

# Lab Scale Sulphonation of Arenes

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Health & Safety  
Executive



HEALTH & SAFETY  
LABORATORY

# Background

- Process Intensification involves rapid fluid mixing and high heat transfer.
- However mass transfer phenomena in novel reactors can result in unforeseen safety problems such as runaway reaction.
- Some traditional reaction models ignore mass transfer effects this too can be inaccurate and sometimes dangerous.

# Objectives of HSL Research Project

- To use standard calorimeters to obtain design data on mass transfer controlled chemical reactions.
- Develop an understanding of mixing phenomena relevant to safety in process intensification.

# Reaction selection

- Heterogeneous liquid - liquid reaction
- Reaction of industrial interest
- Potential for Process Intensification e.g. already carried out in HX reactors
- Rate of reaction depends on both mass transfer and reaction kinetics
- Can be investigated safely in laboratory

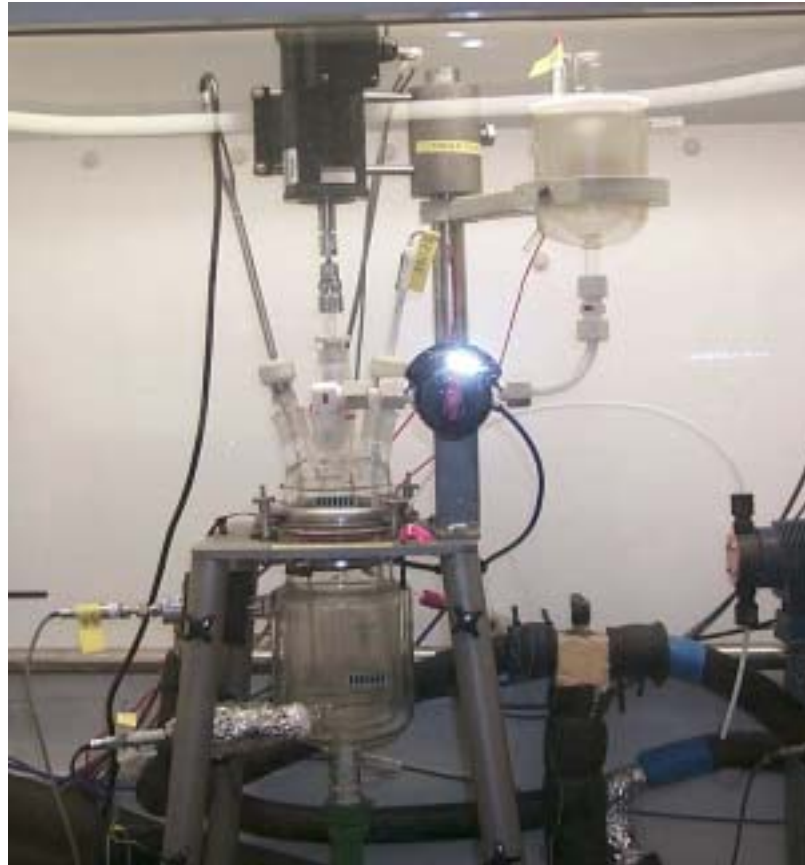
# Sulphonation of Arenes

- $\text{ArH} + \text{SO}_3 \rightarrow \text{ArSO}_3\text{H}$
- $\text{Ar}$  = benzene, toluene or p-xylene
- $\text{SO}_3$  = sulphur trioxide generated from concentrated sulphuric acid or oleum
- Reaction type - Electrophilic substitution

# Adiabatic Calorimeter (Phi Tec)



# Isothermal Calorimeter (Ambient Pressure Simular)



# Proposed methodology

- Make experimental measurements of reaction rates.
- Investigate the dependence of reaction rate on flow, temperature and agitation speed.
- Develop a methodology to predict the safety of mass transfer limited reaction systems.



# Literature review

- PI application (HX reactor) - SRI International, California, 1995 & 1997
- CSTRs and laminar jet mixing - Tehran University, 1981 & 1988
- Jet Loop Reactor - Tianjin University, China, 2001
- Sulphonation of Aromatics - University of Veszprem, Hungary, 1993

# HSL is seeking partners for its research activity

- Mass transfer specialists
- Industrial companies who carry out arene sulphonations
- Process Intensified reactor manufactures
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