

PRELIMINARY STUDY OF THE REMOVAL OF ACETAMINOPHEN FROM WASTEWATER

Florinela Pirvu^{1,2}, Cristina Ileana Covaliu^{1*}, Gigel Paraschiv¹, Iuliana Paun², Gina Alina Catrina (Traistaru)²

¹University Politehica of Bucharest, 313 Splaiul Independentei Street, București, 060042, Romania

²National Research and Development Institute for Industrial Ecology - ECOIND, 71-73 Drumul Podu Dambovitei, Street, 060652 Bucharest, district 6, Romania

INTRODUCTION

Acetaminophen (paracetamol) is a pharmaceutical drug for curing fever, headaches and body aches. The main areas that pollute the environment with acetaminophen and its residues come from hospitals, domestic and veterinary effluents and the pharmaceutical industries. Pharmaceutical drugs have appeared in our environment and entered as residues in rivers, sewage effluents, surface, soil and drinking water.

The adsorption method is economically and technically favourable for wastewater treatment. This technique consists in the ability of the adsorbent material to absorb on its surface's pollutants and its residues from wastewater from the environment.

Fe₃O₄ nanomaterial has been used as an adsorbent due to its high pollutant removal efficiency, small particle size and maximum internal surface area. The specific surface area of the adsorbent material is important because the removal efficiency generally increases with increasing surface area.

MATERIALS AND METHODS

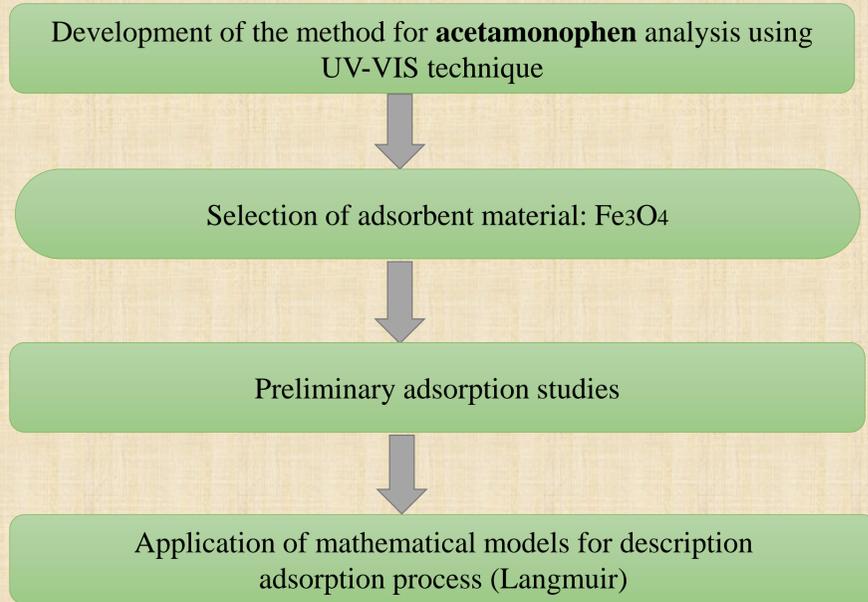


Figure 1. The experiments preparation scheme

EXPERIMENTAL PART

For this study, magnetite (Fe₃O₄) nanomaterial was selected as the adsorbent material. During the experiments, the initial concentration of acetaminophen in wastewater was in the range 10 mg/L - 25 mg/L. The studied parameters were: pH (4, 6, 8), contact time (2h, 4h, 6h, 8h, 24h), the amount of adsorbent material (0.20g and 0.40g) and the adsorption isotherm (Langmuir). To determine the concentration of acetaminophen in wastewater, a method of analysis was developed using the UV-VIS technique at a wavelength of 297 nm. The analysis method was developed to evaluate the performance parameters of the method: LOD detection limit, LOQ quantification limit, repeatability, intermediate accuracy and extended uncertainty.

CONCLUSIONS

It can be concluded that the physical properties of Fe₃O₄ adsorbent material are properly to adsorb the acetaminophen from wastewater.

In about 8 hours of contact of wastewater with the adsorbent, the maximum rate of acetaminophen removal was 70%, using 0.40g of adsorbent in comparison with 0.20g adsorbent material with 32% at 6 value of pH.

The proposed method is simple, sensitive, rapid, specific and could be applied for monitoring of acetaminophen and by-products from wastewater.

ACKNOWLEDGEMENTS

Doctoral School of Biotechnical Systems Engineering within the Polytechnic University of Bucharest.

RESULTS AND DISCUSSION

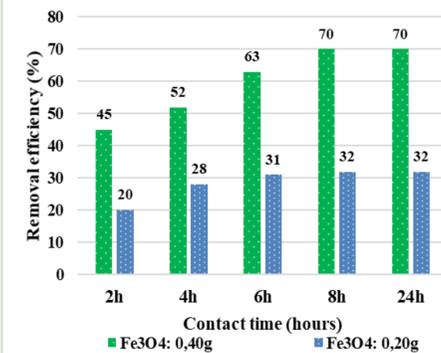


Figure 2. The removal efficiency of acetaminophen using Fe₃O₄ nanomaterial depending on the contact time

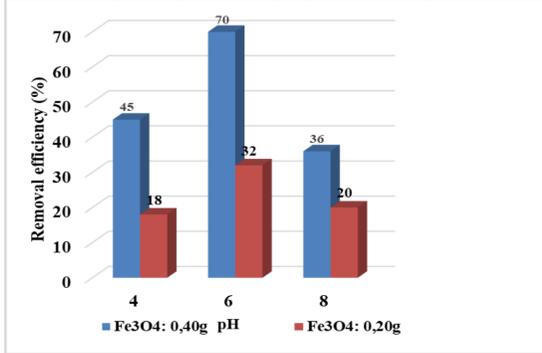


Figure 3. The removal efficiency of acetaminophen using Fe₃O₄ nanomaterial depending on the pH

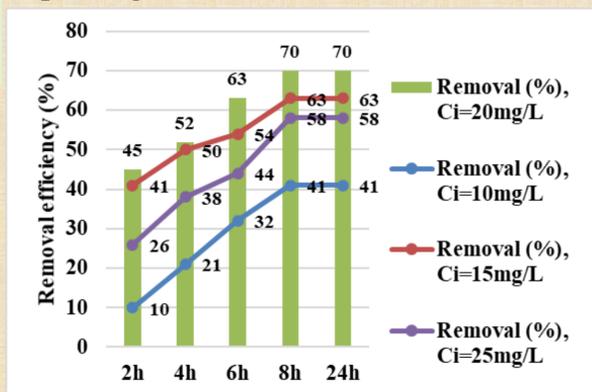


Figure 4. The effect of contact time on the removal efficiency of acetaminophen

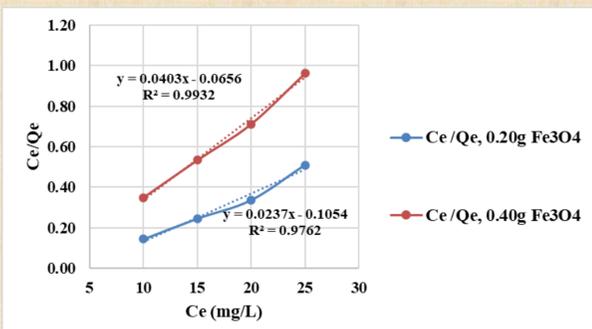


Figure 5. Langmuir linearized isotherm for acetaminophen removal using different dosage of Fe₃O₄

To determine the concentration of the wastewater samples, appropriate dilutions were made to fit the concentration range 0.10-0.50 mg/L. The most representative results are shown in Figures 2, 3 and 4. Higher removal efficiency was obtained at pH 6, using 0.4 g of adsorbent material (70%) compared to 0.2 g of adsorbent material (32%) as can be seen in figure 2 and figure 3. From the obtained results it can be said that the adsorption process can be influenced by experimental parameters such as: amount of adsorbent, adsorbent concentration, pH and contact time.

The amount of adsorbent material Fe ₃ O ₄	Langmuir parameters			
	Q _{max} (mg/g)	K _L (L/mg)	R _L	R ²
0.40 g	55.6	0.105	0.88	0.9932
0.20 g	31.8	0.159	0.99	0.9762

Table 1. The Langmuir adsorption parameters

The Langmuir adsorption isotherm was used to describe the adsorption data for the adsorption process of acetaminophen on Fe₃O₄. The best Langmuir results are explained by the correlation coefficient (R²) and the equilibrium parameter (R_L) which is in the range 0 - 1 (0.88 for Fe₃O₄). The value of 0.88 obtained for R_L (equilibrium factor) supports the correlation of the data obtained with the Langmuir model.

