



## ALUMINA-SUPPORTED STRONTIUM OXIDE AS HETEROGENEOUS CATALYST FOR THE DETOXIFICATION OF AN ORGANOPHOSPHORUS CHEMICAL WARFARE AGENT SIMULANT

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### INTRODUCTION

The Organization for the Prohibition of Chemical Weapons (OPCW) establishes that chemical warfare agents throughout the world must be declared and destroyed safely and quickly. The academic community and industries are developing research on chemical detoxification, due to the existence of large stockpiles of such warfare agents waiting destruction. Methyl paraoxon is a neurotoxic organophosphate typically employed as a simulant of organophosphorus chemical warfare agents in chemical detoxification research. Long-term exposure to methyl paraoxon causes neurological impairments to human beings, while high doses ( $LD_{50} = 10 \text{ mg/kg}$ ) causes death through permanent inhibition of acetylcholinesterase. This study investigated the detoxification of methyl paraoxon using alumina-supported strontium oxide as catalyst.

### MATERIAL AND METHODS

The catalysts were prepared by wet impregnation. Strontium nitrate was dissolved in distilled water and added to alumina in two mass ratios, 1:5 (A) and 2:5 (B) ( $\text{SrO}:\text{Al}_2\text{O}_3$ ). The mixture was dried under mild heating and continuous stirring. The resulting material was heated to 700 °C for 2 h using a muffle furnace. The catalysts were characterized by specific surface area ( $\text{N}_2$  adsorption) and composition (Fourier-Transform Infrared Spectroscopy). Kinetic assays were carried out as follows:  $1.38 \times 10^{-5} \mu\text{mol}$  of methyl paraoxon

was added to 20 mL of 1-propanol containing 300 mg of the catalyst. The reactor was maintained at 80 °C, under inert atmosphere and intense stirring. The reaction extent was monitored by UV-Vis spectrophotometry at 405 nm.

### RESULTS

The catalysts A and B had specific surface area of 70.81 and 63.33  $\text{m}^2/\text{g}$ , respectively. Infrared spectra showed bands at 600 and 460  $\text{cm}^{-1}$ , suggesting the presence of strontium oxide. The propanolysis using catalyst A was found to behave as a pseudo-first order reaction with  $k = 0,1317 \times 10^{-3} \text{ s}^{-1}$ , while catalyst B caused a change in the reaction order after approx. 200 min, to a slower zero-order reaction.

### CONCLUSIONS

Catalyst A promoted reaction rate enhancements in the order of  $9 \times 10^5$ -fold in comparison to the spontaneous propanolysis reaction. Interestingly, in the target reaction, the toxic methyl paraoxon is converted into a trialkyl phosphate triester, which is structurally related to a family of flame-retardant polymer monomers.

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