FOREST PRODUCTS
Project Fact Sheet

VOLATILE ORGANIC COMPOUND (VOC) CONTROL IN KRAFT MILLS

BENEFITS

- Provides new control strategies and membrane separation technologies to reduce and recover VOCs in kraft mills
- Improves VOC prediction capabilities
- Allows both cost-effective and timely compliance with EPA's Cluster Rule
- Supplies greater information for process control
- Reduces odor around mills
- Minimizes negative environmental effects of VOC emissions.

APPLICATIONS

Successful modeling will allow predictive capability for VOC emissions from any given kraft mill. Modeling efforts could then be used as a guideline for reducing VOC emissions for EPA's cluster rule regulation.

Research efforts will also lend information for predicting methanol splits. It will address new paper machines and recausticizing area emission models for significant improvements in VOC prediction abilities.

Newly developed control strategies and thin-film, high-performance membranes will also be available for use by the pulp and paper industry.

Predicting and Modeling VOC Behavior from Kraft Mills Will Control Emissions

As environmental restrictions become more stringent, industry must find ways to conduct its operations in an environmentally and technologically sound manner while remaining economically competitive. The 1990 Clean Air Act Amendments require pulp and paper mills to report their emissions of volatile organic compounds (VOCs) since many VOCs are now considered hazardous air pollutants (HAPs). Cost-effective control of these pollutants will require technologies that can accurately characterize the VOC content in the liquid and gas streams of pulp and paper mils, use this information to minimize VOC generation, and remove VOCs that remain in the waste stream.

Little is known about the behavior of VOCs in the mill stream itself, where the presence of both soluble inorganic compounds and dissolved organic solids can have a significant impact on their release. Existing data and methods used to predict the release of VOCs from mill operations often overestimate the amount emitted. Computer models that can accurately predict the release of VOCs could be used by the industry to optimize mill processes in order to minimize VOC emissions.

In the first two years of this project, researchers developed a membrane separation technology to identify, remove, and recover VOC emissions (chiefly methanol) from mill waste streams. This technology will provide the industry with a continuous, rugged, and simple process that outperforms alternative removal methods.

Further steps toward building a model of resulting VOC emissions are expected to yield a VOC predictive emission parameter database and simulation capability for methanol generation during black liquor storage, evaporation, and oxygen delignification. This knowledge will contribute to the development of control technologies to eliminate other hazardous air pollutants.

OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

PROJECT DESCRIPTION

Goal: To develop a computer model that can predict the formation and release of VOCs in the liquid and gas streams of pulp and paper mills, and to develop a membrane-separation technology for VOCs in kraft mills.

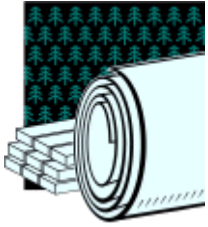
Task A: The liquid-vapor phase equilibrium of model and actual mill streams will be studied in order to generate liquid activity coefficients useful for constructing predictive models. A computer model will then be developed and validated that can predict the generation and release of VOCs. Finally, control strategies and membrane-separation technologies will be developed to reduce and recover VOCs in kraft mills. Since methanol accounts for 90% pf VOC emissions in an typical operation, the study will primarily focus on methanol although the phase equilibrium of methyl ethyl ketone, acetone, and dimethyl sulfide will also be explored (the latter is the major source of odor in mills.)

Task B: This task will demonstrate in a laboratory system that methanol can be efficiently removed form mixtures containing water vapor and air streams typically found around pulp and paper operations. Membranes will be used for this separation.

PROGRESS & MILESTONES

The project began in August 1996 and is scheduled to be completed in 2001. All deliverables and objectives have been achieved and are outlined below:

- Task A milestones:
  1. Collected laboratory phase equilibrium data
  2. Developed rapid, automated methods and protocols for determining VOC concentration and Henry's constants
  3. Simulated and validated VOC levels in 3 Kraft mills
  4. Created VLE models for emission predictions
  5. Produced methanol formation prediction models
- Task B milestones:
  1. Development laboratory vapor separation system
  2. Measured transport properties of selected polymers
  3. Formulated preliminary system design and economics
  4. Produced and tested thin film membrane
  5. Conducted case studies and system design



PROJECT PARTNERS

Georgia Institute of Technology
Atlanta, GA

Institute of Paper Science and Technology
Atlanta, GA

National Council of the Paper Industry for Air & Stream Improvement
Atlanta, GA

North Carolina State University
Raleigh, NC

University of Idaho
Moscow, ID

FOR ADDITIONAL INFORMATION PLEASE CONTACT:

Mark Paster
Office of Industrial Technologies
Phone: (202) 586-2821
Fax: (202) 586-3237
e-mail: mark.paster@ee.doe.gov

JunYong ZHU, Ph.D
Associate Professor of Engineering
Institute of Paper Science and Technology
500 10th Street N.W.
Atlanta, GA 30318
Phone: (404) 894-5310
Fax: (404) 894-5752
e-mail: junyong.zhu@ipst.edu

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

Office of Industrial Technologies
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

October 2000