Capillary Based Processes in Microtechnology

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Objective

Create a family of multi-phase separation technologies that utilize surface and interfacial forces in microchannels.

Advantages

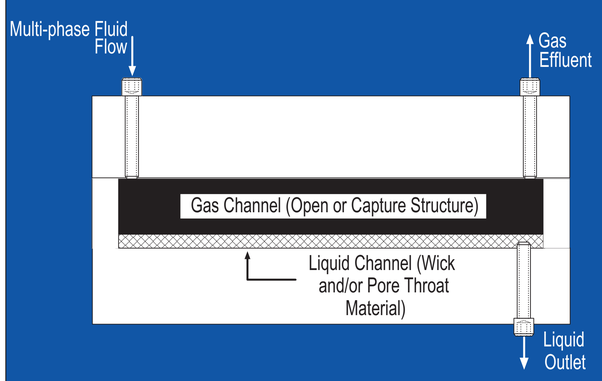
Allows processing in low gravity environments
Causes segregation of fluids through the use of wettability
Process intensification: mass transfer α (film thickness)^2
Permits easy recovery during process upsets

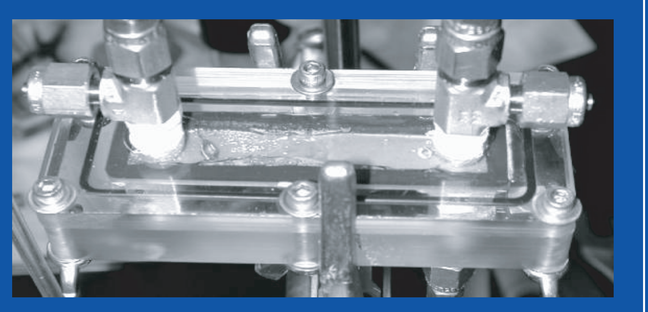
Applications

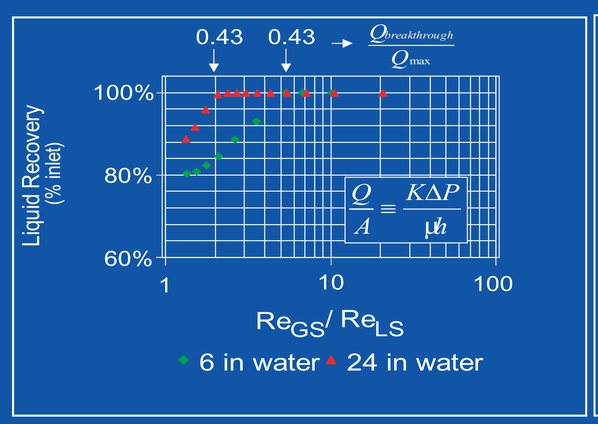
NASA-water recovery in environmental control and life support and in-situ resources utilization
Automotive Fuel Cell Power System - condensation and water recovery
Military - man portable heat pump (thermochemical compression)

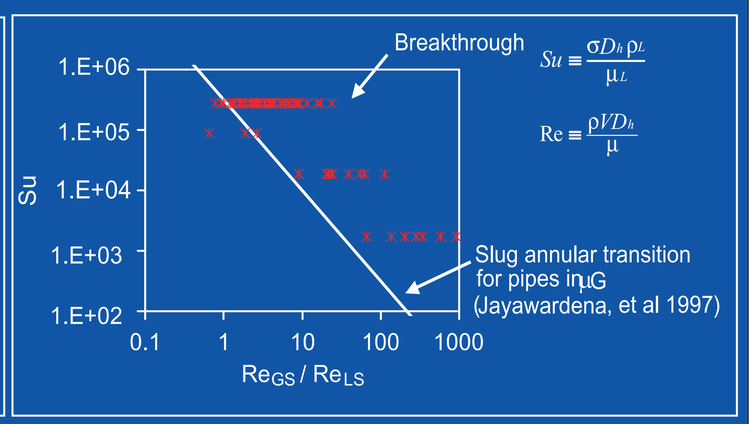
Phase Separation

Removal of liquid from a gas-liquid stream



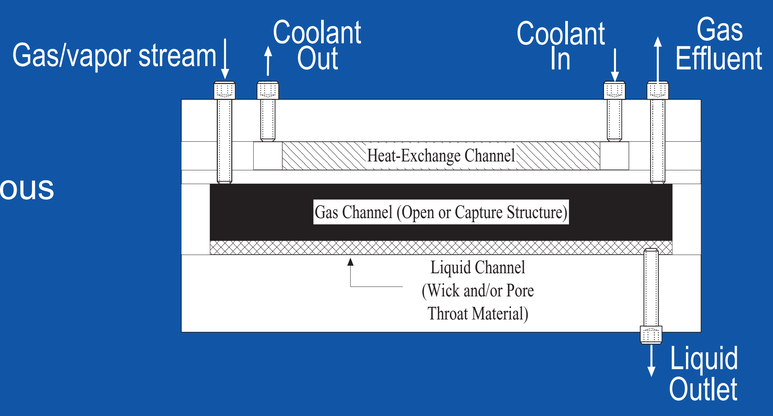






Partial Condensation

Condensation from a stream containing vapor and non-condensable gas with simultaneous removal of liquid

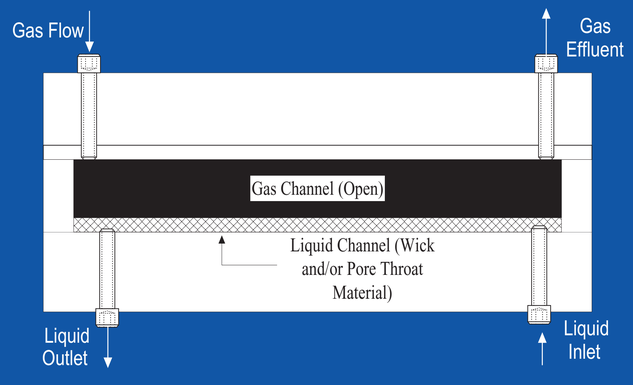


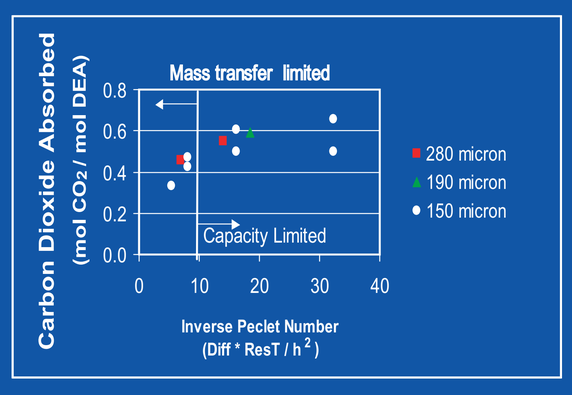
Single-channel Performance

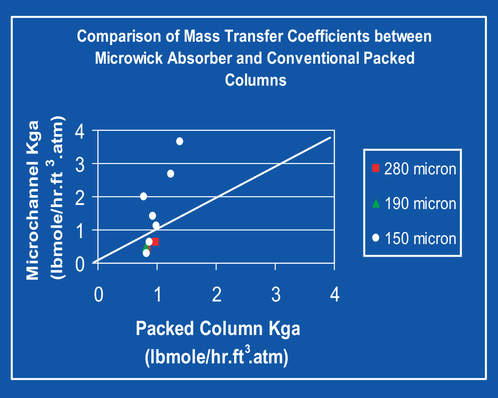
- Heat fluxes up to 55,000 W/m^2
- Overall U – 200-1000 W/m^{2}K
- Mean Nu – 8 to 41
- Gas residence time - 10 - 60 msec
- 87 - 99.6% heat exchange effectiveness
- Complete phase separation

Absorption

Absorption of carbon dioxide from gas into 2 M DEA aqueous solutions.

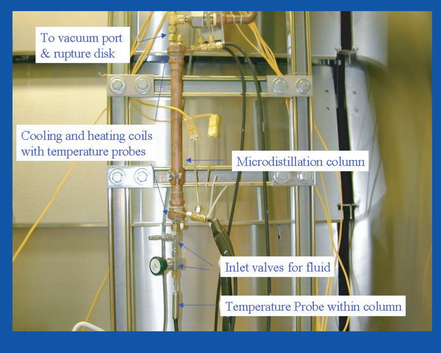


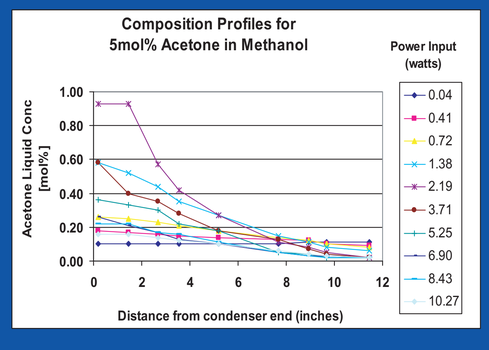


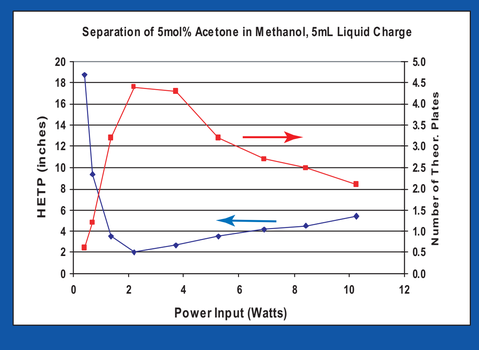


Distillation

Distillation of 5% Acetone in Methanol







Battelle