Study of photochemical and sonochemical processes efficiency for degradation of Acibenzolar-S-Methyl fungicide in aqueous solution

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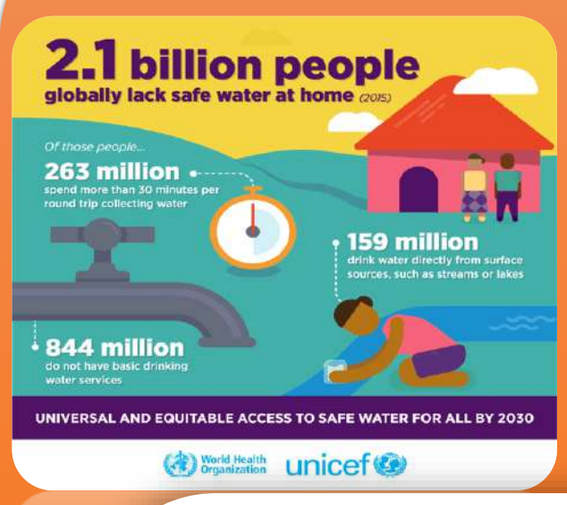
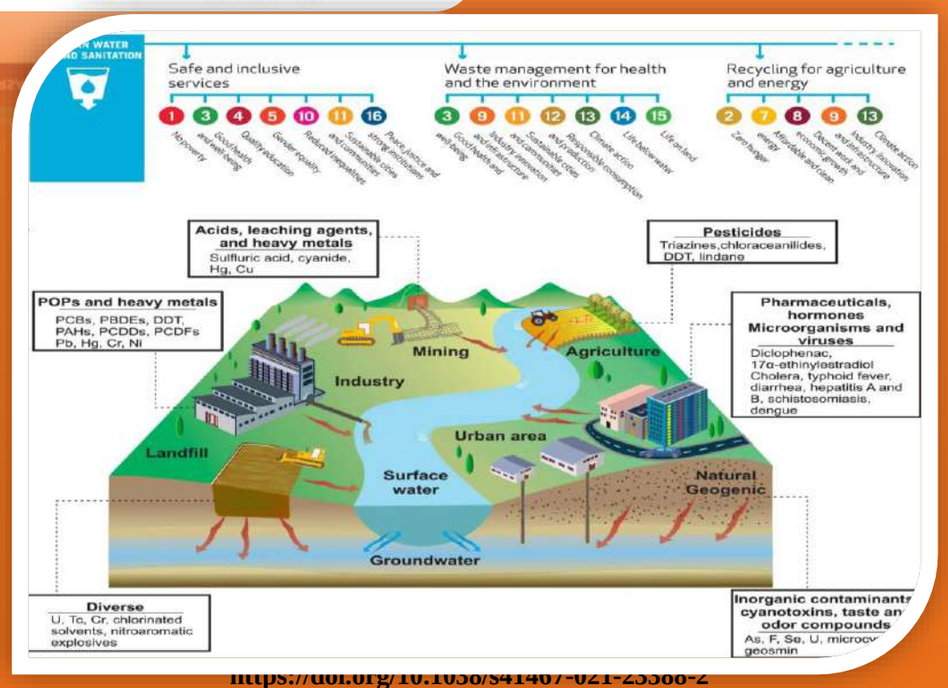
Abstract

In this study, the catalytic performance of Photo-Fenton and sono-Fenton processes were tested on Acibenzolar-S-methyl fungicide. UV light source and ultrasound irradiation source (20 kHz of the frequency with a maximum of 125W power output) were used for Fenton-based reaction. The sono-Fenton process is the most effective in ASM degradation with a 100% degradation rate within 20 min compared to photo-Fenton, Fenton, photolysis, and sonolysis processes that achieved only 90%, 52%, 43% and 19%, respectively. The investigation shows that ultrasound irradiation has accelerated the efficiency of the Fenton process by increasing the hydroxyl radicals •OH generation. The kinetic study was carried out under different pH conditions, ferrous ions concentration and hydrogen peroxide dosages. The result showed that the optimum condition for acibenzolar-s-methyl degradation is at acidic pH medium, low concentration of hydrogen peroxide and ferrous ions. The contaminant was monitored with high-performance liquid chromatography. A transformation mechanism pathway of the sonochemical oxidation was suggested based on gas chromatography/mass spectra analysis.

Introduction

Overview of Global Water issues





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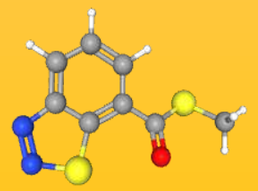
Materials & Methods

❑ Substrate

Acibenzolar-S-Methyl



Fungicide

Formula: $C_8H_6N_2OS_2$

Molecular weight : 210.28 g.mol^{-1}

❑ Treatment processes

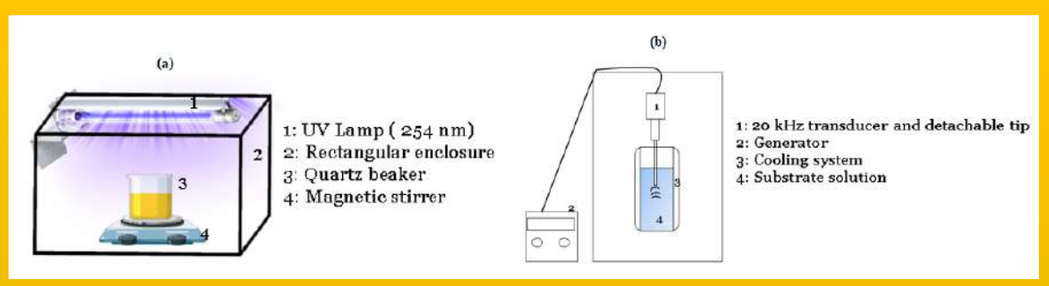


Fig.1: (a) Irradiation UV light system **(b)** ultrasonic radiation system

Results & Discussion

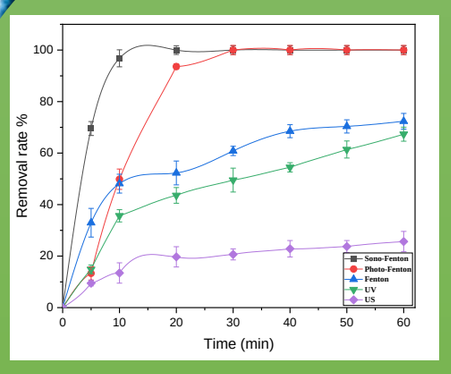


Fig.2: ASM degradation under different processes

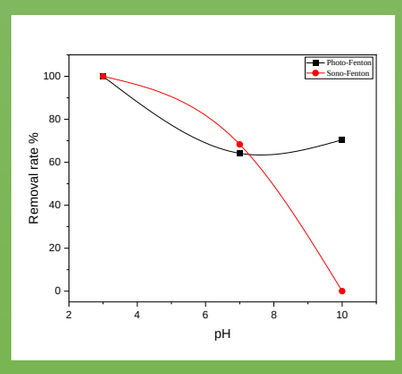


Fig.3: Effect of initial solution pH on Photo-Fenton and Sono-Fenton processes

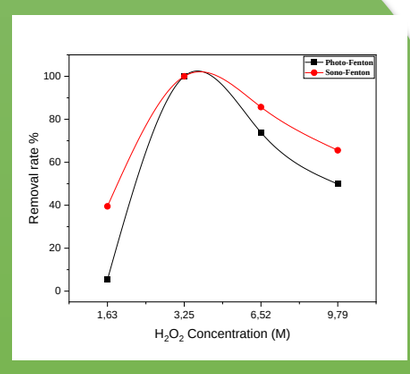
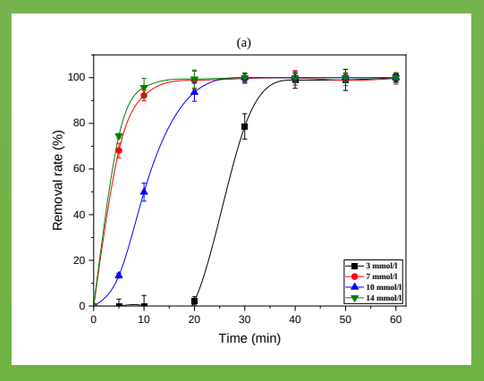


Fig.4: Hydrogen peroxide concentration effect



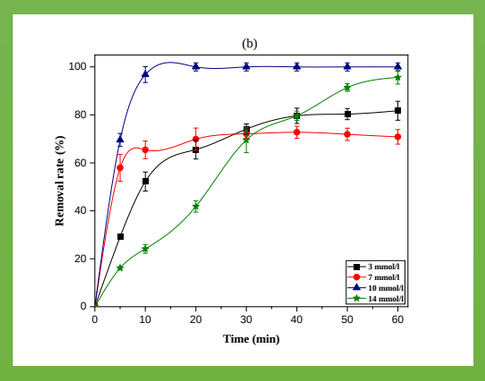


Fig.5 : Ferrous ions concentration effect on processes

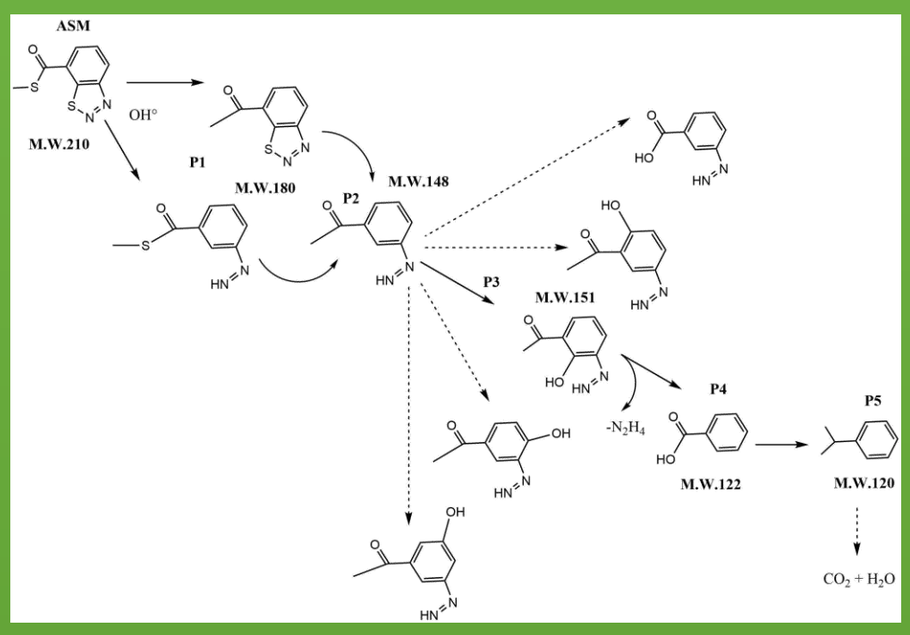


Fig.6: Proposed pathway of sonochemical transformation of ASM

Conclusion

The photochemical and sonochemical degradation performance of Acibenzolar-S-methyl were investigated under different conditions. First, the kinetic study was monitored with the HPLC analysis method. The sono-Fenton process was found to be the most effective for compound degradation (100% within 20 min) compared to other used treatments. The performance was affected by physic-chemical parameters, including pH medium, oxidant dosage, and concentration of ferrous ions. Finally, based on the extracted samples analysed with the GC/MS technique, a series of metabolites were observed that suggest the ASM sonochemical transformation pathway mechanism.