

Membrane Technology Workshop

DOE - Energy Efficiency & Renewable Energy

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Chicago

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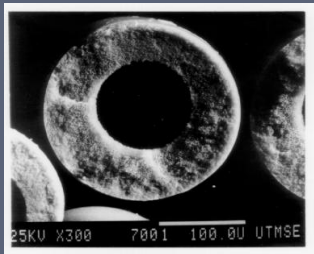
Requirements for Membrane Systems

**Three
Critical
Areas**

*System
Design: Pretreatment &
Controls*



**So Much
Work!**



Membranes



Modules & Vessels

Materials Issues

Lab to Commercial Scale

Performance

- Thick dense films in the lab do not perform the same as the thin skin separating layer of the actual membrane
- Mixed gas + contaminant vs. pure gas data basis
- Reference conditions vs. realistic operating environment
- Wall resistance and fiber morphology/geometry effects

Cost / availability of polymer

- “Designer polymer” is often not commercially available
- Monomer costs are high
- Low volume synthesis process at high cost

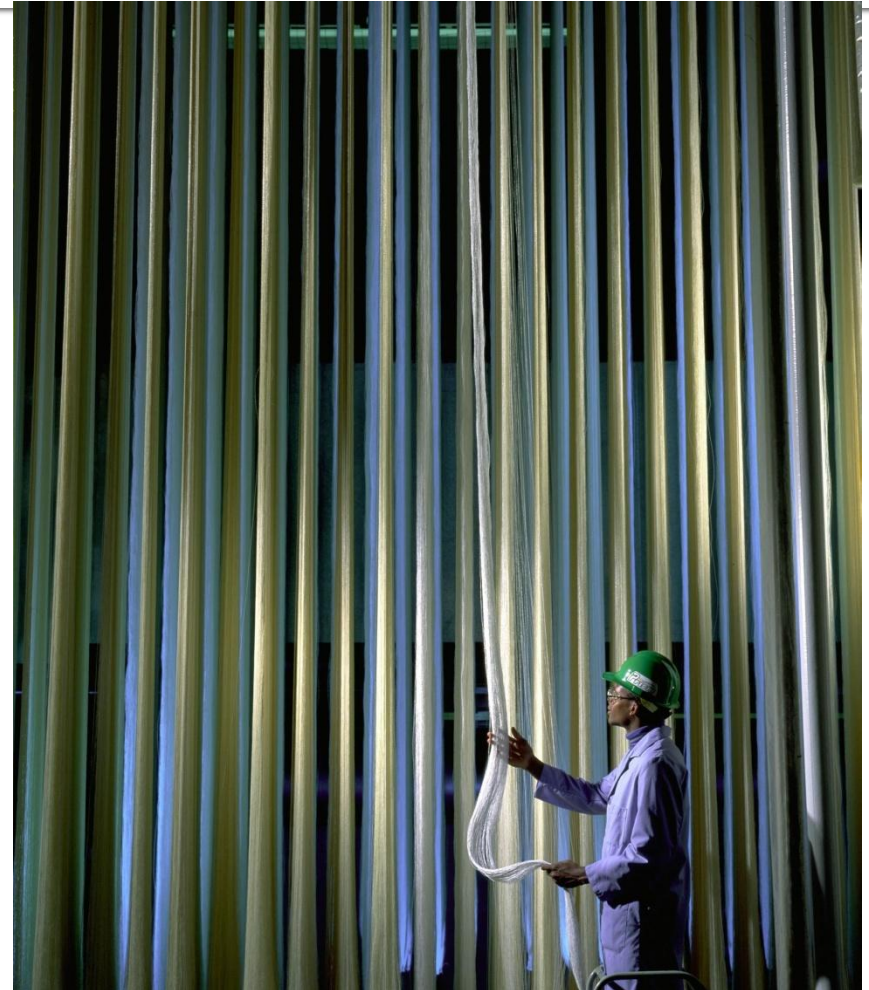
Manufacturing Issues

EH&S

- Materials handling
- Toxicity
- Disposal/recovery of solvents

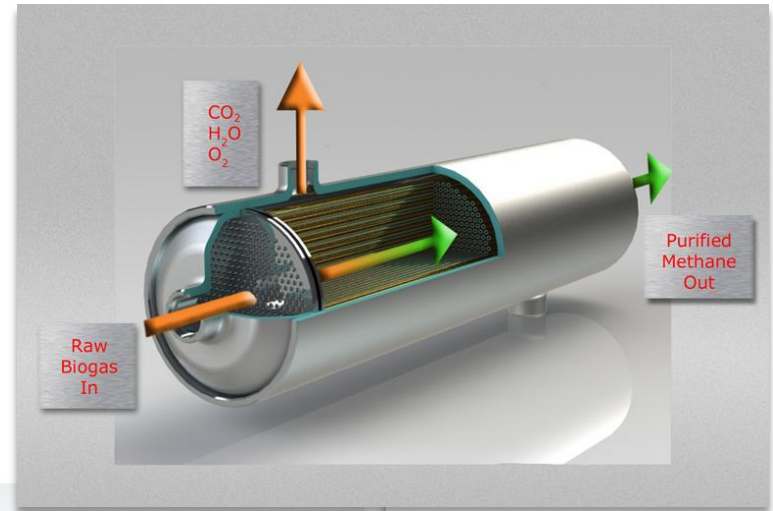
Balance of properties

- Mechanical
- Transport



Module Design Challenges

- What happens at 20X flow improvement?
- Gas distribution
- Tube sheets
- Mechanical seals
- Cyclic operation



System Design Challenges

Expensive field test demonstrations

- Understanding the application nuances
- Pretreatment validation
- Design for transient conditions

Customer Acceptance & Satisfaction require:

- Reliability
- Very high On-Stream time
- Long Service Life

What is needed?

There is opportunity for game changing improvements and product commercialization growth!

However, the business cost for each scale-up attempt is *very significant*.

To reduce risk, we need:

- Practical new polymers
- Attention to module design
- Applications characterization & field demos