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Remediation of Pesticide Endosulfan in solution by Ionizing Radiation, Advanced oxidation Process and Copper nano particle Interaction a comparative studies using GC-MS analysis.

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Abstract. *Pesticide Endosulfan in acetonitrile solution conc in the range1000ppb-1600ppb were subjected to gamma radiation dose for 5kGy to 50kGy and decay profile was found to be exponential , however there was never complete diminution of conc of Endosulfan. But copper nanoparticle solution added in aliquots have found to complete annihilates the endosulfan . The conc. of Endosulfan has been monnitored using SHIMADZU GCMS QP2010PLUS. Similarly advanced oxidation by passing Ozone gas to Endosulfan solution in acetonitrile leads to conversion of endosulfan to endosulfan diol a 1000times less toxic product. But complete annihilation of Endosulfan does not takes place. Thus copper Nano particle interaction seems to be easy and technically suitable as one has to just add nano particle solution. in endosulfan solution whereas in case of gamma radiation and Advanced oxidation process to bring the contaminated solution under the appliance there can be technical difficulty for the treatment and also complete annihilation will take more time.*
Key word: *Pesticide ,Endosulfan ,Copper nano particle, Remediation, Gamma Radiation.*

I. Introduction

The increase of human population globally demand for more food thus the use of pesticides ushered. It leads to increase of production by 30%[1]. Endosulfan a pesticide is highly used still in many parts of the world. The residual endosulfan left over in soil finally goes to water reservoirs. The residual pesticides in solution are highly toxic to aquatics , birds and mammalians and even human population[2].Hence remediation process like Gamma irradiation , and advanced oxidation Process and interaction of Copper nano particles has been tried for remediation of endosulfan in solution .

Endosulfan is widely used organo chloride pesticide. Technical grade Endosulfan exists in α and β stereoisomers in the ratio 2:1. Endosulfan is highly soluble in organic solvents.The solubility in water is only 0.33ppm.The residual pesticides of endosulfan left over in agriculture field is great environ concern**.**The Lethal concentration of endosulfan LC50 for aquatics is 1ppblevel.The death of fishes has already been reported from the water contaminated with endosulfan . Degradation and detoxification of endosulfan using various methods like microbiological decontamination and interaction with metal nanoparticles like Gold or silver [3,4] and ultraviolet radiation has been reported in literatures.However these methods are very slow in action and takes several days for complete decontamination. This paper presents a comparative studies of degradation of endosulfan using gamma radiation and its interaction with copper nano particle and advanced oxidation process subsequent analysis of endosulfan by GC-MS. technique.

II. Experimental

Endosulfan Pestanal grade was procured from Fluka Germany. Acetonitrile was procured from Merck India.Copper nano particle was generated reduction of copper sulfate by sodium boro hydride. as described method [5]

1000ppb solution of endosulfan in acetonitrile war irradiated with gamma radiation for different absorbed doses n Gamma chamber 5000 at ISOMED BARC having a dose rate of 3kGy/hr The conc. of endosulfan after irradiation was monitored by GC-MS analysis using SHIMADZU GC MS QP 2010 plus system. Similarly 1500ppb solutions of endosulfan was made to react 1ml,2ml,3ml,4ml and 5ml of milli molar conc of Cu nano particle solution and final product was analyzed by GC-MS QP 2010Plus .Ozone was passed in to the solution of Endosulfan in which H2O2 was added using Ozone Generator. The final product was analyzed by GC-MS.

Structures of Endosulfan and its metabolites

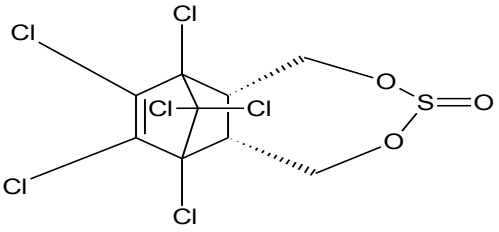


Fig.1 endosulfan alpha isomer

$C_9H_6Cl_6O_3S$

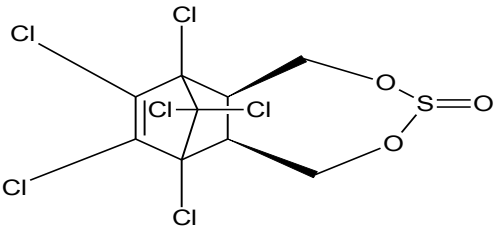


Fig.2 endosulfan beta isomer

$C_9H_6Cl_6O_3S$

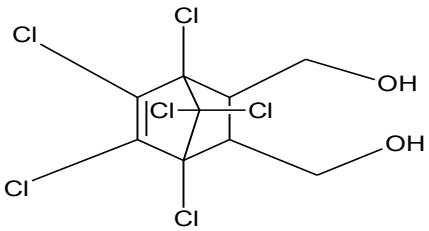


Fig.3 endosulfandiol

$C_9H_8Cl_6O_2$

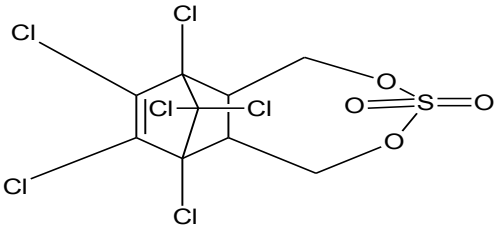


Fig.4 endosulfan sulfate

$C_9H_6Cl_6O_4S$

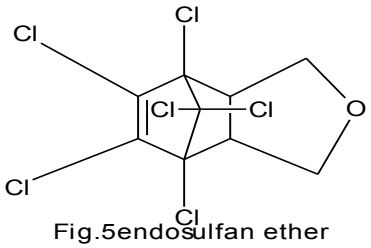


Fig.5endosulfan ether

$C_9H_8Cl_6O$

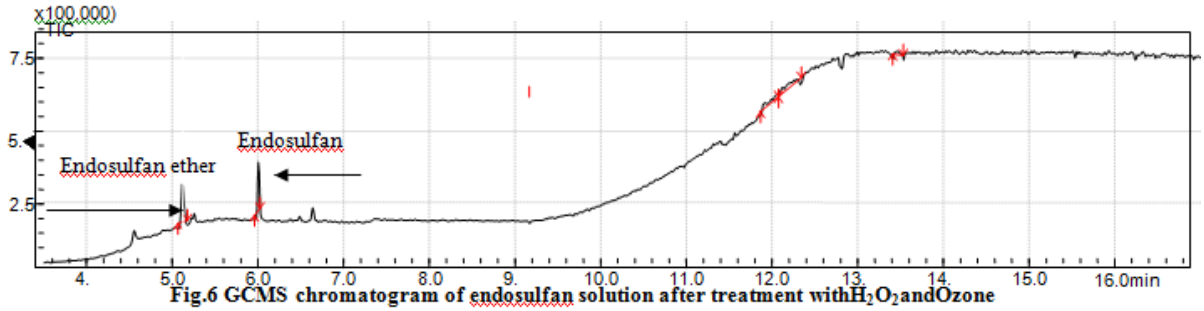


Fig.6 GCMS chromatogram of endosulfan solution after treatment with H_2O_2 and Ozone

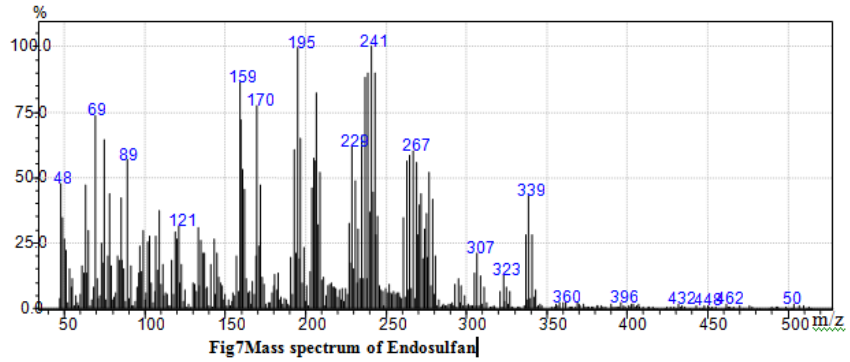


Fig7Mass spectrum of Endosulfan

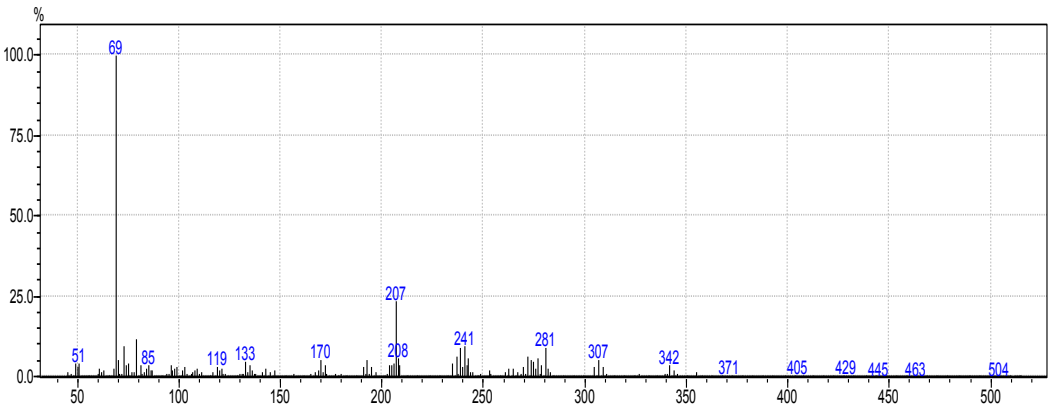


Fig.8 Mass spectrum of Endosulfan ether

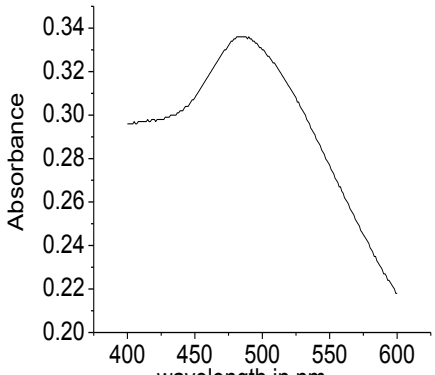


Fig.9 Copper nano Particle Plasmon band

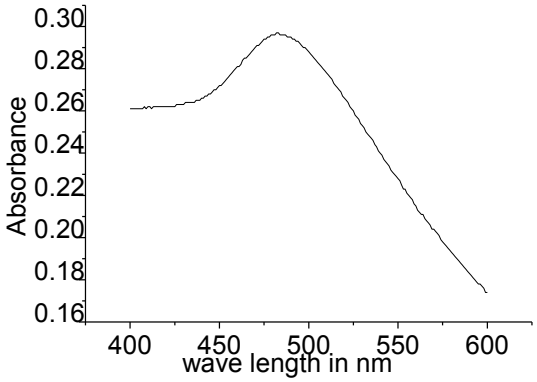


Fig.10Copper nano particle after 1hr.

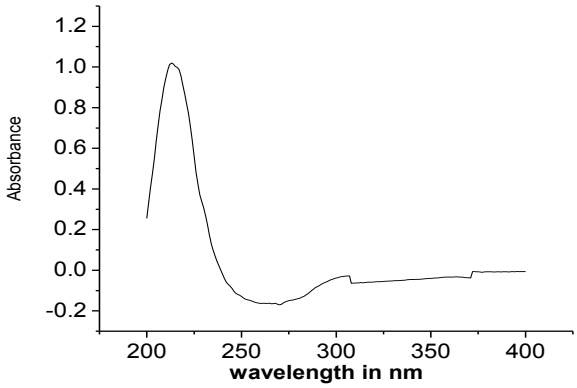


Fig.11endosulfan 100ppm.

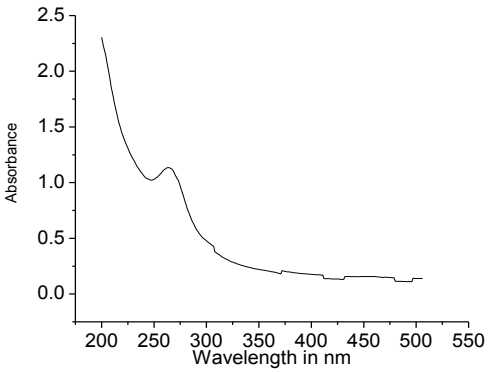


Fig.12 **cu nano particle + endosulfansolution.**

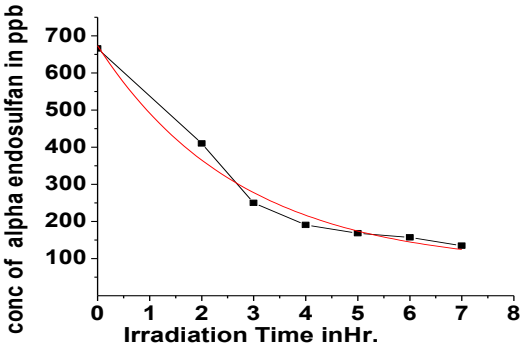
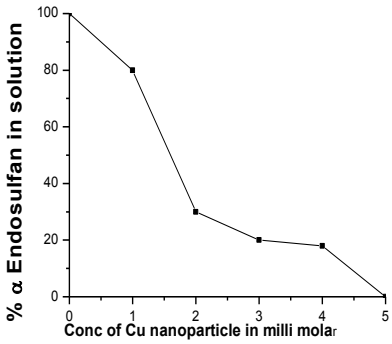


Fig.13 Degradation Profile of Alpha endosulfan under gamma irradiationn



III.Results and Discussion . Ionizing radiation degrades the product Endosulfan subsequently as the dose is increased the products degrades in the exponential way. Hence the conc of Endosulfan will never be zero. In case of H2O2 treatment along with Ozone it oxidizes the product endosulfan to endosulfan ether which is 1000times harmless as compared to endosulfan.

Mechanism $H_2O_2+H_20 \rightarrow HO_2^- + H_3O+$

$O_3+HO_2^- \rightarrow OH^{\cdot} + O_2^- + O_2$

$OH^{\cdot}$ + organic compound → oxidized product

In case of Copper nano particle interaction it forms some complex as visualized by UV absorption spectrum as shown in Fig.9 shows the Plasmon band of copper nano particle at 500nmFig10 after one hr the Plasmon band at 500nm but it decays Fig11.UV visible absorption of endosulfan solution at213nm. and Fig.12.UVvisible spectrum of endosulfan solution and copper nano particle solution when mixed, the copper plasmon band at 500nm andendosulfan absorption at 213nm. both disappears at resultant solution absorbs at 260nm. Thus it completely annihilates the Endosulfan in solution[7]. Fig.13 show the decay profile of alpha endosulfan along with absorbed Gamma radiation dose.Fig.14 shows how the conc. of endosulfan decreases by addition of copper nano particle.

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