The objective of this experiments is to investigate the feasibility of our newly designed bench-scale reactor for oxidation of chemical agent simulants at supercritical water conditions.

**Fate of Sulfur Mustard**

TCI (a mixture of thioglycol [TDG, (HOCl)₂C₂H₄], 10 wt.% and hydrochloric acid [HCl] 1 wt.%) → simulant for Henimustard

**Thiodiglycol**

- General observation:
  - pH input: 6 - 7
  - pH output: 0 - 1
  - The reactor effluent was clear
  - There was no a distinct odor
  - CD and H₂S were not detected in the gases effluent
  - No deposits on the pressure vessel or on the filter

- Conversion increases with higher reaction temperature, oxidant and TOC concentration of the feed, in a good agreement with previous experiments (Ind. Eng. Chem. Res. 44 (2005) 9014-9019).
- TOC conversions were all > 99.4% and the TOC value of effluent < 3 ppm.

- Conversion increases with higher reaction temperature and oxidant concentration.
- When the TOC conversions were > 99.7%, the TOC concentrations at the reactor outlet were all < 4 ppm.

- Carbon balance:
  - The detectable carbon: CO₂
  - Average value: 100.4% ± 2.5%
  - Range: 96.1% - 105%

- Carbon balance:
  - Conversion increases with higher reaction temperature and oxidant concentration.
  - When the TOC conversions were > 99.7%, the TOC concentrations at the reactor outlet were all < 4 ppm.

- Carbon balance:
  - The detectable carbon: CO₂
  - Average value: 100.4% ± 2.5%
  - Range: 96% - 104%

- The detectable sulfur: H₂SO₄
  - Average value: 99% ± 1.8%
  - Range: 96% - 104%

- Chloride balance:
  - The detectable sulfur: H₂SO₄
  - Average value: 99% ± 2.3%
  - Range: 95% - 105%

**Experimental Apparatus**

- A co-stabilizer in the production of polyvinyl chloride
- An antioxidant and a vulcanizing agent
- A solvent in antifreeze solution

**Summary**

- It has been showed that bench scale reactor has a good performance and is effective for the destruction of Thiodiglycol (TDG) and TCl (TDG+HCl).
- At all experiment condition for the destruction of TDG, TOC value of effluent < 3 ppm and the TOC conversion > 99.4%. At several experiments, TOC conversion > 99.9% were actually achieved. Sulfur was totally recovered in the aqueous effluent as sulfuric acid.
- At experiment condition for the destruction of TCI, TOC conversion > 95%. At several experiments, TOC conversion > 99.9% with TOC value of effluent < 3 ppm were actually achieved. Sulfur and chlorine were totally recovered in the aqueous effluent as sulfuric acid and hydrochloric acid.
- ICP analysis result showed that Ni, Mo, and Ti were not detected in the liquid phase effluents.
- New or modified reactor design
- Perox rector
- Double wall reactor
- SUNIX\textsuperscript{®}, floating type reactor
- Transpiring wall reactor
- A film-cooled coaxial hydrothermal burner
- Corrosion of the core tube and coaxial tubes still occur when exposed to acidic conditions

**References**


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