Effect of Hydrogen Peroxide on Photodegradation of Metamifop with Presence of Fe(II) ions

By

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DECLARATION

I declare that this thesis entitled “Effect of Hydrogen Peroxide on Photodegradation of Metamifop with Presence of Fe(II) ions” is the result of my own research as except ascited n the references. The thesis has not been accepted for any degree and is not currently submitted in candidature of any other degree.

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Date :

ACKNOWLEDGEMENT

First of all, I would like to thanks to God for giving me strength in this project from start to the end. All praises belong to Him, who giving me strength and guidance for me to endure all the obstacles in accomplishing my research study successfully.

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H_2O_2	Hydrogen peroxide
•OH	Hydroxyl radical
AOP	Advanced oxidation process
HPLC	High performance liquid chromatography
^oC	Degree Celcius
ppm	parts per million
USEPA	United State Environmental Protection Agency
UV	Ultraviolet
WHO	World Health Organization

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ABSTRACT

Pesticide is modern technology that assists in agriculture sector to enhance the quality of yields on crop production. However, it may contaminate in the soil and cause water pollution from the runoff as a side effect. The experiment on the treatment of water had been conducted by using ultraviolet (UV) light to treat water that contaiminate by metamifop. In this study, the objective is to study effect of hydrogen peroxide (H_2O_2) on the rate of photodegradation of metamifop with presence of Fe(II) ions. The experiment was conducted by using metamifop, Fe(II) ions and H_2O_2. Solutions that had been prepared with the presence of metamifop had been experimental in addition of Fe(II) ions and H_2O_2 solution in different concentration. The effect of the addition was measured by using UV-Vis spectrometer. The presence of Fe(II) ions and hydrogen peroxide increase the photodegradation rate of metamifop. Overall study shows that the highest rate of photodegradation occur when the concentration of Fe(II) ions and H_2O_2 are equal to the concentration of the metamifop. Nevertheless, it will give retardant effect to the rate of photodegradation if higher concentration of Fe(II) ions and hydrogen peroxide used.

Kesan Hidrogen Peroksida terhadap Fotodegradasi Metamifop dengan kehadiran Fe(II) ions

ABSTRAK

Racun serangga merupakan teknologi moden yang membantu dalam sector pertanian dalam meningkatkan kualiti hasil pertanian atas pengeluaran tanaman. Walau bagaimanapun, ia boleh mencemarkan tanah dan menyebabkan pencemaran air yang berpunca daripada air larian sebagai kesan sampingan. Rawatan air telah dijalankan dengan menggunakan ultraviolet (UV) untuk merawat air yang mengandungi metamifop. Objektif dalam kajian ini adalah untuk mengkaji kesan hidrogen peroksida (H_2O_2) ke atas kadar photodegradation terhadap metamifop dengan kehadiran Fe (II) ions. Eksperimen telah dijalankan dengan menggunakan metamifop, Fe(II) ions dan H_2O_2. Larutan yang telah disediakan dengan kehadiran metamifop telah diuji dengan menambah larutan Fe(II) ions dan H_2O_2 dalam kepekatan yang berbeza. Kesan daripada campuran tersebut telah diukur dengan menggunakan UV-Vis spectrometer. Kehadiran Fe(II) ions dan H_2O_2 menunjukkan peningkatan kadar photodegradation. Keseluruhan kajian mendapati bahawa bacaan tertinggi kadar photodegradation berlaku apabila kepekatan larutan tersebut sama dengan kepekatan metamifop. Walaubagaimanapun, kadar fotodegradasi terencat apabila kepekatan larutan tersebut lebih tinggi daripada kepekatan metamifop digunakan.

CHAPTER 1

INTRODUCTION

1.1 Background of study

In Malaysia, the agricultural sector has become common among the citizen. Pesticides that applied to agricultural land as to control pests might contaminate the soil. Soil contamination can alter microbial processes besides increase plant uptake of the chemical. A pesticide is a modern technology that assists to enhance the quality of yield, to control pest on crop production as well as designed to kill specific pests, such as weeds and insects. However, it might reduce soil quality for agricultural production (Sanghi & Sasi, 2001). Moreover, pesticides are possible to harm beneficial insects, such as pollinators, and insects that prey on pests.

The runoff from the agricultural sector might be the reason for the rivers to become polluted. It become worse to people that depend on the rivers as water supply for their daily activities. From time to time, researchers are needed to make a research to treat the runoff from the agricultural sector such the degradation of the pesticides that applied to the agricultural land.

Metamifop is an active ingredient in pesticides that can be used against various pests and insects. However, the frequent application of pesticides may cause contamination of water body. Besides the natural readily presence of heavy metal in the environment, heavy metals properties such as copper, iron and zinc often form a part of the active compounds of pesticides.

Photodegradation is a type of advanced oxidation process (AOP) rely on the production of hydroxyl radical (•OH) and reacts rapidly with most organic compounds such as pesticide, thus lead to the complete mineralization of organic pollutants (Mariana *et al.*, 2002). However, the presence of metal ions may affect the rate of photodegradation of organic contaminants. Advanced Oxidation process, AOP is a promising method for water contamination treatment.

1.2 Problem statement

Pesticides have become one of the most frequently occurring pollutants in nature. Great concern has developed about possible effects of such substances on human health and on the environment (Mansour,1993). The uses of pesticides in agriculture can be the reason of environmental problems as the pesticide can lead to the contaminated soil where the surface runoff from that soil can cause water pollution.

Polluted wastewater by pesticides can be treated with various treatment such as biodegradation, photo fenton, filtration and photocatalytic degradation. However, among these method especially photocatalytic degradation has the major drawback. The catalyst used in the process need to recover back, Thus in this study photodegradation process is proposed one of the suitable method to treat the polluted wastewater.

However, the presence of heavy metal ions may affect the photodegradation of organic pollutants in aqueous solution. Nevertheless, they may act as catalysts for photodegradation of various pollutants in irradiated systems.

1.3 Objectives

1. To identify photodegradation process of metamifop in the presence and absence of Fe(II) ions using UV-Vis spectrometer.
2. To determine the effect of the hydrogen peroxide (H_2O_2) on photodegradation process in the presence or absence of Fe(II) ions.

CHAPTER 2

LITERATURE REVIEW

2.1 Water pollution

Water pollution source can be either from point source or non-point source. The point source of water pollution occur with presence of contaminant in waterway from any discharged such as a ditch or pipe. Sewage treatment plant, drain or a factory can be the sources of the discharges. Meanwhile, non-point source pollution refers to the contaminant diffused has point of any single discrete source (Duncan, 2014).

Water pollution has been divided into several categories by United States Environmental Protection Agency (USEPA). First, biodegradable waste that consists of human and animal waste. This categories also include plant nutrients, such as phosphates and nitrates, that come through the sewage, and livestock and fertilizer runoff into water. Besides that, heat can be a source of pollution in water where it cause the water temperature increases. So it can be the result of decreasing the amount of dissolved oxygen (DO). Sediment is one of the most common sources of water pollution where it consists of mineral or organic solid matter that runoff from land into water sources. Other than that, hazardous and toxic chemicals are usually human-made materials that are not used or disposed properly. Radioactive pollutants include wastewater discharges from factories, hospitals and uranium mines. Agricultural pollution brings up to the environmental consequences that can be the result in contamination or degradation of the surrounding ecosystems. When pesticides accumulation occur in soils, the contamination occur where it change the microbial processes, increase plant uptake of the chemical besides it can also cause toxicity to the soil. Potential contaminants are essential for the agricultural product, but it may become hazardous if there are excess in the soil (Sanghi & Sasi, 2001). Contaminating groundwater may occur from the pesticide leaching when pesticides are mixed with water and move through the soil. The surface runoff from the agricultural land can lead to water pollution.

2.2 Metamifop

Metamifop is an anryloxyphenoxypropionate herbicide under evaluation in the United States for annual grass control in cool-season turfgrasses (Micheal & Shawn, 2014). Figure 2.1 below shows the structure of metamifop. Metamifop is a relatively new herbicide developed in Korea and is widely used to control weeds inmany places, such as forest parks, golf courses, and gardens (Moon *et al.*, 2007).

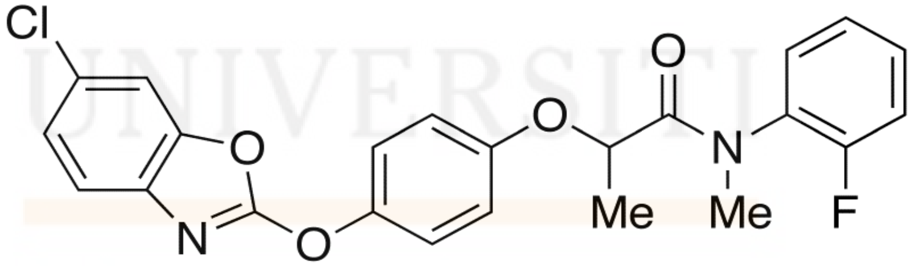

Figure 2.1: Structural formula of metamifop

Many possible chronic effects of these pesticides have been reported, including carcinogenesis, neurotoxicity, and effects on reproduction (Burrows et al., 2002). Even though tolerance levels of pesticide residues have been set by the U.S.

Environmental Protection Agency (EPA), there are still many uncertain issues, such as whether the tolerance levels are absolutely safe, whether results from animal studies are completely applicable to human, and whether the actual amount of pesticide consumed by people is known. Several factors serve to reduce pesticide residues in food and the environment including sunlight, rain, and microbial activity. Hence, the fate of pesticides by photodegradation has been studied intensively over the past couple of decades.

2.3 Photodegradation process

Photodegradation used to degrade metamifop by UV-irradiated for a period and the efficiency of photodegradation is usually monitored by spectroscopic techniques such UV-Visible spectroscopy (Fernandez, 2013). Photodegradation is type of Advanced oxidation processes (AOPs). AOPs have attracted much attention as powerful methods for efficient decomposition of organic pollutants. AOPs feature in the production of active oxygen species such as hydroxyl radical as their main oxidizing agent (Sun et al, 2010). Pesticides studied for photodegradation using simulated environmental aqueous systems include pirimicarb (pirisi, 1996), carbetamide (Meallier, 1993); phenmedipham(Guittonneau *et al.*, 1995); prometryn, terbutryn, simazine, and atrazine (Kiss, 2007); and coumaphos and azinphosmethyl (Franko *et al.*,2005).

2.4 Heavy metal

Heavy metals are thus commonly defined as those having a specific density of more than 5 g/cm3. Severely soil microorganisms and soil microbial processes can become disrupted by elevated metal concentrations, sometimes resulting in severe ecosystem disturbance. For typical AOPs, the degradation of organic pollutants catalyzed by iron species has shown particular promise in recent years because of its high photocatalytic efficiency (Sun *et al*., 2010).

Iron is the fourth most abundant element and second most abundant metal in the Earth's crust after aluminium. Elemental iron is rarely found in nature, as the iron ions Fe^{2+} and Fe^{3+} readily combine with oxygen and sulphur-containing compounds to form oxides, hydroxides, carbonates and sulphides (WHO, 2003). Table 2.3 and 2.4 show the physical and chemical properties of iron.

Table 2.1: Physical properties of iron (Alchin, 2015)

PHYSICAL PROPERTIES OF IRON	
Color	Silver-gray metal
Malleability	Capable of being shaped or bent
Ductility	Easily pulled or stretched into a thin wire
Luster	Has a shine or glow
Conductivity	Good transmission of heat or electricity
Allotropy	It occurs in two or more crystalline forms in the same physical state
Tensile	It can be stretched without breaking
Ferromagnetic	Easily magnetized

Table 2.2: Chemical properties of iron (Alchin, 2015)

CHEMICAL PROPERTIES OF IRON	
Chemical Formula	Fe
Toxicity	Non toxic
Reactivity with water	Reacts with very hot water and steam to produce hydrogen gas
Oxidation	Readily combines with oxygen in moist air which produces iron oxide also known as rust
Solubility	Dissolves in acids

2.5 Photodegradation with hydrogen peroxide

Production of hydroxyl radical, mostly occurs through cleavage of hydrogen peroxide and with the presence of chemical intermediate. Photolysis of hydrogen peroxide is occurring to produce hydroxyl radicals.

$$H_2O_2 + h \rightarrow OH + OH$$

This means that in order to generate a sufficient level of OH radicals, one must have a rather high concentration of hydrogen peroxide in the medium explain more: that’s why your study of different concentration. Studies also suggest that hydroxyl radical may diffuse into the solution and react with organic pollutants. Therefore, the adsorption of organic contaminants would increase the reaction rate, but it is not required in the case of radicals, they cannot diffuse far and the reaction has to take place close to the surface (Li *et al.*, 2012).

The hydroxyl radical reaction is rapid with most organic compounds, either by hydrogen abstraction or addition to double bonds, initiating a sequence of oxidative degradation reaction (Neamtu, 2000).

CHAPTER 3

MATERIALS AND METHODS

3.1 Materials

Metamifop is pesticide used in this experiment as object in photodegradation process. High performance liquid chromatography (HPLC) is used to measure the standard absorbance of metamifop. The concentration of metamifop used are 5 ppm and 10ppm.

Fe(II) ions is prepared in a aqueous form of iron (II) sulphate (Fe_2SO_4) that will be used to analyze the rate of reaction of photodegradation process. HPLC and UV-Vis spectrometer have been used to analyze it. The concentration of the Fe(II) ions used are 5 ppm and 10 ppm.

Hydrogen peroxide, H_2O_2 used to analyze how it affects the rate of photodegradation process of metamifop with presence or absence of the Fe(II) ions. The concentration of hydrogen peroxide used are 5 ppm and 10 ppm.

3.2 Characterization

3.2.1 HPLC

High Performance Liquid Chromatography (HPLC) is the instrument that is used to measure the absorbance material in the solution. Generally, it is able to separate, identify, and quantify each element in the solution. In this research, it had been used to measure the concentration of metamifop before and after the photodegradation process.

3.2.2 Laminar Flow Chamber

This study consists the use of the laminar flow chamber with UV lamp, depicting sunlight. The laminar flow used will be covered in aluminium foil in such a way that the UV light is not reflected outside the chamber. The laminar flow uses a UVX radiometer with 40µW/cm^2 and it was covered in aluminium foil in such as way that the UV light is not reflected outside the chamber. In this research, the samples were kept in this chamber as the photodegradation process has taken place as shown in appendix figure 2.

3.2.3 Ultraviolet – Visible Spectrometer (UV-Vis)

In this experiment, UV-Vis was used to read the absorbance which is metamifop.

3.3 Method

3.3.1 Preparation of stock solution

a) 1000 ppm metamifop solution

10.5g of Nominee-M formulation had been dissolved in 1L of deionized water to prepare 1000 ppm of stock solution. Aluminium foil had been used to prevent the interference of light, of the stock solution and it had been kept in a 1000 ml volumetric flask. The stock solution of metamifop then stored in refrigerator at 4ºC appendix Figure 1.

b) 1000 ppm of Fe(II) ions

The 1000 ppm of Fe(II) ion solution had been prepared by dissolving 2.7202g of Fe_2SO_4 salt in 1L of deionized water. The stock solution had been kept in a 1000 ml volumetric flask covered in aluminium foil to prevent interference of light. Then, it had been stored in refrigerator at 4°C appendix Figure 1.

c) 1000 ppm H_2O_2 solution

1000 ppm of stock solution had been prepared by dissolving 10.5g of H_2O_2 in 1L of deionised water. Aluminium foil had been used to prevent the interference of light of the stock solution and it had been kept in a 1000 ml volumetric flask. Then, the stock solution of hydrogen peroxide had been stored in refrigerator at 4ºC as shown in appendix Figure 1.

3.3.2 Preparation of metamifop with H_2O_2

a) 5ppm metamifop with 5ppm H_2O_2

1.25 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask covered with aluminium foil. Then it had been added to 1.25 ml of 1000 ppm of H_2O_2 from stock solution. The solution had been diluted with deionized water.

b) 5 ppm metamifop with 10 PPM H_2O_2

1.25 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask covered with aluminium foil. Then, it had been added with 2.50 ml of 1000ppm of H_2O_2 from stock solution.

c) 10 ppm metamifop with 10 ppm H_2O_2

2.50 ml of 1000 ppm metamifop of stock solution had been added into the 250 ml volumetric flask covered with aluminium foil. Then, it had been added to 2.50 ml of 1000 ppm of H_2O_2 from stock solution. The solution had been diluted with deionized water.

d) 10 ppm metamifop with 5 ppm H_2O_2

2.50 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask covered with aluminium foil. Then, it had been added with 1.25 ml of 1000 ppm of H_2O_2 from stock solution. The solution had been diluted with deionized water.

3.3.3 Preparation of metamifop and Fe(II) ions

a) 5 ppm metamifop with 5 ppm Fe(II) ions

1.25 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask covered with aluminium foil. It was then added with 1.25 ml of 1000 ppm Fe(II) ions from stock solution. The solution had been diluted with deionized water.

b) 5 ppm metamifop with 10 ppm Fe(II) ions

1.25 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask covered with aluminium foil. Then, it had been added with 2.50 ml of 1000 ppm Fe(II) ions from stock solution. The solution had been diluted with deionized water.

c) 10 ppm metamifop with 5 ppm Fe(II) ions

2.50 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask covered with aluminium foil. Then, it had been added to 1.25 ml of 1000 ppm Fe(II) from stock solution. The solution had been diluted with deionized water.

d) 10 ppm metamifop with 10 ppm Fe (II) ions

2.50 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask covered with aluminium foil. Then, it had been added to 2.50 ml of 1000 ppm Fe(II) ions from stock solution. The solution had been diluted with deionized water.

3.3.4 Preparation of metamifop and Fe (II) ions with the presence of H_2O_2

a) 5 ppm metamifop with 5 ppm Fe(II) ions and 10 ppm H_2O_2

1.25 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask. 1.25 ml of 1000 ppm Fe(II) ions and 2.50 ml of 1000 ppm of H_2O_2 had been added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from the surrounding area.

b) 5 ppm metamifop with 5ppm Fe (II) ions and 5 ppm H_2O_2

1.25 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask. 1.25 ml of 1000 ppm Fe(II) ions and 2.50 ml of 1000 ppm of H_2O_2 had been added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from the surrounding area.

c) 5 ppm metamifop with 10 ppm Fe(II) ions and 10 ppm H_2O_2

1.25 ml of 1000 ppm metamifop of the stock solution had been added into 250 ml volumetric flask. 2.50 ml of 1000 ppm Fe(II) ions and 2.50 ml of 1000 ppm of H_2O_2 then had been added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from the surrounding area.

d) 5 ppm metamifop with 10 ppm Fe (II) ions with 5 ppm H_2O_2

1.25 ml of 1000 ppm metamifop of the stock solution had been added into 250 ml volumetric flask. 2.50 ml of 1000 ppm Fe(II) ions and 1.25 ml of 1000 ppm of H_2O_2 then had been added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from surrounding area.

e) 10 ppm metamifop with 10 ppm Fe(II) ions with 5 ppm H_2O_2

2.50 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask. 2.50 ml of 1000 ppm Fe(II) ions and 1.25 ml of 1000 ppm of H_2O_2 then had been added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from the surrounding area

f) 10 ppm metamifop with 10 ppm Fe (II) ions and 10 ppm H_2O_2

2.50 ml of 1000 ppm metamifop of the stock solution had been added into 250 ml volumetric flask. 2.50 ml of 1000 ppm Fe(II) ions and 2.50 ml of 1000 ppm of H_2O_2 then had been added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from the surrounding area.

g) 10 ppm metamifop with 5 ppm Fe (II) ions and 5 ppm H_2O_2

2.50 ml of 1000 ppm metamifop from stock solution had been added into 250 ml volumetric flask. 1.25 ml of 1000 ppm Fe(II) ions and 1.25 ml of 1000 ppm of H_2O_2 then added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from the surrounding area.

h) 10 ppm metamifop with 5 ppm Fe(II) ions with 10 ppm H_2O_2

2.50 ml of 1000 ppm metamifop of stock solution had been added into 250 ml volumetric flask. 1.25 ml of 1000 ppm Fe(II) ions and 2.50 ml of 1000 ppm of H_2O_2 then had been added into 250 ml volumetric flask. The solution had been diluted with deionized water and covered with aluminium foil to avoid the light from the surrounding area.

3.4 The experimental setup of photodegradation system

A photodegradation system had been set up by the preparing the stock solution of all samples. Photodegradation of metamifop solution had been conducted by exposing different concentration of metamifop to UV light in the laminar flow chamber for 3 hours continuously. The Fe (II) ions had been added into the metamifop solution. The entire laminar flow chamber had been covered in aluminium foil to concentrate the UV irradiation for treatment purpose. The UV lamp had been turned on for 15 minutes for warm up before start the experiment. Hydrogen peroxide will be added into Metamifop and Fe(II) ions solution to identify the effect of hydrogen peroxide on the photodegradation of Metamifop in the presence of metal ions. The solution was allowed for treatment for 3 hours continuously under UV irridation. UV-Vis spectrometer was used to detect the concentration on metamifop before and after the treatment.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Standard calibration curve for standard metamifop

For HPLC system, the results are explained in the percentage of degradation. The corresponding concentration of metamifop standard that have been analyzed using 2 ppm, 4 ppm, 6 ppm, 8 ppm and 10 ppm were determined based on Figure 4.1.

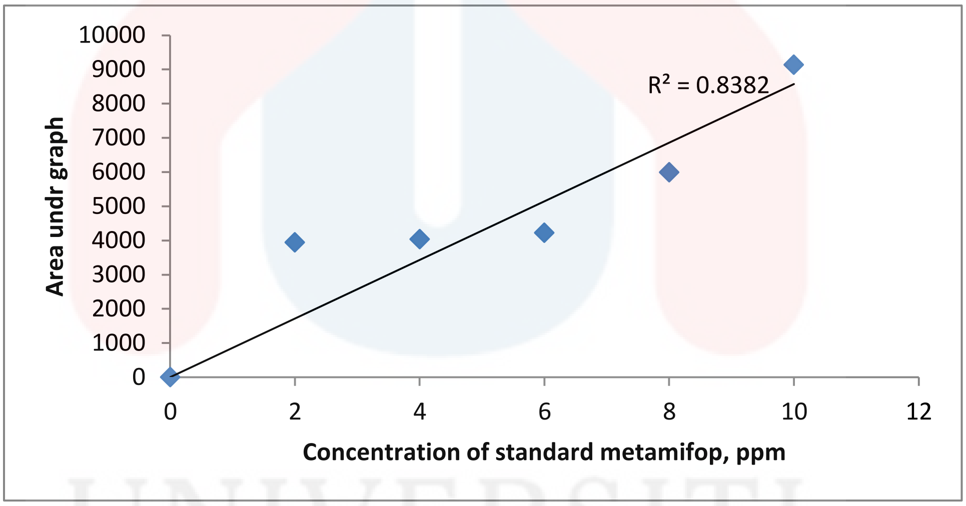

Figure 4.1: Calibration curve of standard metamifop

4.2 Photodegradation of metamifop

The effect of the Fe(II) ions and hydrogen peroxide on the photodegradation of metamifop was studied by carrying out experiments using 5 ppm and 10 ppm concentration for Fe(II) ions, hydrogen peroxide and metamifop. In this experiment, most of the results show the increment rate of photodegradation in addition of Fe(II) ion and hydrogen peroxide. Table 4.1 determine the absorbance reading for 18 samples obtained from UV-Vis Spectrometer before and after 3 hours of the treatment process.

Table 4.1: Absorbance reading for 18 samples obtained from UV-Vis before and after 30 minutes of the treatment process.

Metamifop	Fe(II) ions	H_2O_2	Initial	Final	Degradation, %
5	0	0	0.093	0.069	25.806
5	0	5	0.909	0.286	68.547
5	0	10	0.390	0.273	30.000
5	5	0	0.115	0.043	62.609
5	5	5	0.940	0.153	83.723
5	5	10	0.075	0.073	2.667
5	10	0	0.186	0.131	29.570
5	10	5	0.248	0.158	36.290
5	10	10	0.172	0.111	35.465
10	0	0	0.187	0.132	29.412
10	0	5	0.275	0.161	41.455
10	0	10	1.056	0.671	36.458
10	5	0	0.141	0.113	19.858
10	5	5	0.167	0.103	38.323
10	5	10	0.141	0.087	38.298
10	10	0	0.212	0.153	27.830
10	10	5	0.263	0.084	68.061
10	10	10	0.238	0.006	97.479

4.2.1 Effect of initial concentration of metamifop

As the result obtained, the percentages photodegradegradation of the absorbance for every sample were calculated. Figure 4.2 shows the percentage photodegradation of metamifop in concentration 5 ppm and 10 ppm. It can be seen that 10 ppm metamifop has higher rate of photodegradation than 5 ppm. The percentage photodegradation occur in 10 ppm has higher rate compared to 5 ppm.

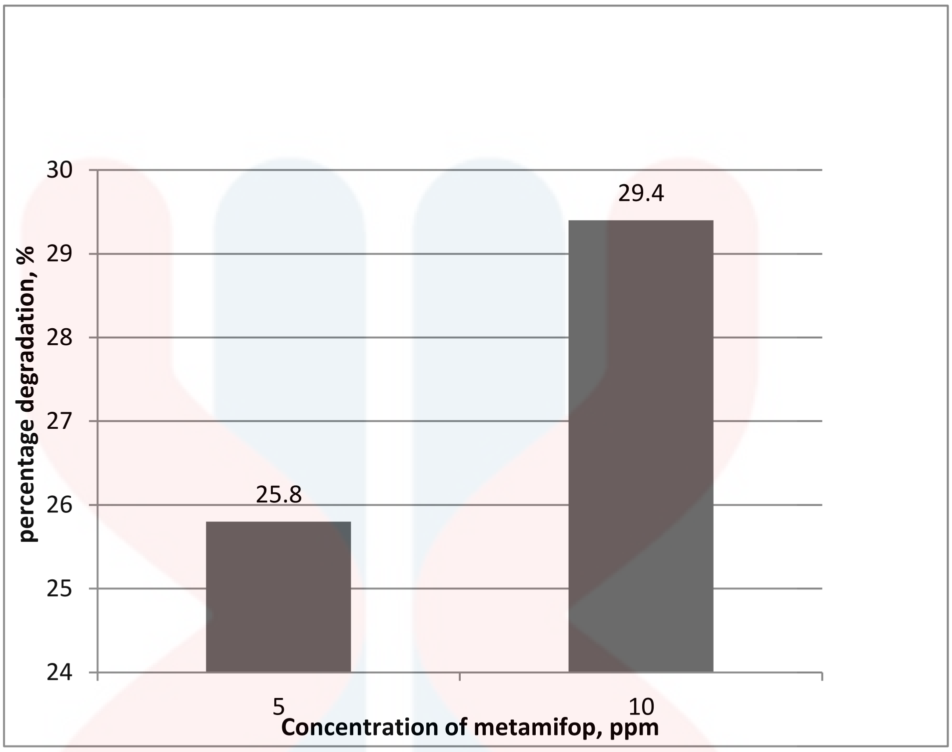

Figure 4.2: Photodegradation process of metamifop

4.2.2 Effect of Fe(II) ions

Figure 4.3 indicates the percentage of photodegradation of metamifop in presence of Fe(II) ions. Addition of 5 ppm Fe(II) ions in 5 ppm metamifop increase photodegradation rate from 25.8% to 62.6%. The experiment then proceeds with addition 10 ppm Fe(II) ions into 5 ppm metamifop. There was retardants result where the rate declined from 62.8% to 29.5%. For 10 ppm of metamifop, the results were not consistent due to beneficial and retardant effect of the Fe(II) ions.

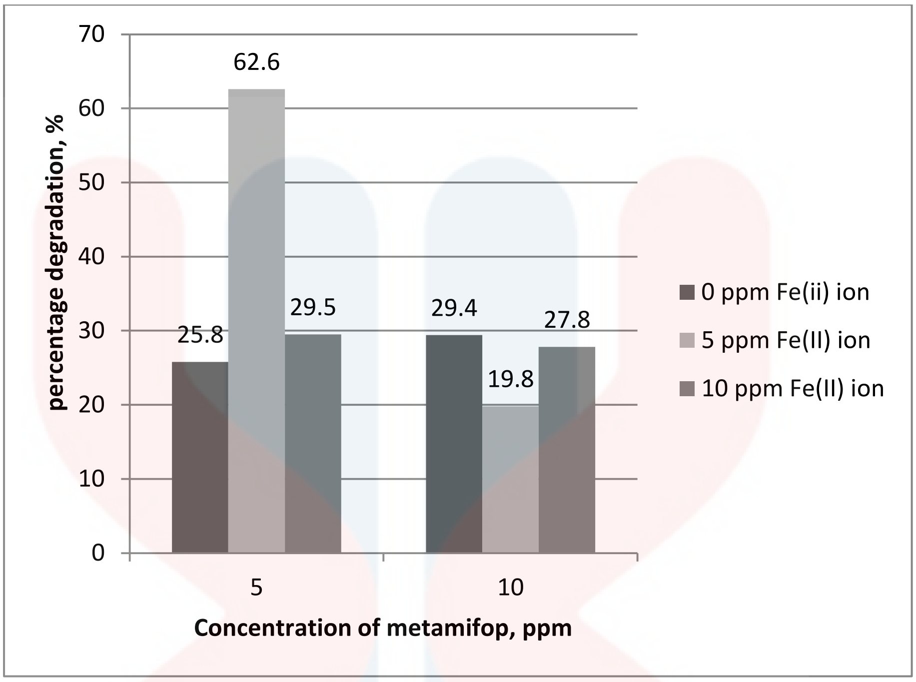

Figure 4.3: Photodegradation process of metamifop with presence of Fe(II) ions

4.2.3 Effect of hydrogen peroxide

Figure 4.4 shows the rate of photodegradation of metamifop in presence of hydrogen peroxide. Photodegradation rate for 5 ppm hydrogen peroxide in 5 ppm metamifop indicate inclined result from 25.8% to 68.9%. However, the presence of 10 ppm in 5 ppm metamifop indicate declining result where the photodegradation rate down to 30%. Meanwhile, the presence of 5 ppm hydrogen peroxide in 10 ppm metamifop has increase the photodegradation rate from 29.4% to 41.4% and decrease to 36.4% in presence of 10 ppm hydrogen peroxide.

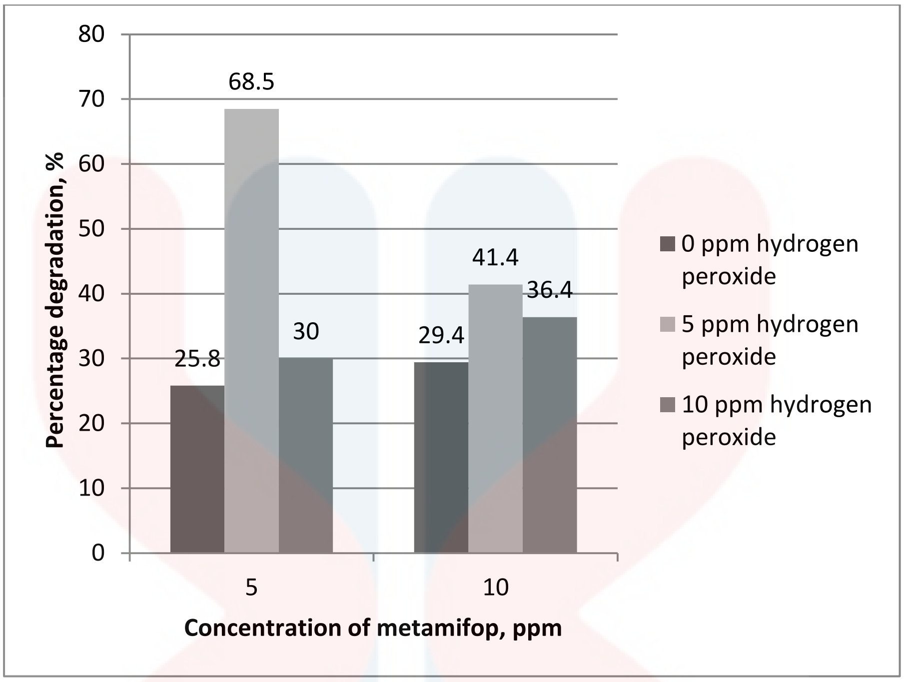

Figure 4.4: Photodegradation process of metamifop with presence of hydrogen peroxide

4.2.4 Effect of hydrogen peroxide in the presence of Fe(II) ions

Since the photodegradation process metamifop was not perform well,thus further study in the addition of hydrogen peroxide was conducted as the result in section 4.2.3 shows beneficial effect when using 5 ppm of hydrogen peroxide. .

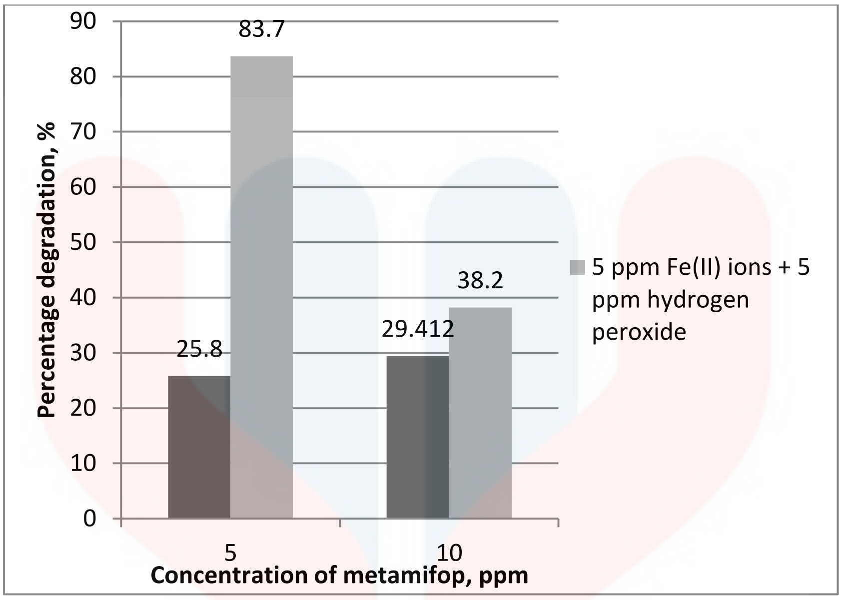

Figure 4.5: Photodegradation process of metamifop in presence of Fe(II) ions and hydrogen peroxide.

In Figure 4.5, it can be seen that the 5 ppm hydrogen peroxide boost the rate of photodegradation of metamifop with 5 ppm Fe(II) ions.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This experiment was carried out to investigate the effect of hydrogen peroxide to the rate of photodegradation of metamifop in the presence of Fe(II) ions. The presence of Fe(II) ions and hydrogen peroxide increase the rate of photodegradation of metamifop.

Overall experiment shows the highest rate of photodegradation in the condition where the concentration of metamifop is equal to the concentration of Fe(II) ions and hydrogen peroxide. Nevertheless, it will give retardant effect to the rate of photodegradation if higher concentration of Fe(II) ions and hydrogen peroxide used.

5.2 Recommendation

The control of organic pollutants in water is a matter for the Malaysian that concern about environmental sustainabiliy. The government had limit the discharge of the organic compounds by implementing the environmental regulation (DOE, 2013). Since, the pesticide that contain metamifop is commonly used in Malaysia, the step to counter the pollution must be taken to reduce the side effect of pesticide. UV can be used for the water treatment with the addition of hydrogen peroxide and heavy metal such Fe(II) ions in standard concentration because of its benefical effect on the rate of photodegradation.

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APPENDIX

Figure 1: Stock solution had been prepared

Figure 2: Samples were being treated in laminar flow chamber