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RADIATION-INDUCED DEGRADATION OF PIRIMIPHOS METHYL IN AERATED SOLUTION*

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ABSTRACT

RADIATION-INDUCED DEGRADATION OF PIRIMI'HOS METHYL IN AERATED SOLUTION. Degradation of pirimiphos methyl insecticide as Minawet 250 EC formulation in aqueous solution was studied. The absorbance, pH, COD (chemical oxygen demand) in aerated solution, and the analyses of degradation products a various irradiation doses with dose rate of 5 kGy/h were measured. The absorbance decrea:ed with the increasing dose. At low doses (≤ 10 kGy), the absorbance decreased rapidly at a :id pH (pH 3.6), while at high doses (> 10 kGy) decreased slowly. The optimum irradiati:n dose for pirimiphos methyl degradation in aerated solution of Minawet 250 EC was found o be 15 kGy at pH 3.6. At that condition, more than 99% of pirimiphos methyl has been de graded and the COD decreased about 82%. Meanwhile, at doses ≤ 5 kGy, the pHs of solution s decreased sharply to 3.5, and at doses > 5 kGy the pHs decreased slowly. The analysis of irradiated samples at optimum condition showed that 2-ethylamino-6-methyl-4-oxo-3,4-dihy dropyrimidine and oxalic acid were formed, as identified by GC-MS and HPLC, respectively.

ABSTRAK

PENGARUH RADIASI PADA DEGRADASI PIRIMIFOS METIL DALAM LARUTAN YANG DIAERASI. Penguraian pirimifos metil sebagai formulasi Minawet 250 EC dalam larutan telah dipelajari. Pengukuran dilakukan terhadap absorbansi, pH, COD (kebutuhan oksigen kimiawi) dalam larutan yang diaerasi, dan analisis produk degradasi pada berbagai dosis dengan laju dosis 5 kGy/jam. Absorbansi larutan berkurang dengan bertambahnya dosis. Pada dosis rendah (≤ 10 kGy), absorbansi menurun dengan cepat pada pH asam (pH 3,6), sedangkan pada dosis tinggi (> 10 kGy) menurun secara perlahan. Kondisi iradiasi optimum untuk penguraian pirimifos metil dalam larutan Minawet 250 EC yang diaerasi ialah dosis iradiasi 15 kGy dan pH 3,6. Pada kondisi tersebut > 99% pirimifos metil

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telah terurai dan COD berkurang sebanyak 82%. Selain itu, pada dosis ≤ 5 kGy, pH larutan menurun dengan tajam sampai 3,5, dan pada dosis > 5 kGy pH larutan menurun dengan perlahan. Analisis sampel yang telah diiradiasi menggunakan GC-MS and HPLC menunjukkan bahwa 2 diantara senyawa hasil degradasi ialah 2-etilamino-6-metil-4-okso-3,4-dihidropirimidin dan asam oksalat.

INTRODUCTION

Along with rapid development of industry, the use of various organic compound are increasing. In Indonesia, pesticide industries have developed fastly, and this will produce waste from the raw materials and active ingredients. If it is not managed by good handling, the waste will cause pollution to the environment.

Some methods for treatment of waste water such as by absorption using activated charcoal, aeration, coagulation, or oxidation using ozon had been conducted, but so far no satisfactory results was obtained. So, more effective and efficient methods are still needed.

SUN and PIGNATELLO [1] reported that 60% of 2,4-dichlorophenoxy acetic acid could be degraded by UV irradiation combined with the addition of Fe^{3+}/H_2O_2 as catalyst. Oxalic acid was identified as an intermediate compound.

The use of ionizing radiation to eliminate non biodegradable organic pollutants in raw material of drinking water and waste water had been investigated by many researchers [2-4]. Based on the previous research, the degradation of fenitrothion and prothiophos insecticides in aerated aqueous solution using gamma radiation could reach 90% (initial concentration was 50 mg/L) at the dose of 6 and 8 kGy, respectively [5,6]. One of the degradation products was oxalic acid.

In this research, degradation of pirimiphos methyl insecticide as Minawet 250 EC formulation was studied. Generally, this insecticide is used for controlling a wide range of pests of building and stored products, namely fruits, vegetables, and other crops [7]. The chemical name of pirimiphos methyl is *O*-(2-diethylamino-6-methylpyrimidin-4-yl)-*O*,*O*-dimethyl phosphorothioate. Its structural formula can be seen in Figure 1.

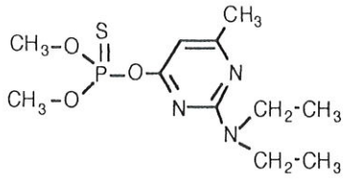

Figure 1. Structural formula of pirimiphos methyl