On-line Oxidation of Volatile Organic Compounds Generated by Sawmill Wood Kilns

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Background

- 30,000 short tons of VOCs are released as emissions from kiln drying of softwood species per year
- Traditional methods for VOC emissions control
  - Regenerative thermal oxidizers (RTO)
  - Recuperative catalytic oxidizers (RCO)
  - Bioreactors
- Barriers associated with traditional VOC emissions control
  - Expensive
  - Difficult to implement due to fluctuations in humidity and flow
    - Humidity fluctuations decrease effectiveness of oxidation control devices and are detrimental to bioreactor organisms
    - Temperature fluctuations are also detrimental to bioreactor organisms

Background

- Minimum of 60,000 board feet of lumber are produced each year in the US
- Pine lumber drying produces 3.5 lbs of VOCs per thousand board feet
- Pine lumber drying could produce enough VOC emissions to be classified as a major point source polluter

Background

- Advanced Oxidation Process (AOP) tested for this project
  - UV photolysis of H_2O_2 produces hydroxyl radicals (OH^-)
  - Preliminary testing of kiln off-gas showed as high as 40% reduction of VOC emissions could be achieved
  - Initial data taken for the project has shown little success has been achieved
  - Current work done using liquid phase H_2O_2

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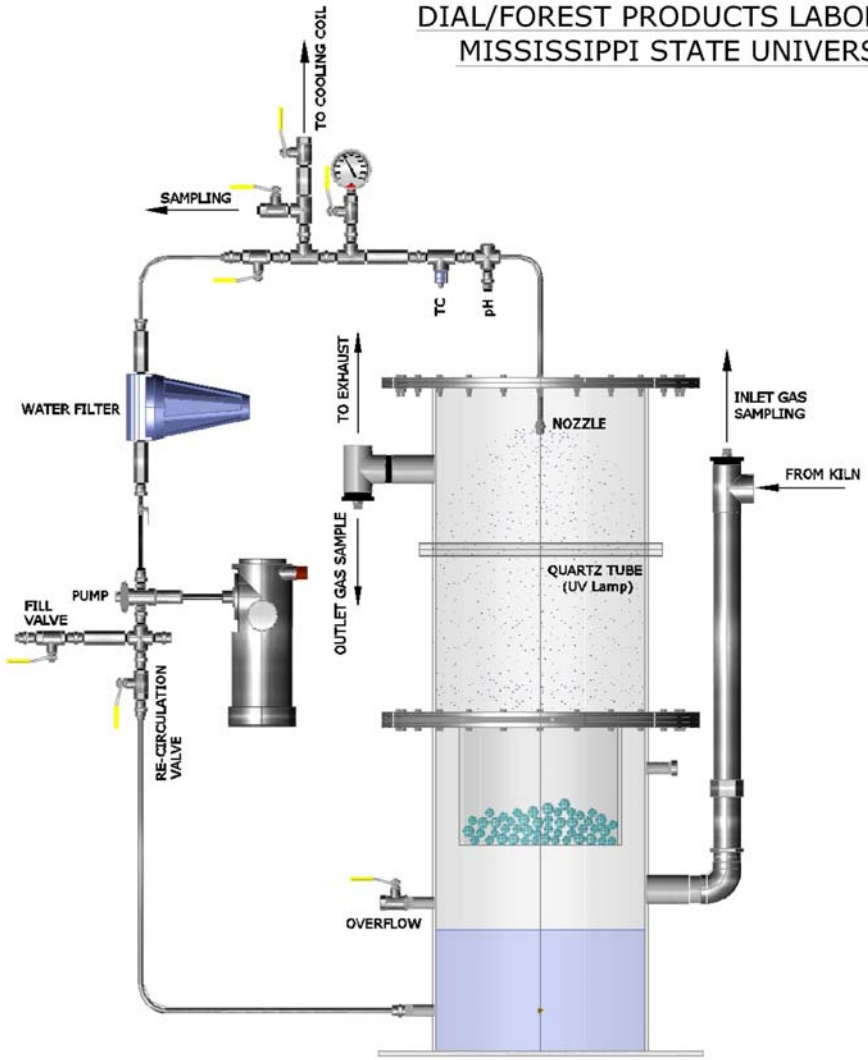


VOC Treatment Process

Kiln and VOC treatment process

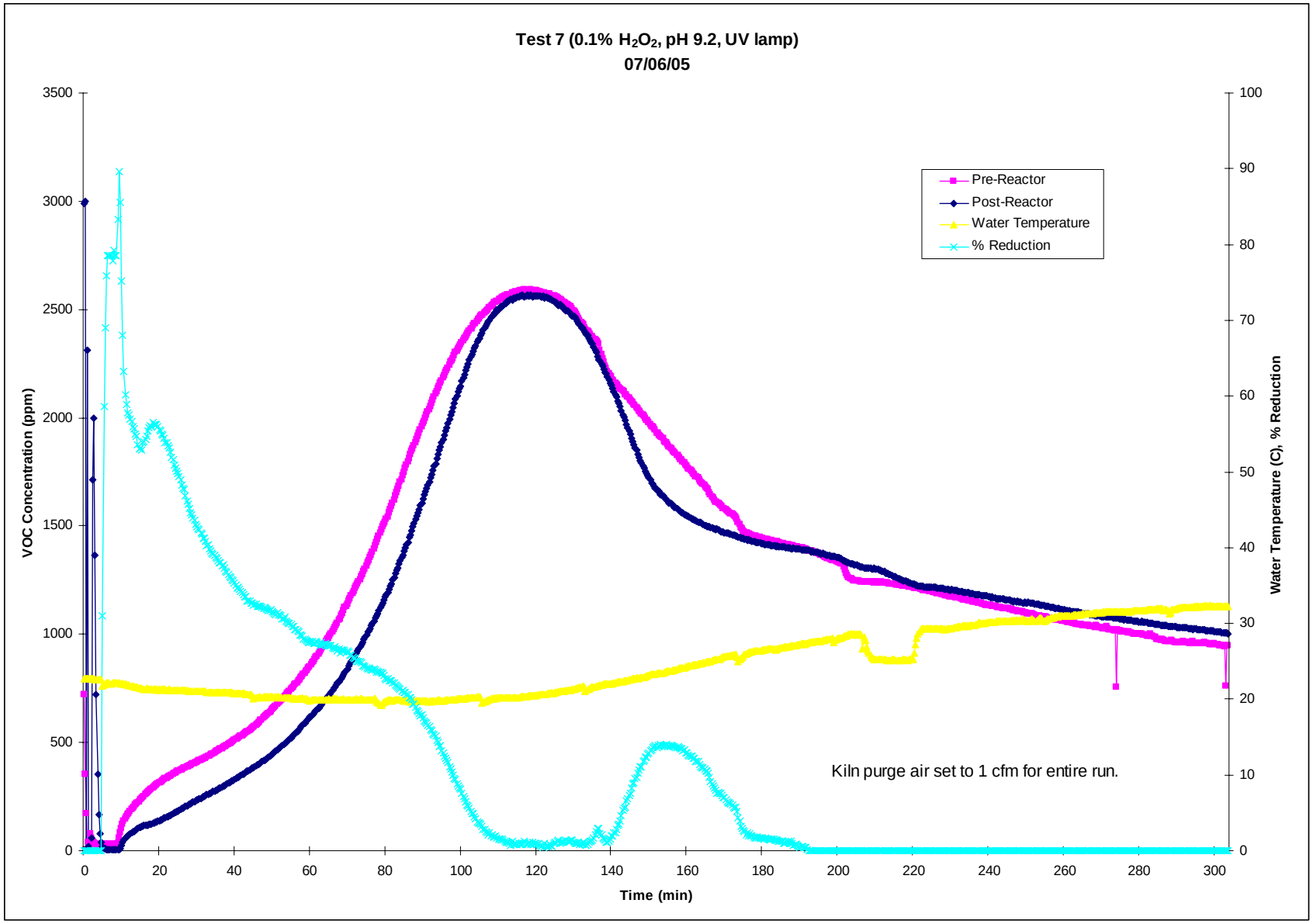
VOC treatment process

Kiln off-gas emission analyzer

Measurements Performed

- Concentration of H_2O_2 determined by titration
- pH of H_2O_2 solution measured periodically
- Temperature of recirculating H_2O_2 solution monitored by computer system
- VOC concentration in off-gas determined by dual Jum VE7 total hydrocarbon analyzers

Typical Results Data



Process Variables Adjusted

- pH
- Concentration of H_2O_2
- Temperature of recirculating solution
- Kiln operating conditions (ramp rate, length of drying cycle)
- UV lamp power/ volumetric intensity

Fenton's Reagent

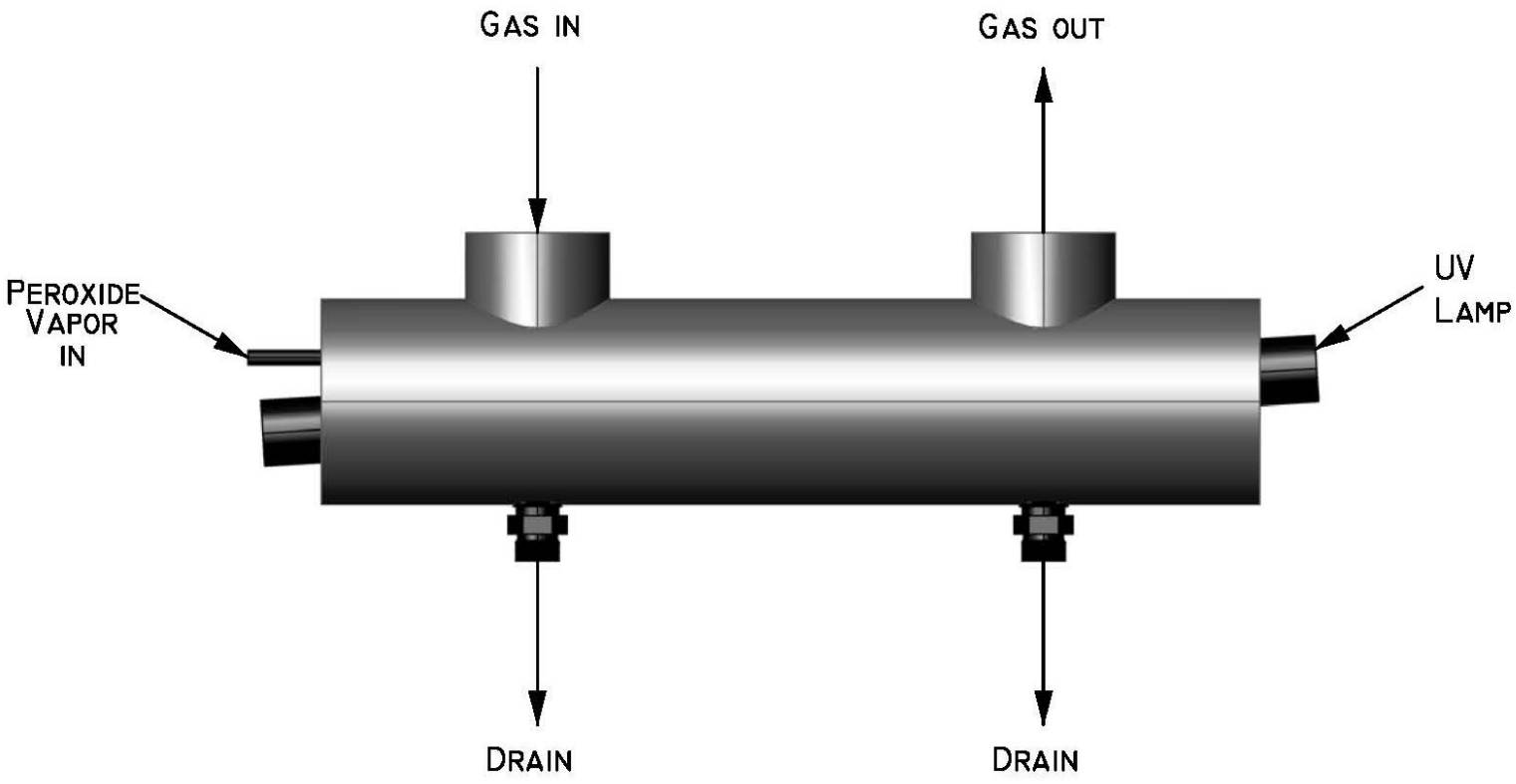
- Ferrous sulfate ($FeSO_4$)

  $Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + OH^{\cdot} + OH^-$

  $Fe^{3+} + H_2O_2 \rightarrow Fe^{2+} + OOH^{\cdot} + H^+$

  $2Fe^{3+} + H_2O_2 + 2OH^- \rightarrow 2Fe^{2+} + H_2O_2 + O_2$
- Applied mainly for waste water treatment
- The effect of the reaction of H_2O_2 and VOCs was reduced by excess O_2 production

Secondary Treatment Chamber



Work Planned for 2006

(no cost extension)

- Vapor phase H_2O_2 in combination with UV lamp
- Catalytic oxidation of H_2O_2

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