# Efficiency of a Magnetic Multi-Core Shell Catalyst in the Degradation of Paracetamol and Sulfamethoxazole: A Catalytic Wet Peroxide Oxidation Approach

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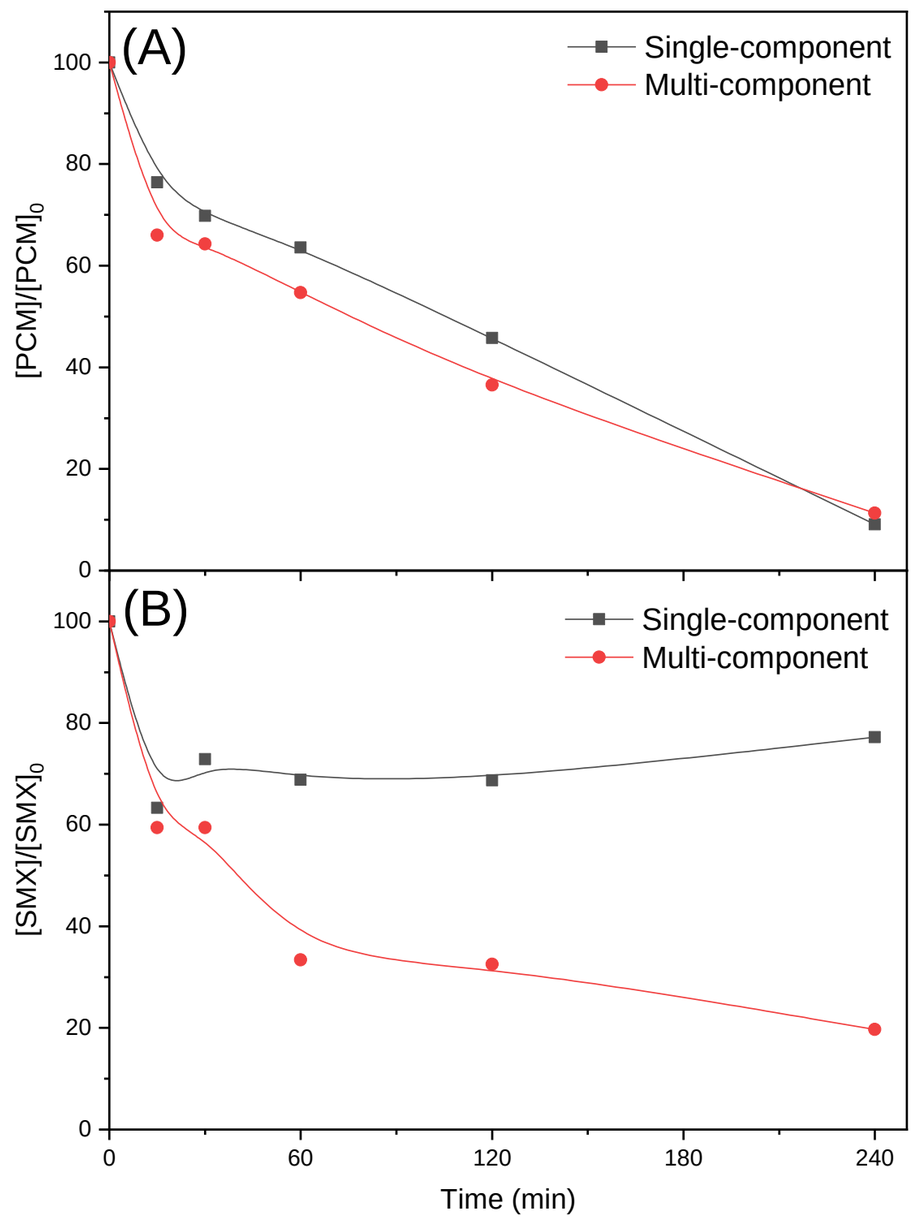
## INTRODUCTION

The UN 2030 agenda aims to achieve sustainable water resource utilization and conservation, as water is a crucial natural resource for all organisms and human activities. With shrinking global resources and tightening legislation, the industrial sector is requiring innovative technologies to treat and manage water efficiently. Proper removal and neutralization of organic pollutants in wastewater, including pharmaceutically active compounds, synthetic hormones, food additives, and personal care products, is a major environmental challenge. These pollutants are constantly discharged into the environment, causing adverse effects on ecosystems and humans.

## METHODOLOGY

The catalysts were synthesized in a two-step process. The core was initially synthesized via a coprecipitation methodology with iron (III) nitrate nonahydrate and cobalt (II) nitrate hexahydrate, the cobalt ferrite core was dried and then passivated in an iron (III) nitrate nonahydrate solution, followed by the sol-gel synthesis of the niobium pentoxide shell where were used niobium (V) chloride and ammonium hydroxide solution.

The tests were conducted with three different matrixes, two in single components ([SMX] =10 ppm or [PCM] =100 ppm) and one in multi-component ([SMX] = 10 ppm and [PCM] = 100 ppm). The liquid-phase oxidation reactions were carried out at 80 °C, pH 3.5, and stirring at 300 rpm and a catalysts concentration of 2.5 g L-1. .




Graph 1 – (A) PCM concentration over time and (B) SMX concentration over time

## RESULTS

Results showed that the catalyst maintained its magnetic property, accelerating the removal process from the matrix and resisting the CWPO process, not showing leaching. In single-component matrices, the degradation of PCM and SMX led to the removal of approximately 90.9% of PCM and 22.8% of SMX within 4 hours. However, in the case of multi-components, 88.7% of PCM and 80.1% of SMX were removed within the same time frame, indicating a potential synergy between the catalyst and the pollutants.

## CONCLUSIONS

In conclusion, the degradation of the pharmaceuticals by the new catalyst developed proved to have a high degradation rate and low toxicity.

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