



Pall Corporation

High-Performance, Durable, Palladium-Alloy Membrane for Hydrogen Separation and Purification

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People. Ideas. Solutions.

Project ID #PDP30

This presentation does not contain any proprietary or confidential information

Overview

Timeline

- April, 2005 start date
- April, 2008 end date
- 20% complete

Budget

- \$4 million Total
 - \$2.4M DOE share
 - \$1.6M Contractor share
- \$85k funding rec'd FY05
- \$255k anticipated FY06

2005 Targets

- Flux = 100scfh/ft² @20 psi & 400°C
- System Cost = \$1500/ft²
- Durability = 8760 hrs (1 year)

Partners

- Chevron Texaco
- Colorado School of Mines
- ORNL

Project objectives

- Apply an effective thermal diffusion barrier on a porous stainless steel tube, over which a defect free, dense palladium alloy membrane is applied.
- Obtain performance values equal to relevant hydrogen production and cost targets.
- Optimize copper/palladium ratios and furnace cycles to form alloys for best overall performance.

Approach

- Apply membranes by multiple methods, upon porous metal substrates with various diffusion barriers, and measure performance.
- Improve the surface roughness of the porous substrate/diffusion barrier composite
- Improve the permeance of the support tube without loss of collapse resistance

Technical Accomplishments/ Progress/Results

Permeance of composite

- Version #1 = 8-18 scfh/ft² @400°C/20 psi
- Version #2 = 45-118 scfh/ft² @400°C/20 psi
- Version #3 = 55-81 scfh/ft² @400°C/20 psi

Surface roughness

- Improved version #2 from Ra=73 u in to Ra=23 u in

Base tube permeance

- Improved version #3 by more than 50% while achieving sufficient collapse resistance

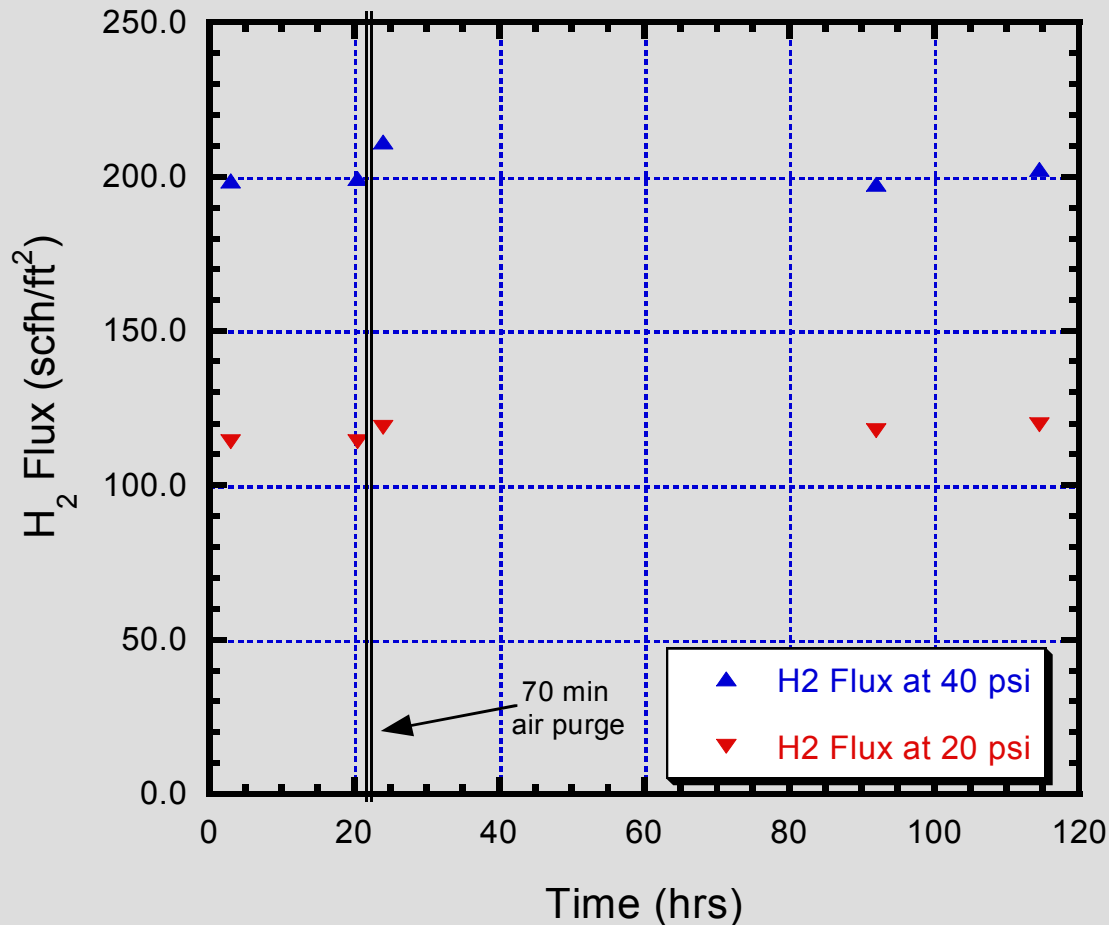
Separation factor

- Achieved 2005 target of 99.9% w/ single gas testing

Technical Accomplishments/ Progress/Results

Meeting 2005 permeance targets

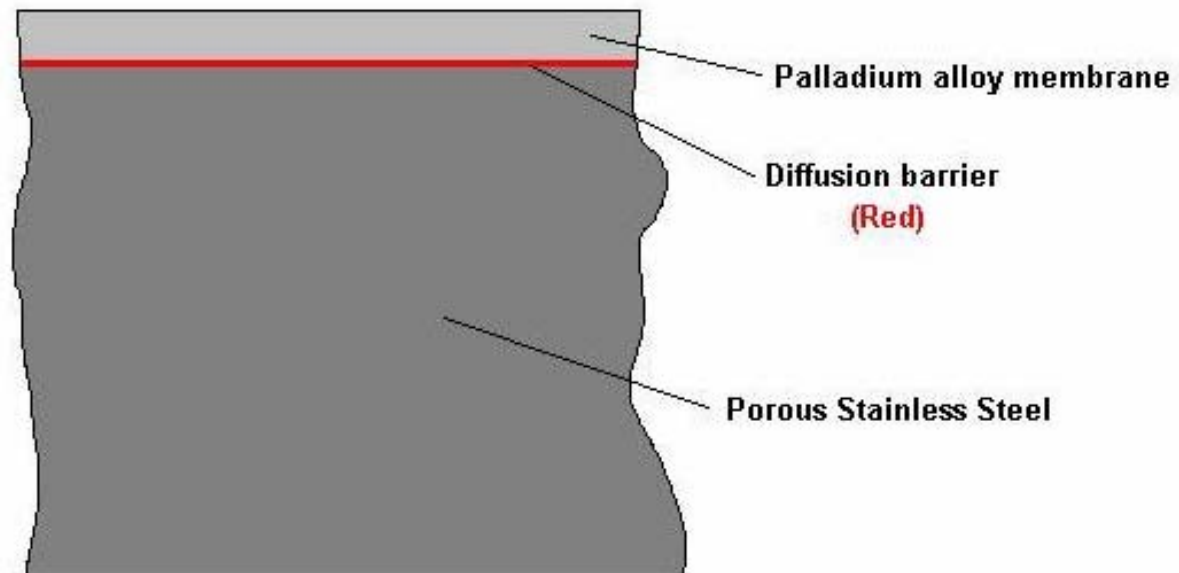
Hydrogen Flux @ 400 °C Vs. Time for Pd Membrane, CSM-Pall-69, on Pall AccuSep Support



Future Work

- Continue making thinner membranes on smoother, more permeable substrates to achieve 2010 target performance.
- Evaluate methods to produce palladium copper alloys and evaluate vs. pure palladium
- Chevron-Richmond will begin system testing using synthetic reformat streams.
- Evaluate 2 different methods to apply fittings to the composite tubes

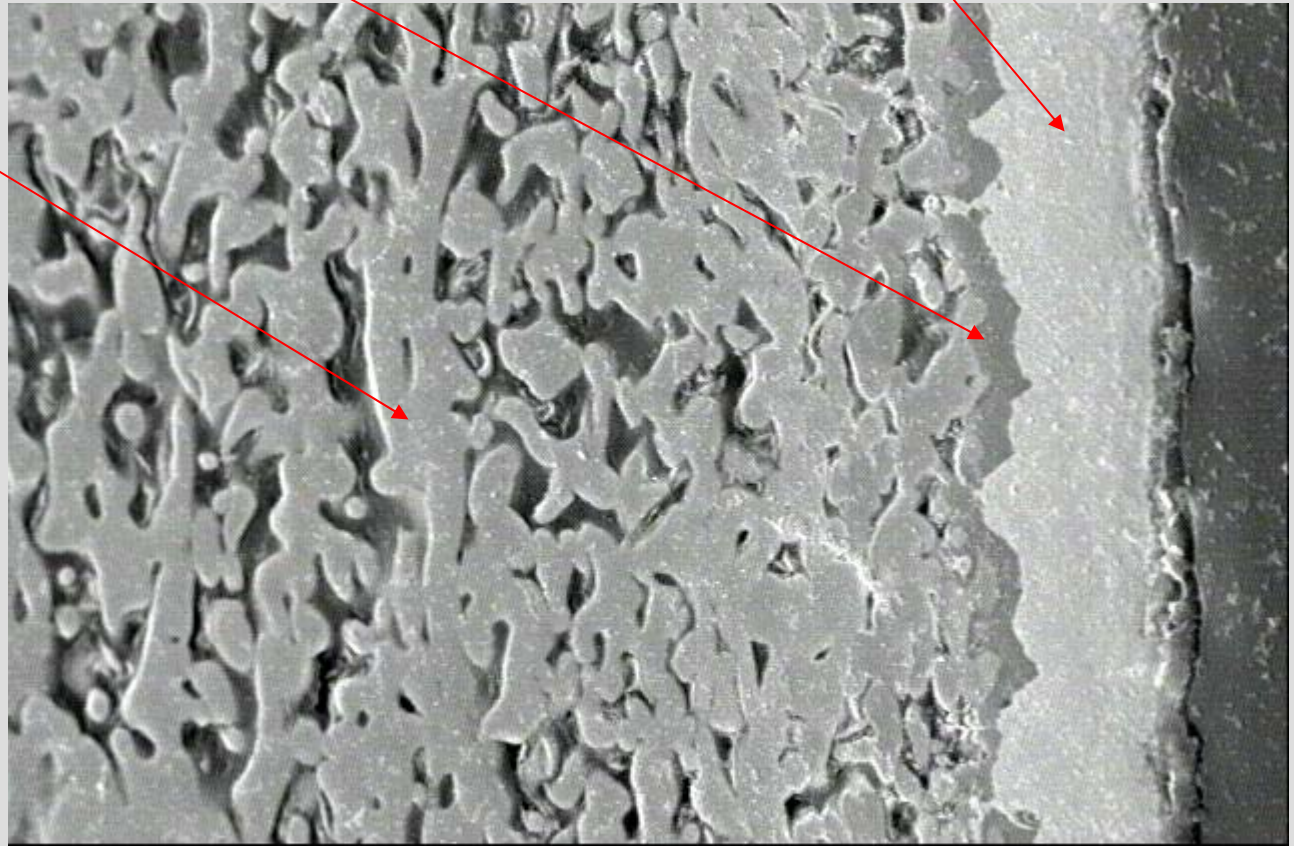
Planned Cross section of composite structure



Diffusion barrier

Palladium membrane

Porous metal



1,000x

20.0 kV

10µm

13 mm

CL:5.0