentration(ppm)	degradation	% degradation
10	11.932	0.52272	52.272
20	7.625	0.695	69.5
30	5.515	0.7794	77.94
40	3.976	0.84096	84.096
50	2.884	0.88464	88.464
60	2.008	0.91968	91.968
90	0.958	0.96168	96.168
100	0.82	0.9672	96.72
110	0.753	0.96988	96.988
120	0.685	0.9726	97.26
130	0.655	0.9738	97.38
140	0.621	0.97516	97.516
150	0.615	0.9754	97.54

**Table 6 : 6 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**

Figure 11 below shows the effect of seven milliliter hydrogen peroxide in 50 ml Dye

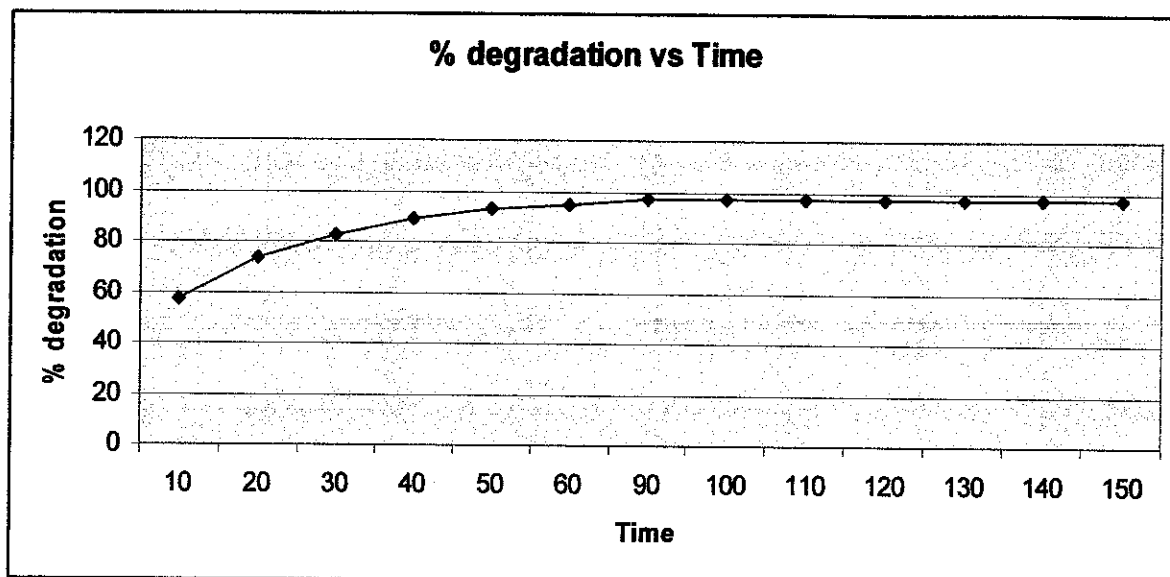


Figure 11 : 7 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration(ppm)	degradation	% degradation
10	10.652	0.57392	57.392
20	6.629	0.73484	73.484
30	4.372	0.82512	82.512
40	2.765	0.8894	88.94
50	1.74	0.9304	93.04
60	1.238	0.95048	95.048
90	0.707	0.97172	97.172
100	0.67	0.9732	97.32
110	0.624	0.97504	97.504
120	0.623	0.97508	97.508
130	0.616	0.97536	97.536
140	0.615	0.9754	97.54
150	0.615	0.9754	97.54

Table 7 : 7 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

#### 4.1.2 Effect of stirring speed on degradation

Figure 12 below shows the effect of stirring speed at 3 in 50 ml Dye and 5 ml H<sub>2</sub>O<sub>2</sub>

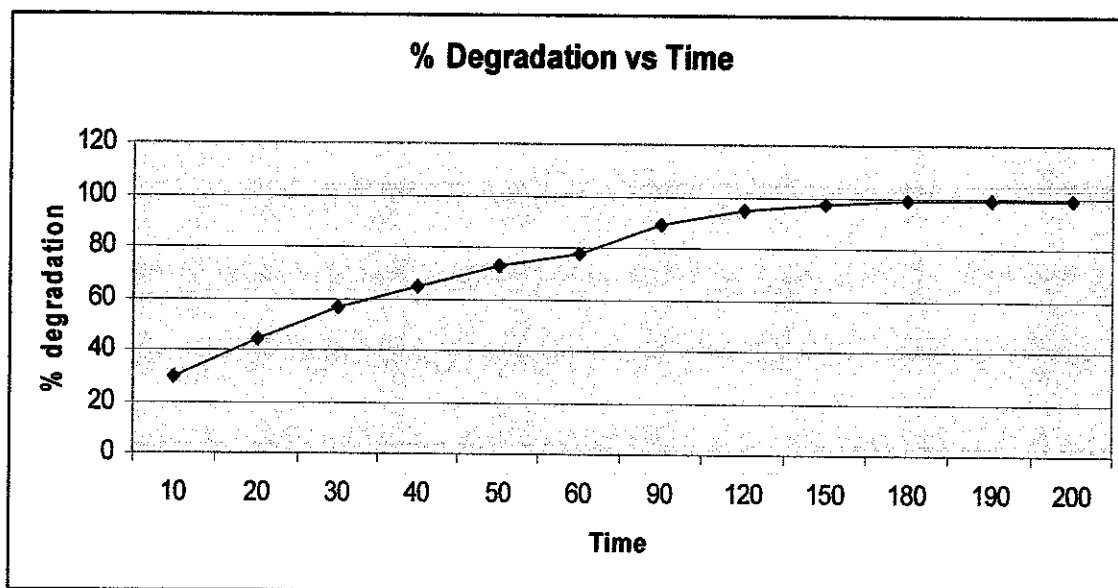


Figure 12 : Speed 3 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration (ppm)	degradation	% degradation
10	17.728	0.29088	29.088
20	14.049	0.43804	43.804
30	10.861	0.56556	56.556
40	8.838	0.64648	64.648
50	6.924	0.72304	72.304
60	5.541	0.77836	77.836
90	2.738	0.89048	89.048
120	1.355	0.9458	94.58
150	0.692	0.97232	97.232
180	0.372	0.98512	98.512
190	0.36	0.9856	98.56
200	0.358	0.98568	98.568

Table 8 : Speed 3 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Figure 13 below shows the effect of stirring speed at 4 in 50 ml Dye and 5 ml Hydrogen Peroxide

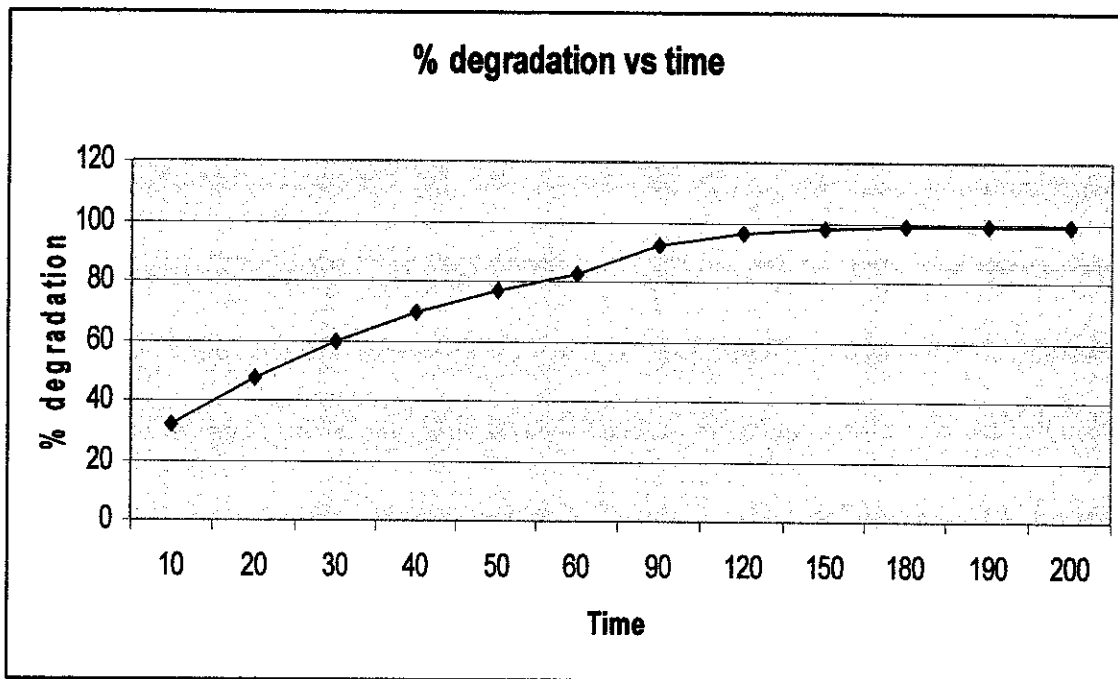
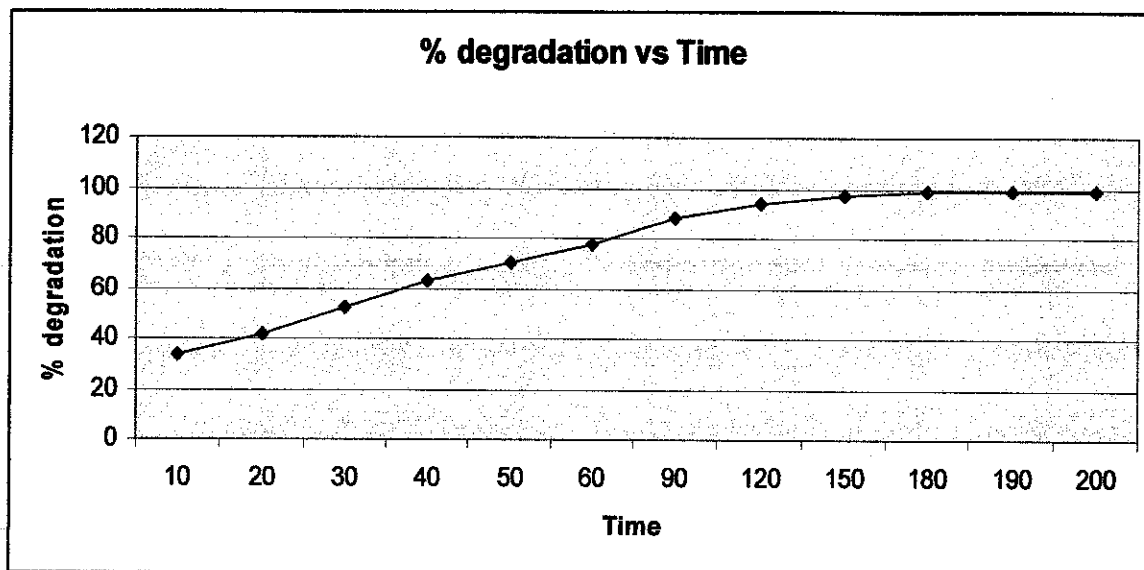


Figure 13 : Speed 4 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration (ppm)	degradation	% degradation
10	17.074	0.31704	31.704
20	13.226	0.47096	47.096
30	10.136	0.59456	59.456
40	7.719	0.69124	69.124
50	5.863	0.76548	76.548
60	4.409	0.82364	82.364
90	2.017	0.91932	91.932
120	0.93	0.9628	96.28
150	0.425	0.983	98.3
180	0.24	0.9904	99.04
190	0.237	0.99052	99.052
200	0.232	0.99072	99.072

Table 9 : Speed 4 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Figure 14 below shows the effect of stirring speed at 5 in 50 ml Dye and 5 ml Hydrogen Peroxide



**Figure 14 : Speed 5 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**

time(min)	concentration (ppm)	degradation	% degradation
10	16.644	0.33424	33.424
20	14.563	0.41748	41.748
30	11.845	0.5262	52.62
40	9.385	0.6246	62.46
50	7.523	0.69908	69.908
60	5.627	0.77492	77.492
90	2.94	0.8824	88.24
120	1.464	0.94144	94.144
150	0.69	0.9724	97.24
180	0.375	0.985	98.5
190	0.373	0.98508	98.508
200	0.372	0.98512	98.512

**Table 10 : Speed 5 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**

Figure 15 below shows the effect of stirring speed at 7 in 50 ml Dye and 5 ml Hydrogen Peroxide

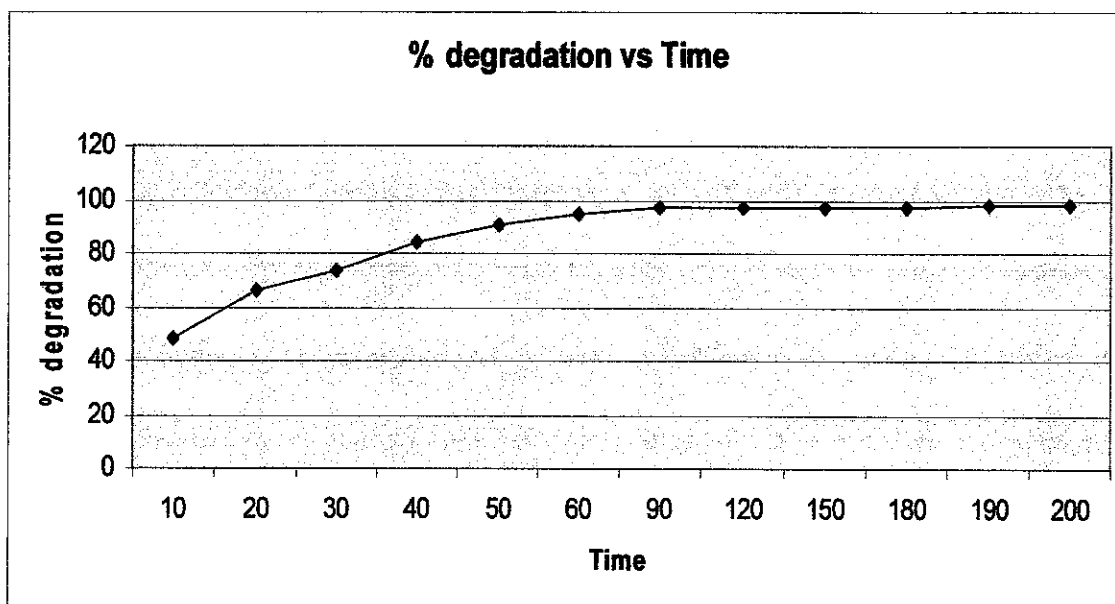


Figure 15 : Speed 7 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

time(min)	concentration (ppm)	degradation	% degradation
10	12.977	0.48092	48.092
20	8.463	0.66148	66.148
30	6.578	0.73688	73.688
40	3.879	0.84484	84.484
50	2.367	0.90532	90.532
60	1.295	0.9482	94.82
90	0.812	0.96752	96.752
120	0.76	0.9696	96.96
150	0.726	0.97096	97.096
180	0.662	0.97352	97.352
190	0.6	0.976	97.6
200	0.556	0.97776	97.776

Table 11 : Speed 7 with 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

### 4.1.3 Effect of temperature on degradation

Figure 16 below shows the effect of temperature at 35°C in 50 ml Dye and 5 ml Hydrogen Peroxide

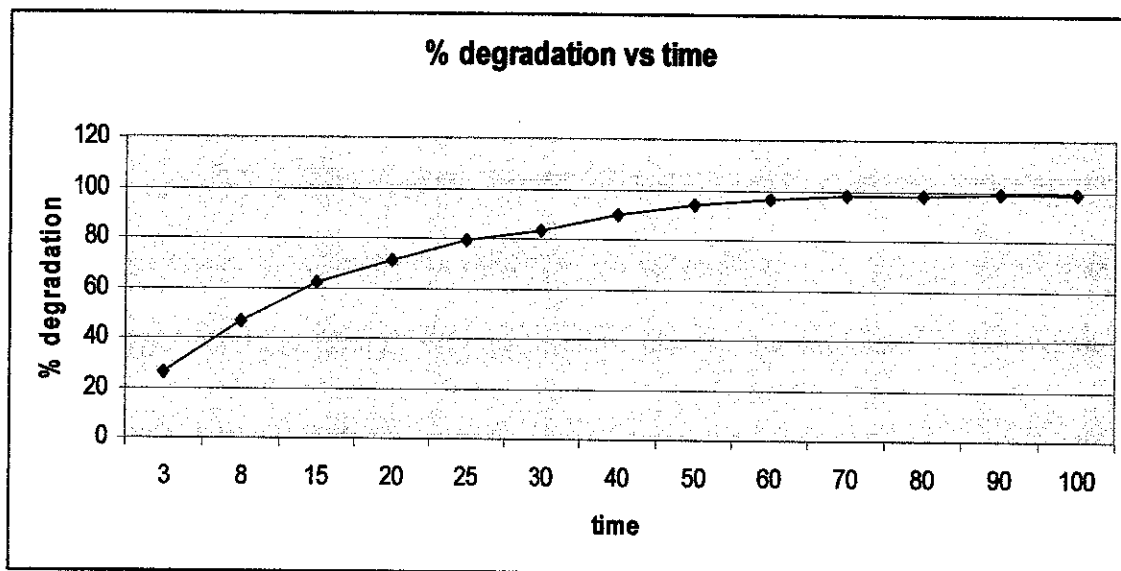


Figure 16 : At 35°C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Time(min)	concentration(ppm)	degradation	% degradation
3	18.444	0.26224	26.224
8	13.377	0.46492	46.492
15	9.398	0.62408	62.408
20	7.174	0.71304	71.304
25	5.262	0.78952	78.952
30	4.188	0.83248	83.248
40	2.627	0.89492	89.492
50	1.518	0.93928	93.928
60	0.952	0.96192	96.192
70	0.576	0.97696	97.696
80	0.419	0.98324	98.324
90	0.308	0.98768	98.768
100	0.237	0.99052	99.052

Table 12 : At 35°C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Figure 17 below shows the effect of temperature at 50°C in 50 ml Dye and 5 ml Hydrogen Peroxide

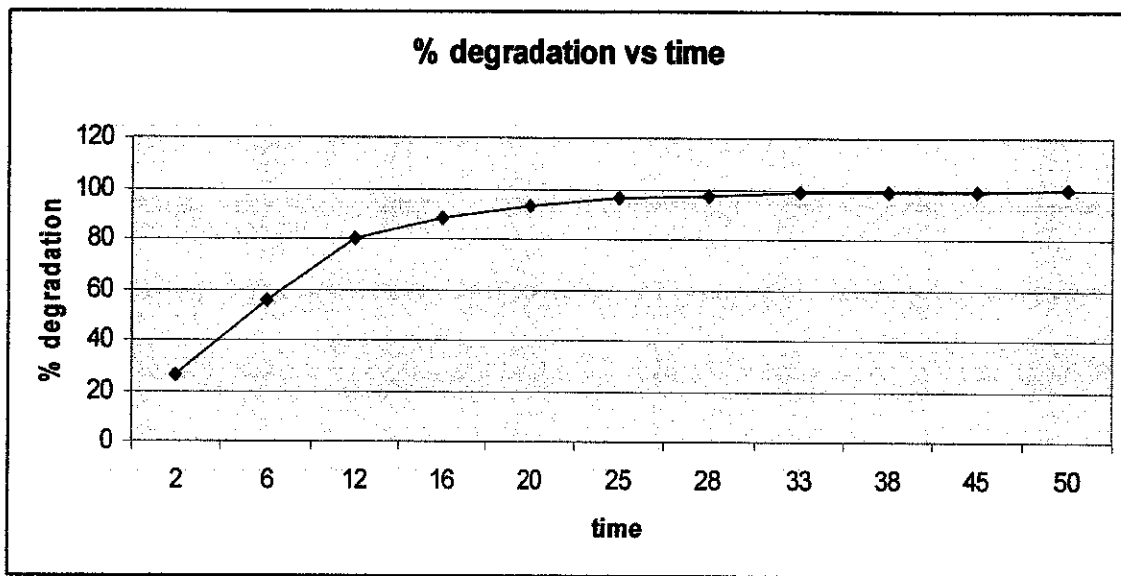


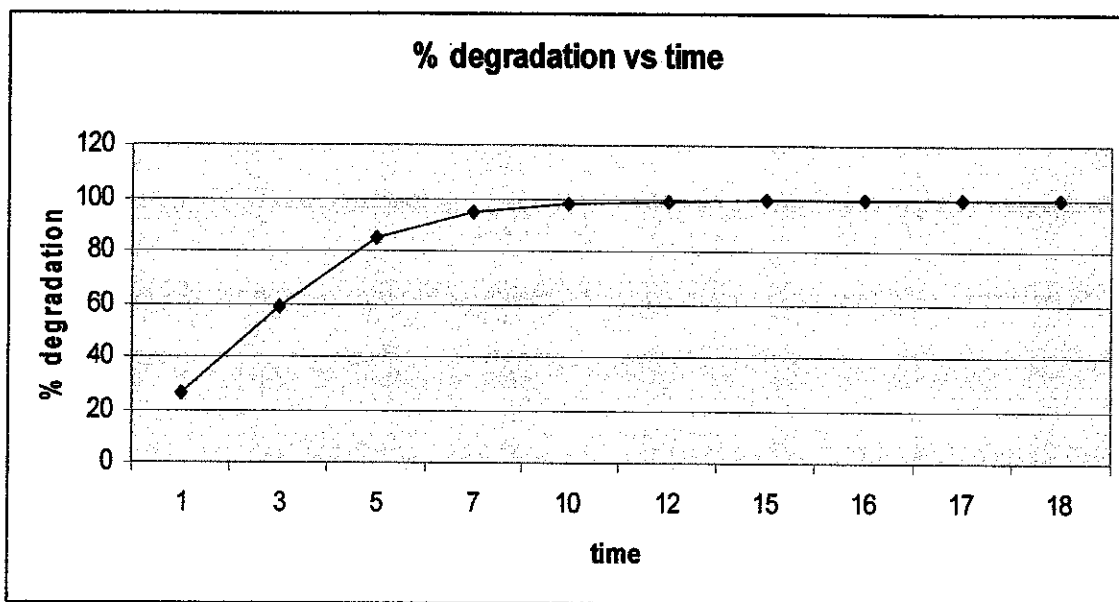
Figure 17: At 50°C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate, 25 ppm

Time(min)	concentration(ppm)	degradation	% degradation
2	18.444	0.26224	26.224
6	11.054	0.55784	55.784
12	5.063	0.79748	79.748
16	3.035	0.8786	87.86
20	1.777	0.92892	92.892
25	0.955	0.9618	96.18
28	0.667	0.97332	97.332
33	0.401	0.98396	98.396
38	0.285	0.9886	98.86
45	0.205	0.9918	99.18
50	0.199	0.99204	99.204

Table 13 : At 50°C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate, 25 ppm



Figure 18 below shows the effect of temperature at 75<sup>0</sup>C in 50 ml Dye and 5 ml Hydrogen Peroxide



**Figure 18 : At 75<sup>0</sup>C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**

Time(min)	concentration(ppm)	degradation	% degradation
1	18.444	0.26224	26.224
3	10.243	0.59028	59.028
5	3.872	0.84512	84.512
7	1.298	0.94808	94.808
10	0.439	0.98244	98.244
12	0.21	0.9916	99.16
15	0.174	0.99304	99.304
16	0.165	0.9934	99.34
17	0.164	0.99344	99.344
18	0.164	0.99344	99.344

**Table 14 : At 75<sup>0</sup>C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm**

Figure 19 below shows the effect of temperature at 100°C in 50 ml Dye and 5 ml Hydrogen Peroxide

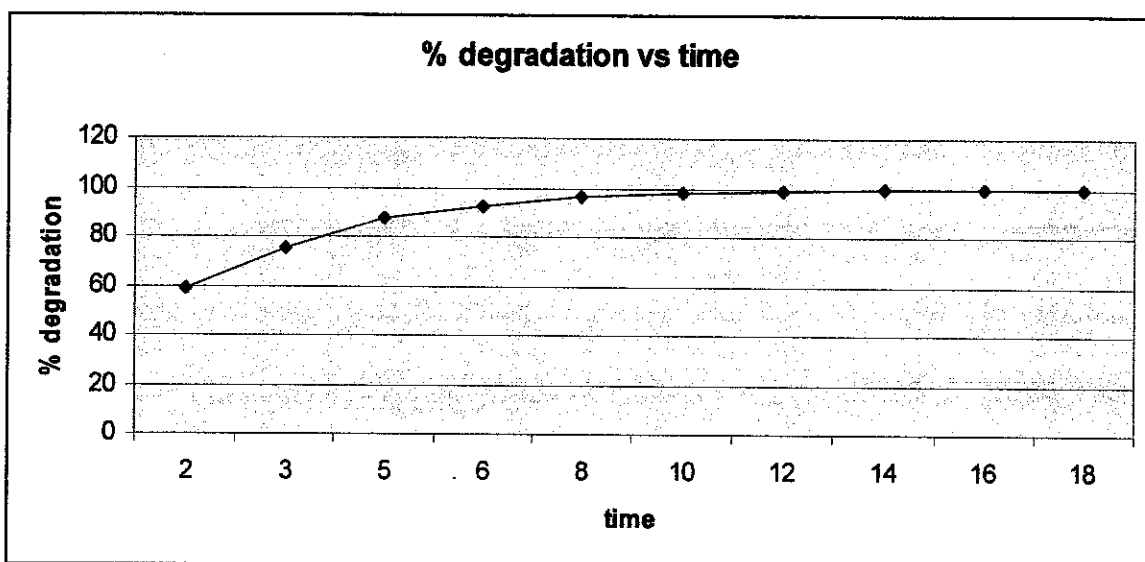


Figure 19 : At 100°C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

Time(min)	concentration(ppm)	degradation	% degradation
2	10.359	0.58564	58.564
3	6.195	0.7522	75.22
5	3.167	0.87332	87.332
6	1.869	0.92524	92.524
8	0.963	0.96148	96.148
10	0.482	0.98072	98.072
12	0.267	0.98932	98.932
14	0.167	0.99332	99.332
16	0.14	0.9944	99.44
18	0.103	0.99588	99.588

Table 15 : At 100°C: 5 ml H<sub>2</sub>O<sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm

#### 4.1.4 Effect of malachite green concentration on degradation

Figure 20 below shows the effect of dye concentration 50 ml Dye 25 ppm in and 5 ml Hydrogen Peroxide

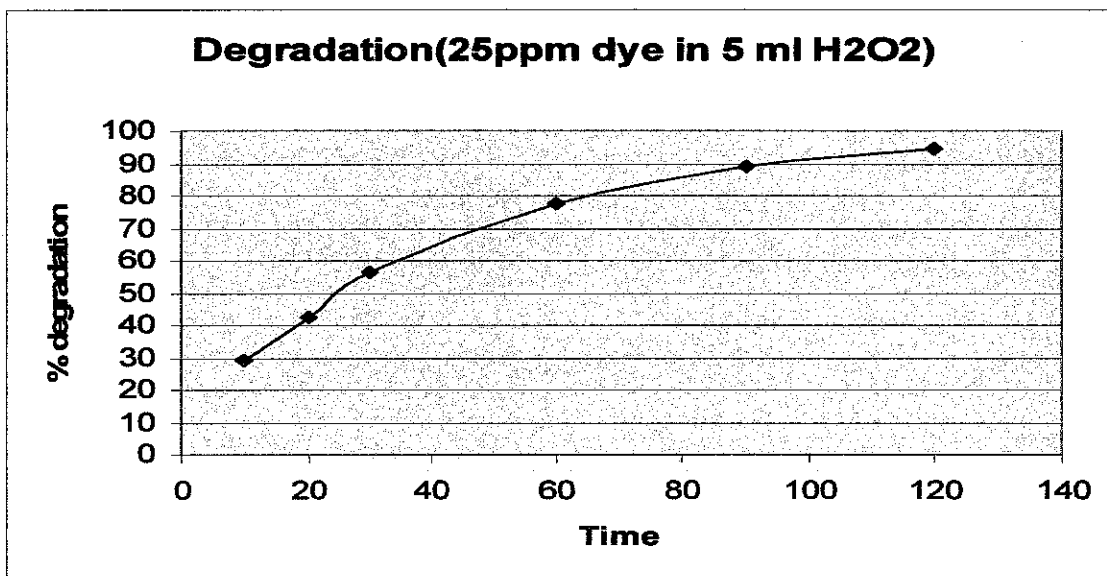


Figure 20 : 50 ml Malachite Green Oxalate,25 ppm in 5 ml H2O2

Time (min)	Concentration (ppm)	% Degradation
10	17.728	29.088
20	14.409	42.364
30	10.861	56.556
60	5.541	77.836
90	2.738	89.048
120	1.355	94.58

Table 16 : 50 ml Malachite Green Oxalate,25 ppm in 5 ml H2O2

Figure 21 below shows the effect of dye concentration 50 ml Dye 50 ppm in and 5 ml Hydrogen Peroxide

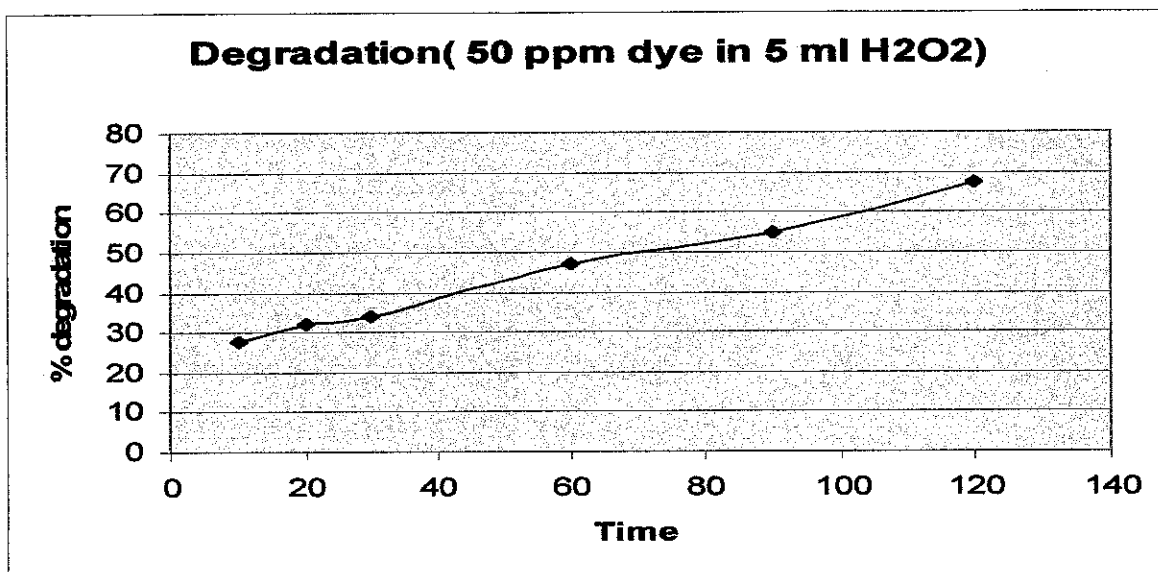


Figure 21 : 50 ml Malachite Green Oxalate,50 ppm in 5 ml H2O2

Time (min)	Concentration (ppm)	% Degradation
10	36.2	27.6
20	34	32.00
30	33.1	33.80
60	26.5	47.00
90	22.6	54.80
120	16.3	67.40

Table 17 : 50 ml Malachite Green Oxalate,50 ppm in 5 ml H2O2

Figure 22 below shows the effect of dye concentration 50 ml Dye 75 ppm in and 5 ml Hydrogen Peroxide

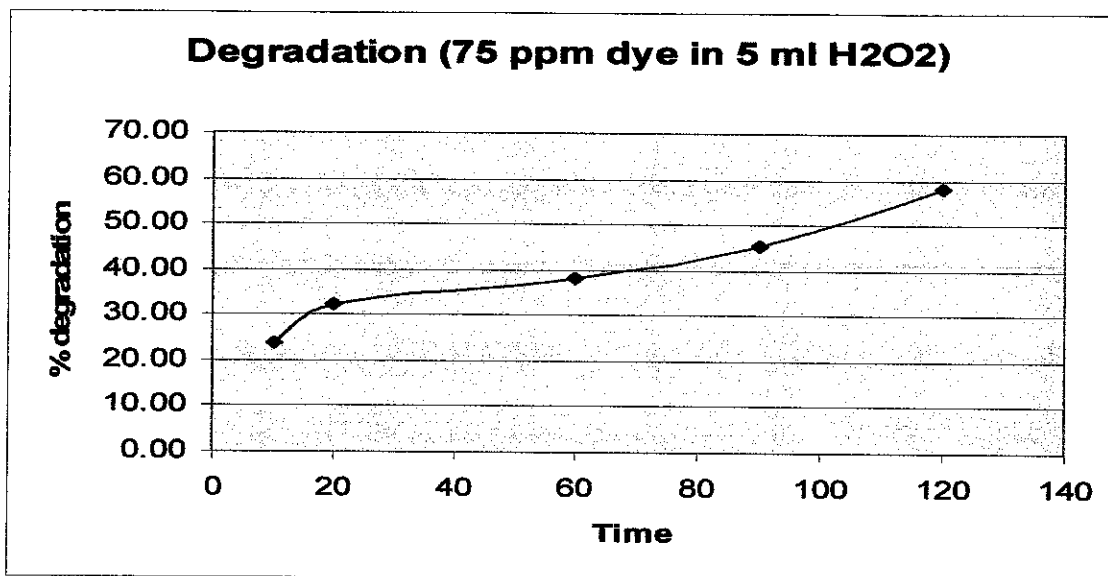


Figure 22 : 50 ml Malachite Green Oxalate,75 ppm in 5 ml H<sub>2</sub>O<sub>2</sub>

Time (min)	Concentration (ppm)	% Degradation
10	57.3	23.60
20	50.8	32.27
60	46.4	38.13
90	40.9	45.47
120	31.4	58.13

Table 18 : 50 ml Malachite Green Oxalate,75 ppm in 5 ml H<sub>2</sub>O<sub>2</sub>

Figure 22 below shows the effect of dye concentration 50 ml Dye 75 ppm in and 5 ml Hydrogen Peroxide

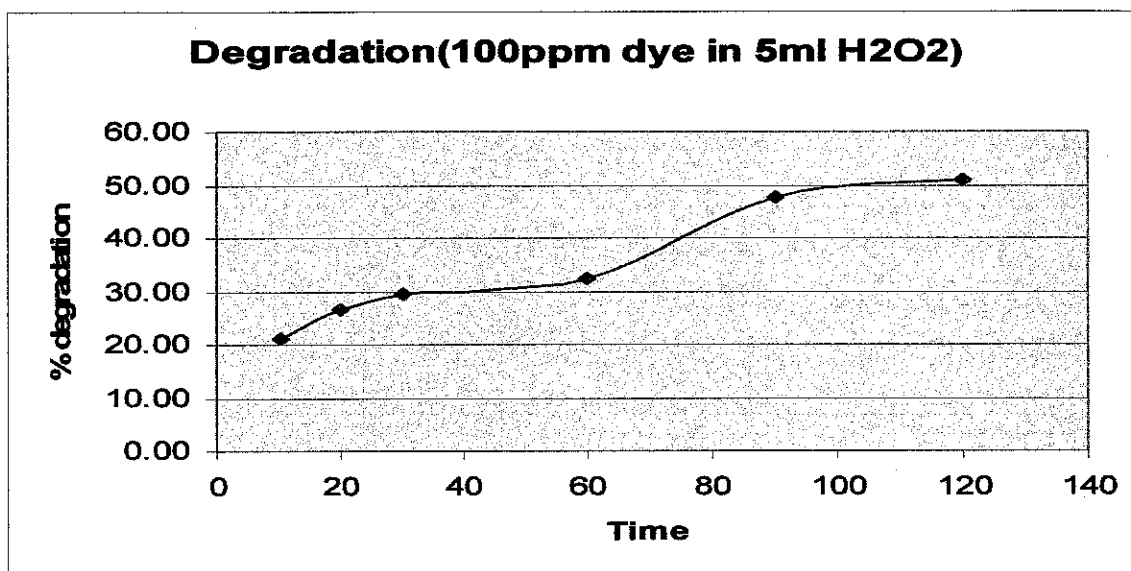


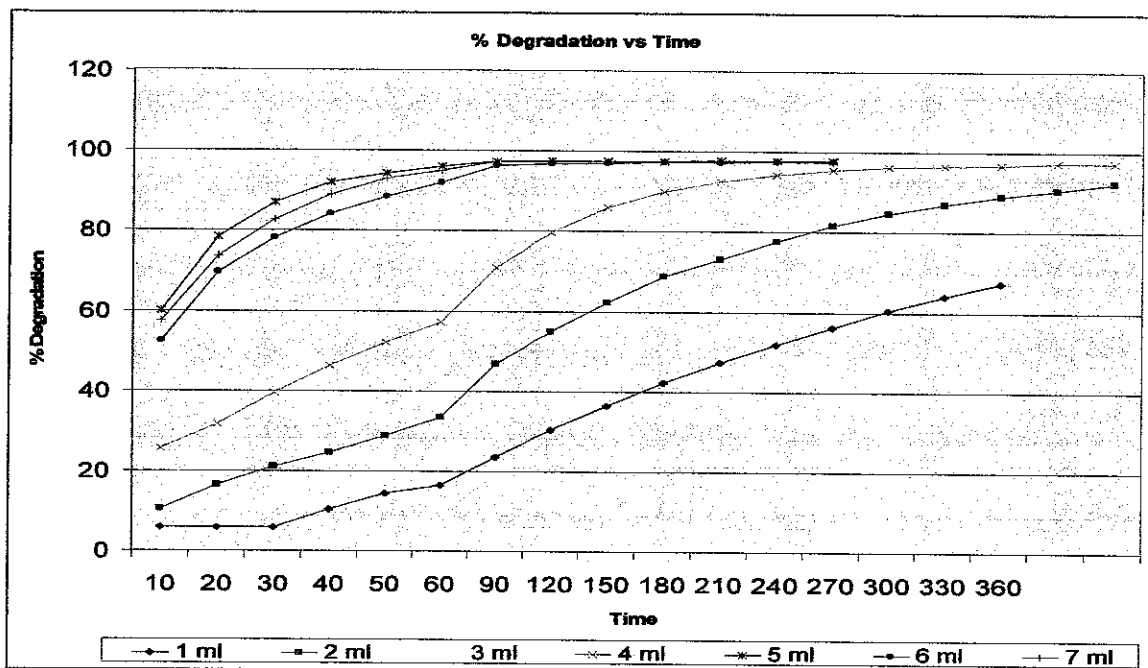
Figure 23 : 50 ml Malachite Green Oxalate,100 ppm in 5 ml H<sub>2</sub>O<sub>2</sub>

Time (min)	Concentration (ppm)	% Degradation
10	79	21.00
20	73.5	26.50
30	70.7	29.30
60	67.8	32.20
90	52.5	47.50
120	49	51.00

Table 19 : 50 ml Malachite Green Oxalate,100 ppm in 5 ml H<sub>2</sub>O<sub>2</sub>

## 4.2 DISCUSSION

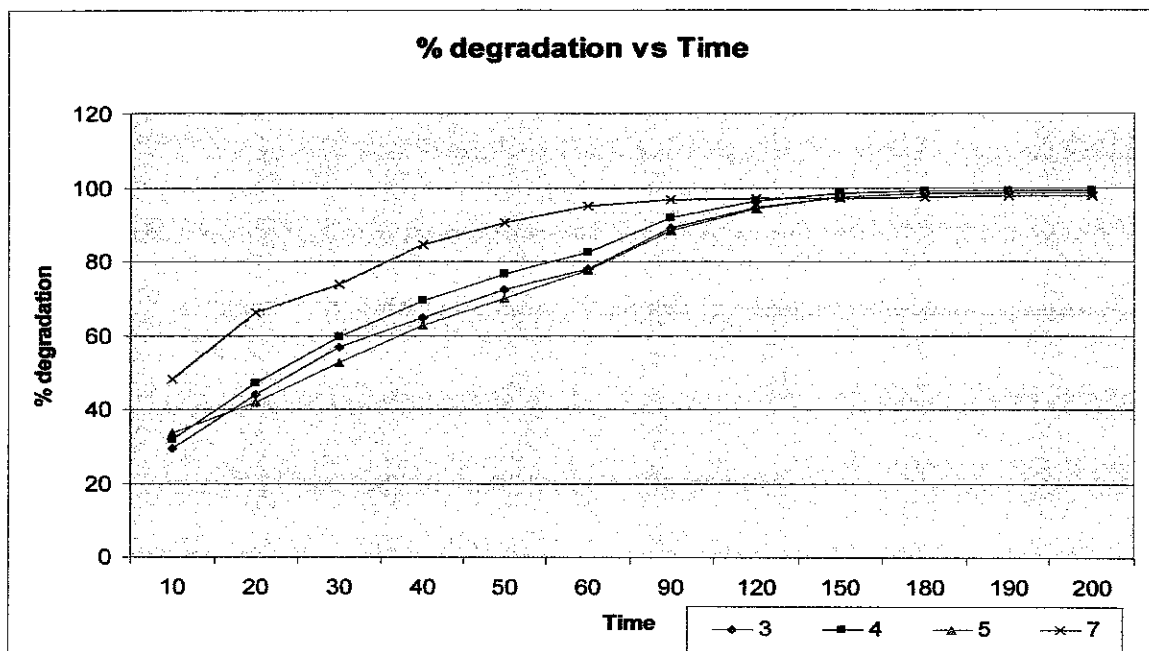
### 4.2.1 Effect of Hydrogen Peroxide Concentration on dye degradation



**Figure 24 : Effect of Hydrogen Peroxide Concentration on dye degradation**

From the graph we can see that when the Hydrogen Peroxide amount is increased, the degradation of dye increased. When 5 ml of Hydrogen Peroxide is used, the degradation reaches its optimum level. Increasing the hydrogen peroxide concentration after that did not show much increase in the degradation. The degradation rate was not as fast as at 5 ml Hydrogen peroxide but the degradation was complete at 90 minutes.

#### 4.2.2 Effect of Stirring Speed on dye degradation

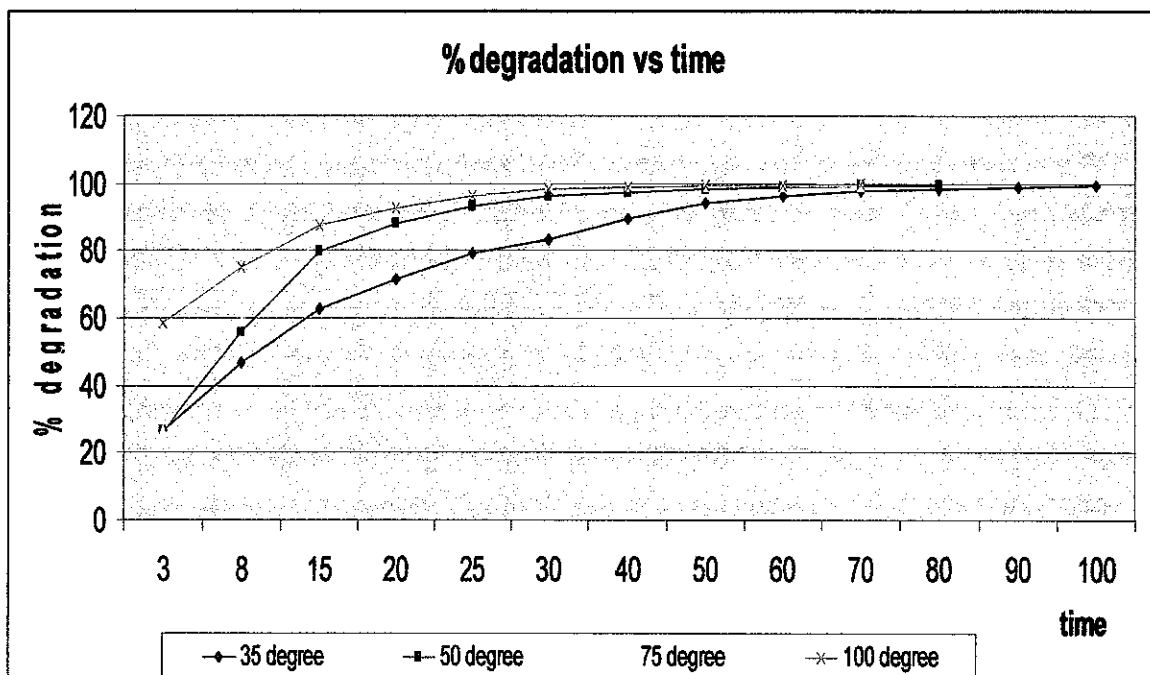


**Figure 25 : Effect of Stirring Speed on dye degradation**

From the graph, we can see that the degradation rate of dye increased as the speed of stirring increased. When the speed was 3,4 and 5 the degradation rate did not change that much but when the speed was increased to 7, the degradation rate largely increased.



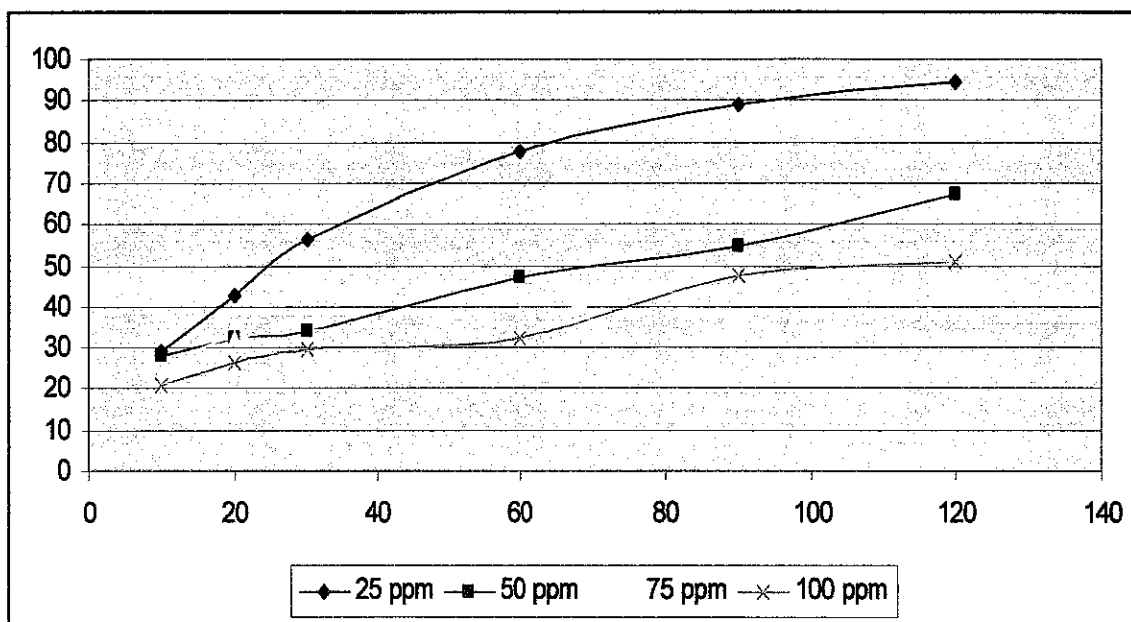
### 4.2.3 Effect of Temperature on dye degradation



**Figure 26 : Effect of Temperature on dye degradation**

From the graph we can see that as the temperature is increased the degradation rate increases. At 35°C, the degradation of dye completes in 90 minutes. At 50°C, the degradation completes in 33 minutes. At 75°C, the degradation completes in 15 minutes and at 100°C, the degradation completes in 10.5 minute.

#### 4.2.4 Effect of dye concentration on dye degradation



**Figure 27: Effect of dye concentration on dye degradation**

From the graph, it can be seen that as the concentration of dye is increased, the degradation rate of dye decreases. The total degradation of dye also decreases. At 25 ppm, it is observed that after two hours, the total degradation is 94.6%. At 50 ppm, it is observed that after two hours the total degradation is 67.4%. At 75 ppm, it is observed that after two hours the total degradation is 58.13%. At 100 ppm, it is observed that after two hours the total degradation is 51.0%.

## **CHAPTER 5**

### **CONCLUSION**

From experiment 1, I have found that increasing the concentration of hydrogen peroxide will increase the degradation of malachite green dye. When optimum level of Hydrogen Peroxide is reached, the degradation of dye will not change much as the hydrogen peroxide level is increased above the optimum level.

From experiment 2, I have found out that increasing the stirring speed will increase the dye degradation rate.

From experiment 3, I have found that increasing the temperature will largely increase the degradation rate of dye.

From experiment 4, I found that increasing the concentration of dye reduces the total degradation rate of dye.

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4. Journal refer to N. Daneshvar, A.R Khataee, M.H Rasoulifard, M.Pourhassan (2006)

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## LIST OF FIGURES

Figure 1	Three Forms of malachite green oxalate	3
Figure 2	Mechanism for degradation of dye with hydrogen peroxide	6
Figure 3	Standard Table	10
Figure 4	Sample Concentration Table	10
Figure 5	1 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	11
Figure 6	2 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	12
Figure 7	3 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	13
Figure 8	4 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	14
Figure 9	5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	15
Figure 10	6 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	16
Figure 11	7 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	17
Figure 12	Speed 3 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	18
Figure 13	Speed 4 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	19
Figure 14	Speed 5 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	20
Figure 15	Speed 7 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	21
Figure 16	At 35 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	22
Figure 17	At 50 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	23
Figure 18	At 75 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	24
Figure 19	At 100 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	25
Figure 20	50 ml Malachite Green Oxalate,25 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	29
Figure 21	50 ml Malachite Green Oxalate,50 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	30
Figure 22	50 ml Malachite Green Oxalate,75 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	31
Figure 23	50 ml Malachite Green Oxalate,100 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	32
Figure 24	Effect of Hydrogen Peroxide Concentration on dye degradation	33
Figure 25	Effect of Stirring Speed on dye degradation	34
Figure 26	Effect of Temperature on dye degradation	35
Figure 27	Effect of dye concentration on dye degradation	36

## LIST OF TABLES

Table 1	1 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	12
Table 2	2 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	13
Table 3	3 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	14
Table 4	4 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	15
Table 5	5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	16
Table 6	6 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	17
Table 7	7 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	18
Table 8	Speed 3 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	19
Table 9	Speed 4 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	20
Table 10	Speed 5 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	21
Table 11	Speed 7 in 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	22
Table 12	At 35 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	23
Table 13	At 50 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	24
Table 14	At 75 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	25
Table 15	At 100 <sup>0</sup> C: 5 ml H <sub>2</sub> O <sub>2</sub> in 50 ml Malachite Green Oxalate,25 ppm	26
Table 16	50 ml Malachite Green Oxalate,25 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	29
Table 17	50 ml Malachite Green Oxalate,25 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	30
Table 18	50 ml Malachite Green Oxalate,25 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	31
Table 19	50 ml Malachite Green Oxalate,25 ppm in 5 ml H <sub>2</sub> O <sub>2</sub>	32

## **LIST OF DIAGRAMS**

<b>Diagram 1</b>	<b>UV Spectrophotometer</b>	<b>11</b>
<b>Diagram 2</b>	<b>Glass apparatus</b>	<b>11</b>
<b>Diagram 3</b>	<b>Beaker and agitator</b>	<b>11</b>
<b>Diagram 4</b>	<b>Conical Flask</b>	<b>12</b>
<b>Diagram 5</b>	<b>Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>)</b>	<b>12</b>
<b>Diagram 6</b>	<b>Malachite Green Oxalate, dye</b>	<b>12</b>
<b>Diagram 7</b>	<b>During Degradation</b>	<b>13</b>
<b>Diagram 8</b>	<b>After Degradation</b>	<b>13</b>