247b Ozone-Enhanced Catalytic Oxidation of Dimethyl Methylphosphonate and Dimethyl Sulfide

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The US Army is challenged to destroy stockpiles of chemical weapons in several locations around the country. Incineration has been used at Johnston Atoll and at Dugway Proving Grounds, Utah. However, due to public concern, alternative methods for the destruction of chemical warfare agents have been sought. Catalytic oxidation has been considered for the destruction of chemical warfare agents, but due to the fouling nature of sulfur and phosphorous to catalysts, it has found limited success.

We have investigated a low-temperature method for destroying gas-phase organophosphorus and organosulfur compounds over ozone-enhanced titania/vanadia catalysts. Dimethyl methylphosphonate and dimethyl sulfide were selected to represent chemical warfare agents in our lab. We have found that the catalysts are significantly more active in the presence of ozone than without ozone, and the service life of the catalyst appears to be enhanced in the presence of ozone.

The operating conditions, including chemical concentration, ozone / chemical ratio, residence time, and reactor temperature are significant to the destruction of the selected chemical warfare agent simulants. Efforts were made to understand the mechanism of the reactions on the catalyst surface with and without ozone.

Possible applications of this process include secondary treatment of the flue gas from chemical agent incineration, homeland security to protect air ducts of buildings and other public places from chemical agent vapors, and mobile or stationary collective protection for soldiers.