CHEMICALS

Project Fact Sheet

HARSH FLUOROCHEMICAL SEPARATIONS

BENEFITS

- Increases energy efficiency by reducing the use of thermal distillation columns
- Prevents landfilling of hazardous wastes, fluorinated salts and sludges

APPLICATIONS

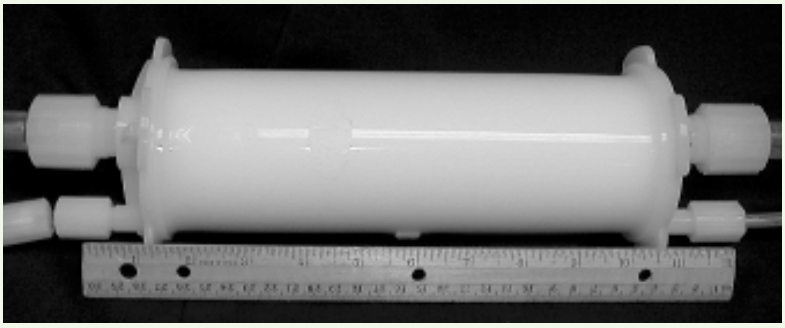
The developed membranes are presently used for introduction of aggressive gases into ultra-pure processes in semiconductor manufacturing. Planned demonstrations of degassing applications are scheduled. In addition, the petroleum processing industry may be able to use these membranes for waste reduction and recycling of corrosive gases and aqueous solutions of hydrogen fluoride and hydrogen chloride.

CHEMICALLY RESISTANT MEMBRANE PERFORMS AGGRESSIVE CHEMICAL SEPARATIONS THAT SAVE ENERGY AND REDUCE HAZARDOUS WASTE

Distillation separation of organic mixtures accounts for nearly three percent of total U.S. energy consumption. In several U.S. industries, separations utilizing selective permeation through membranes can offer significant economic and environmental advantages over conventional distillation processes. These processes are not used, however, because current commercial membranes are not able to withstand the aggressive conditions associated with important industrial chemicals, including hydrogen fluoride, hydrogen chloride, and ozone. To overcome this challenge, project partners are developing chemically resistant perfluorinated membranes to perform separations in hydrogen chloride and hydrogen fluoride process gases and their highly acidic aqueous solutions.

Project research is focused on eliminating the current drawbacks of rubbery membrane technology: poor chemical resistance, poor system design, and poor fabricability. Glassy perfluorinated membranes, as a class, eliminate all three limitations. Glassy perfluoropolymers are highly chemical resistant and have high fabricability due to their ability to form thin membranes. In addition, glassy polymers separate by molecular size, allowing small molecules such as hydrogen fluoride to preferentially permeate through the membrane. Notably, the modules being developed by project partners will be the first ever commercially available fully-perfluorinated non-porous membrane modules for gas and gas/liquid separations.

MEMBRANE CONTACTOR



Fully perfluorinated, chemically resistant, high gas-transfer membrane contactor.

Project Description

Goal: The goal of this project is to demonstrate practical process chemical separations and applications for a membrane contactor constructed entirely of perfluorinated materials that is chemically compatible with highly aggressive compounds, including acid gases (HF, HCl) and oxidizers (O_3).

Progress and Milestones

Early stage research successfully determined the stable permeation of several aggressive gases, including hydrogen fluoride and hydrogen chloride, without apparent decreases in membrane performance and operational stability. Ozone compatibility has already been demonstrated outside this program.

Current research is focused on the development and demonstration of membrane separation of appropriate aggressive chemical species using all-fluoropolymer membrane separator modules. Project partners will test stock and customized membrane separator modules that incorporate the novel membrane developed during early research. In addition, they will demonstrate separations in energy-intensive processes requiring the separation of mixtures of aggressive chemicals at the bench and pilot scales. Specific tasks include:

- Fabricate laboratory and full-scale membrane modules for testing
- Set-up prototype systems for laboratory testing
- Select applications for scale-up and pilot demonstrations
- Build and test scaled-up pilot demonstrations
- Conduct membrane enhancement and membrane optimization
- Perform technical and economic analyses on industrial applications for these new membranes

Commercialization

A major filtration and separations company has already licensed this technology and presently manufactures perfluorinated modules designed to gasify ultra-pure materials with aggressive gases for semiconductor manufacturing. Compact Membrane Systems, Inc. (CMS) anticipates additional demand for all-fluoropolymer membrane contactors designed and sized for other aggressive chemical applications. CMS will actively seek development partners and negotiate additional licenses for specific applications of the membrane contactor technology. It is expected that the development partners will have rights to market products within their licensed areas of practice.

Project Partners

Compact Membrane Systems, Inc.
Wilmington, DE

Air Liquide
Houston, TX

Air Products and Chemicals
Allentown, PA

Daikin America, Inc.
Orangeburg, NY

Delaware Economic Development Office
Dover, DE

Innovative Membrane Systems
Norwood, MA

Pall Corporation
East Hills, NY

Praxair, Inc.
Tonawanda, NY

SRI International
Menlo Park, CA

UOP LLC
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