

Characterizing the Pore-Size Distribution of Membranes via Evaporometry (EP)

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This technology relates to an apparatus and method for determining the porosity, pore size, pore-size distribution (PSD), and internal pore fouling of all membrane types, namely flat-sheet, hollow fibre or tubular (including lumen side or outer wall). Evaporometry (EP) is based on the evaporative mass loss from membranes that have been pre-saturated with a wetting volatile liquid, whose vapour pressure is reduced due to surface curvature at the air-liquid interface within the pores

I. Problem Statement

Characterize Membrane Pore-Size Distribution

- Broader Spectrum of Pore Sizes
- Improved Accuracy
- Non-destructive
- Assess Internal Pore Fouling

Membrane Performance:

- Selectivity
- Permeate Flux

II. What Evaporometry Can Do

➤ Measure pore size distribution of membranes

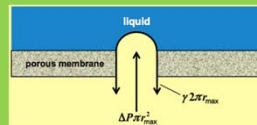
- 1- Flat sheets
- 2- Hollow fibres (with selective layer on the outer or lumen side)
- 3- Tubular & multibore membranes (with selective layer on the outer or lumen side)

- Straightforward analysis protocol
- Wider pore size range
- High degree of accuracy
- No calibration needed
- Potentially less expensive instrument

III. Comparison with Existing Technology

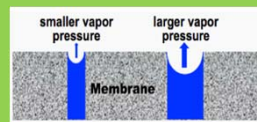
✗ Liquid Displacement Porometry (LDP)

- High operating pressure
- Inapplicability to membrane autopsies
- Limitation in measuring small pores (<14 nm) in UF membranes
- Expensive



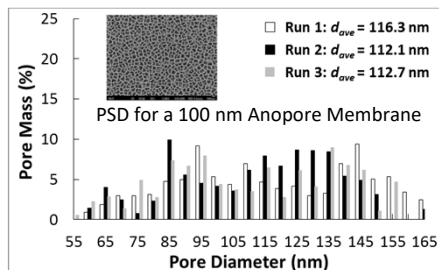
✓ Evaporometry (EP)

- Based on evaporation at ambient conditions
- Wider pore size range (5 – 200 nm)
- Less costly (35% that of LDP)

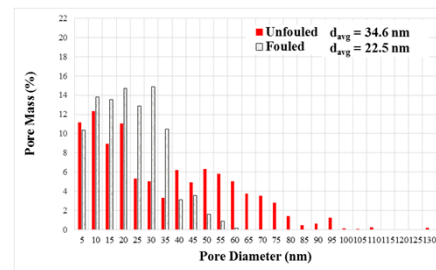


| | NTU Technology: Evaporometry (EP) | Competitor: Liquid Displacement Porometry (LDP) |
|---|-----------------------------------|---|
| Operating Pressure | Ambient | As high as 35 bar |
| Potential membrane damage | No | Yes |
| Use for membrane autopsies? | Yes | No |
| Smallest pore measureable | 4 nm | 14 nm |
| Characterize hollow fibre with internal active layer? | Yes | No |

IV. Pore Size Distribution



Reproducibility



Membrane Autopsy

V. Market Opportunities

A conservative estimate of the number of LDP (the market-dominant instrument for measuring membrane PSD) in the world currently in use is around 10,000 units. A LDP typically costs around \$100,000. Hence, the market potential for a high-resolution EP instrument is in the neighbourhood of S\$1 billion. Even a 10% share of this market would be worth a very significant \$100 million.

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