

Applications for Advanced Oxidation Technologies (AOTs) in Waste Treatment

Presented by: Janice Schneider

Brad Striebig

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Outline

- Background to AOTs
- Advantages
- Disadvantages
- Design tools
- Applications
- Summary



Background to AOTs

- Use a combination of oxidizing chemicals or reactants
 - Ozone
 - Peroxide
 - UltraViolet (UV) light
 - Titanium Dioxide Catalyst (TiO_2)
 - Iron
- Produce short lived highly reactive radical species
 - Hydroxyl radicals (OH^*)
 - Oxygen radicals (O^*)
 - Peroxyl Radicals
- May be applicable to
 - Air pollutants
 - Water pollutants





AOT Processes

Ozone

Peroxide

Iron

UV Light

Reactive Radicals*

Organic Pollutants

Titanium Dioxide

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Products of AOT Reactions

- The Radical Species are capable of oxidizing organic pollutants at low temperatures
 - Complete oxidation yields
 - Carbon dioxide & Water
 - Incomplete oxidation may yield
 - More highly oxygenated organic compounds
 - May be less toxic & more biodegradable !
 - Or they may be more toxic and less biodegradable !

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Advantages of AOTs

- Specific Reactive Chemistries
 - Halogenated compounds
 - Non-saturated compounds
- Reactions occur at low temperatures
- Economical for small flow rates & batch processes
- Require only a short-start-up time
- Can handle variable loading rates up to the maximum design capacity

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Disadvantages of AOTs

- Only economical for low organic loading rates
- Relatively immature technology
- May require removal of secondary pollutants
 - Excess ozone
 - Acid gases
 - Aldehydes
- May have high O&M costs due to UV lights
- May require pilot testing and design
- Limited application by chemistry reaction rates



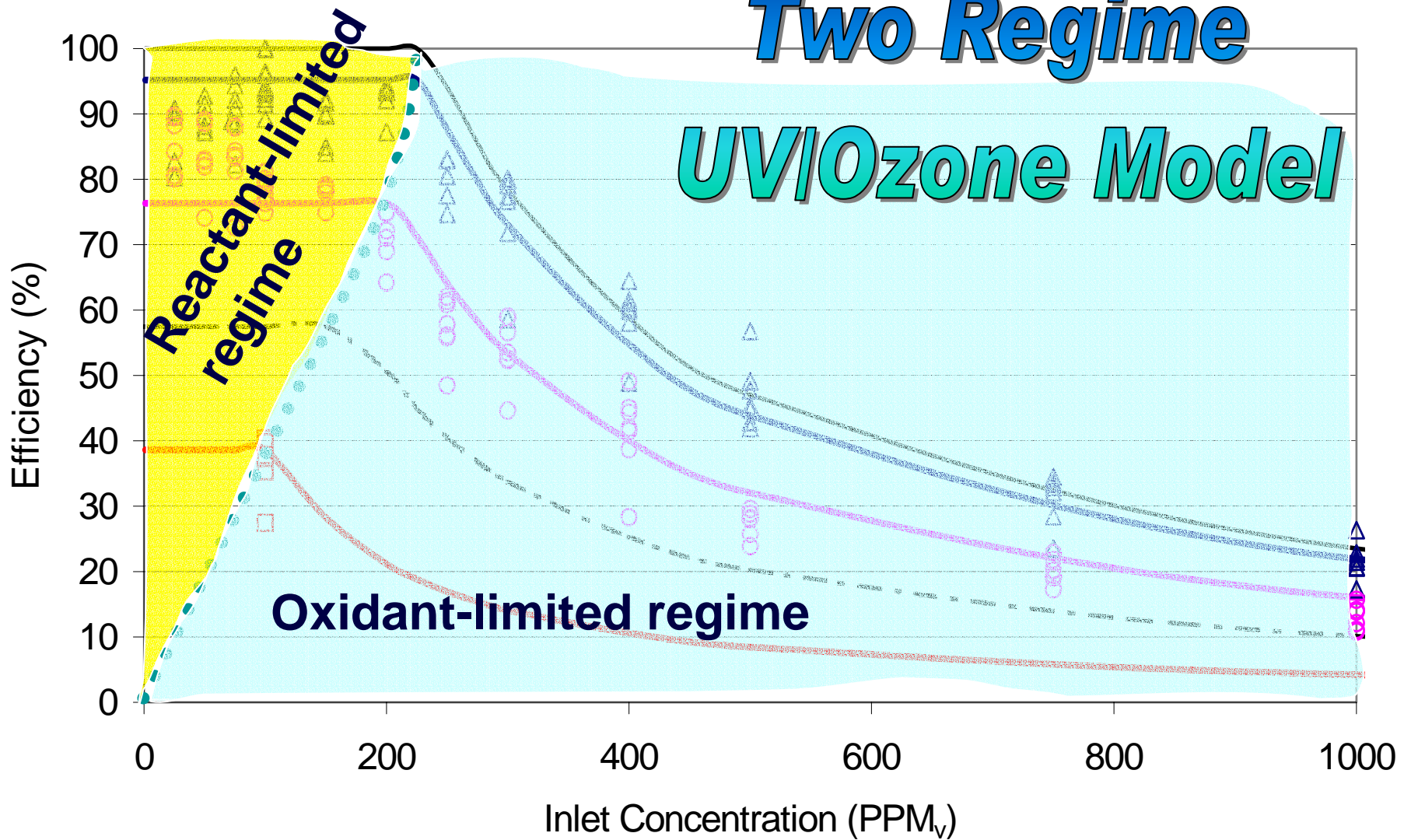
Design tools

- Bench and pilot scale testing can be used to determine:
 - Reaction rates
 - Optimal flow rates and oxidant generation
- Computational models can be used to determine:
 - Reactor size
 - Predict and compare technology costs



Two Regime

UV/Ozone Model



— 0.364 CFM model

— 1.0 CFM model

— 2.0 CFM model

○ Data obtained from reactor operation at 1.0 CFM

— 0.5 CFM model

- - 1.5 CFM model

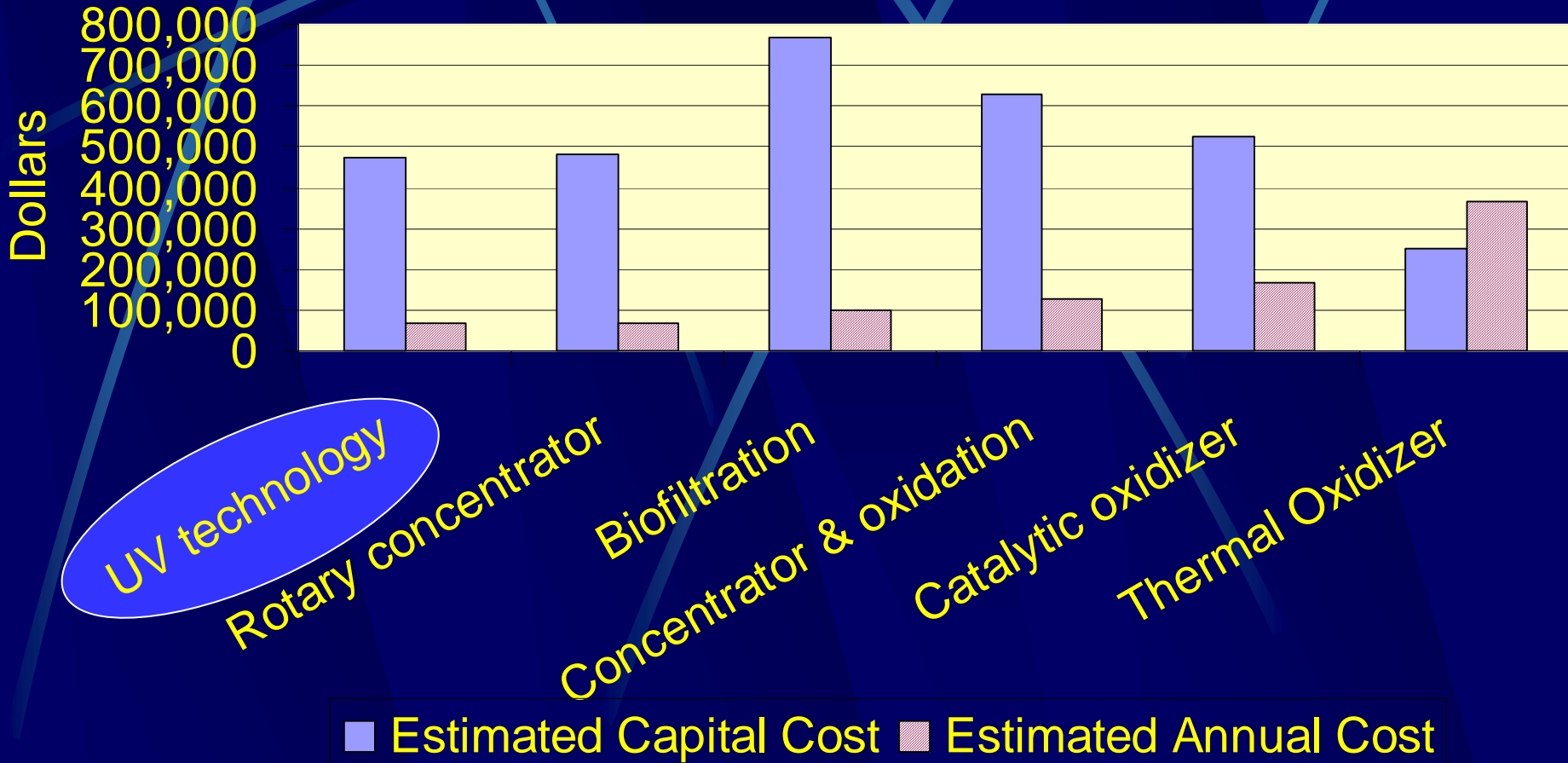
△ Data obtained from reactor operation at 0.5 CFM

□ Data obtained from reactor operation at 2.0 CFM



Cost Comparison

Projected Capital and Annual Costs for Styrene Control
(50 ppm inlet concentration, 14,000 SCFM)



UV technology

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Summary

- AOTs may be effective low temperature oxidation pollutant control processes
- AOTs must be adequately designed
 - Oxidant generation capability
 - Adequate retention times
- AOTs may be cost competitive for reactive chemical species such as
 - Halogenated compounds – *Ex. TCE*
 - Unsaturated Compounds – *Ex. Styrene*

