

## **Fabrication of NaX zeolite/ZnFe<sub>2</sub>O<sub>4</sub> as a magnetically separable nanocomposite catalyst for the removal of sulfur mustard agent simulant from aqueous solution**

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### **Abstract**

In the present research, ZnFe<sub>2</sub>O<sub>4</sub> nanoparticles were successfully supported on the NaX zeolite by the ultrasonic-assisted hydrothermal route to achieve the magnetically separable NaX/ZnFe<sub>2</sub>O<sub>4</sub> nanocomposite catalyst. The as-fabricated nanocomposite was identified applying FESEM, EDAX, XRD, FTIR, AFM, and VSM analyses. The NaX/ZnFe<sub>2</sub>O<sub>4</sub> nanocomposite was then used for the effective removal of sulfur mustard agent simulant 2-chloroethyl ethyl sulfide (2-CEES) from aqueous solution and monitored by the GC-FID and GC-MS analyses. Besides, the influences of multiple factors such as contact time, catalyst amount and catalyst type on the removal efficiency of 2-CEES were investigated in detail. By applying 100 mg of NaX/ZnFe<sub>2</sub>O<sub>4</sub> nanocomposite in n-hexane solvent, a removal yield of 100% was attained after 120 min of contact time. Lastly, the presence of elimination and hydrolysis products, including ethyl vinyl sulfide (EVS) and 2-hydroxy ethyl ethyl sulfide (2-HEES) from the 2-CEES degradation on the NaX/ZnFe<sub>2</sub>O<sub>4</sub> nanocomposite were clearly affirmed.

Keywords: NaX/ZnFe<sub>2</sub>O<sub>4</sub>, nanocomposite catalyst, removal, 2-CEES, EVS, 2-HEES.