

## TECHNOLOGY PROFILE

**A new low-energy water purification and/or product concentration system using conventional heat exchange in process industries**

### Technology Overview:

Researchers at Victoria University's Institute for Sustainability and Innovation, led by A/Prof Mikel Duke, have developed a new membrane distillation system.

This new and innovative system integrates membrane distillation with conventional process heat-exchange. The key to the new system is that the heat energy source used to treat the stream by membrane distillation can be further utilised in the plant.

Membrane distillation is a separation process that works by allowing only water vapour to pass through the membrane: the incoming stream is heated (e.g. 50°C) while a lower temperature (e.g. 15°C) is maintained on the other side of the membrane. This creates a vapour pressure differential across the membrane which drives the separation. Conventional thinking of how to apply membrane distillation is to use low-grade heat from waste sources and/or solar energy; however, this approach limits the application of membrane distillation because waste heat sources in a plant are diffuse and are low in energy.

By integrating membrane distillation with a heat-exchange process, the need for additional heating/cooling energy input is eliminated. Heat exchange is now simultaneously used to purify and/or concentrate an independent process stream, using the energy transferred between the raw input stream and the purified output stream, thus reducing the energy burden associated with conventional stand-alone treatment technologies that achieve the same effect.

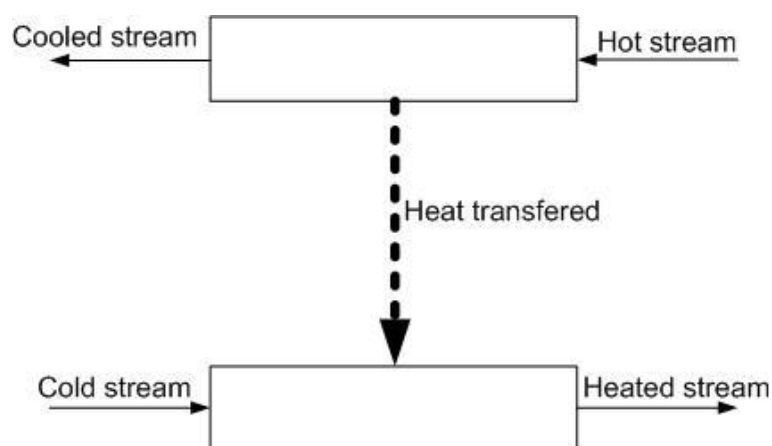


Figure 1: Normal process heat exchanger showing heat exchange present within a process.

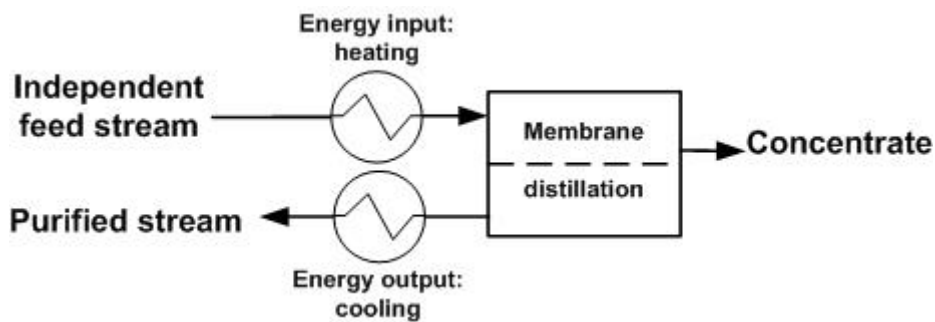


Figure 2: Normal membrane distillation system with external energy input for heating and cooling.

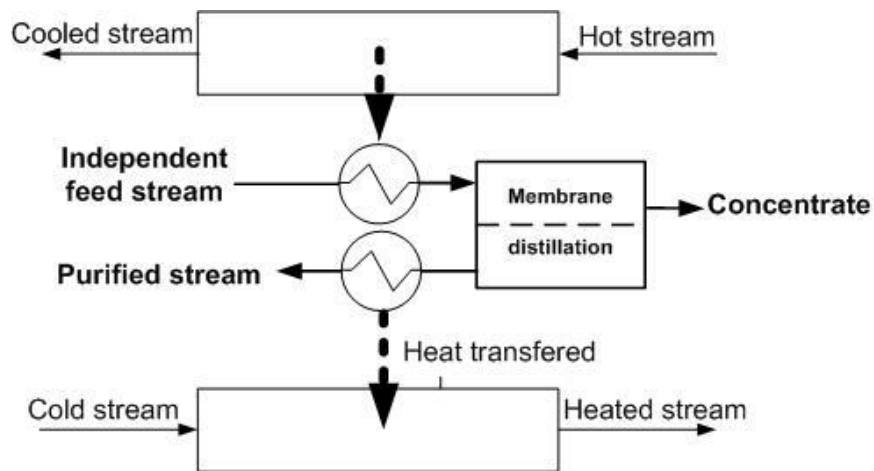


Figure 3: Combining the two systems represented in Figures 1 & 2 shows the concept of the membrane distillation heat exchanger (MDHX) system: the conventional process heat exchange passes through the membrane distillation system and thereby drives it to treat a separate water stream.

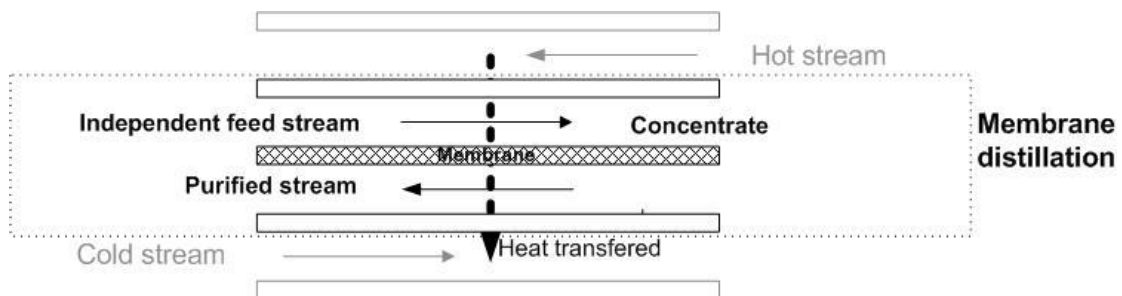


Figure 4: Refinement of the module to boost membrane distillation efficiency can be achieved by incorporating both processes into a single unit

The MDHX system can work using conventional membrane distillation (Figure 3). In the added refinement of the new membrane distillation system shown in Figure 4, the input stream is heated as it passes along the membrane. This improves performance of the temperature-driven process compared to conventional heating of the input stream before it enters the module. In conventional systems, as the input stream passes along the membrane surface it cools, and as it cools the vapour pressure decreases resulting in decreased performance towards the end of the module. In the new system the input stream is heated as it passes along the membrane thus stabilising the temperature profile along the membrane and substantially boosting performance.

**State of Development:**

A membrane distillation heat exchange module has been manufactured, and testing of a wide range of different parameters is currently underway.

**Intellectual Property Position:**

This technology is protected by Australian Provisional Patent Application Number 2011900759 entitled **A Membrane Distillation System** which was filed 3<sup>rd</sup> March 2011.

**Market Overview:**

Membrane distillation is a relatively recent commercial process. It has its origins in desalination, where it is estimated to be a cheaper water treatment system compared to existing technologies. Reverse osmosis and evaporation are traditionally used for concentration processes that generate purified water. However, apart from their lower energy demand, these processes do not generate purified water of the same high quality as that produced by membrane distillation. The main obstacle for commercialisation of membrane distillation is its comparatively higher energy requirement – this new invention overcomes this obstacle.

Process industries on a global basis can benefit from this invention. It has specific application in industries requiring ultra pure water, and any industry which uses reverse osmosis or any evaporation process can benefit from the new membrane distillation process. For example:

- desalination
- water recycling where the end product is a generated purified stream and the concentrate is considered a waste stream
- chemical processing which requires ultra pure water
- food and dairy industries in which both concentration and purification are of interest.

The utilisation of heat streams generated as a by-product of production lines is crucial for any of these process industries.

**Opportunities for Technology Co-development:**

Victoria University is seeking partners who have an interest in either investing in or licensing this technology for further development and commercialisation.

**Contact Details:**

Name: Tina Rankovic  
Title: Director  
Organisational Unit: Innovation &  
Commercial Development  
Phone : + 61 3 9919-5316  
Email: [tina.rankovic@vu.edu.au](mailto:tina.rankovic@vu.edu.au)  
[www.vu.edu.au](http://www.vu.edu.au)

Name: Rosemary Paxton  
Title: IP Manager  
Organisational Unit: Innovation &  
Commercial Development  
Phone : + 61 3 9919-9421  
Email: [rosemary.paxton@vu.edu.au](mailto:rosemary.paxton@vu.edu.au)  
[www.vu.edu.au](http://www.vu.edu.au)

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