

# PROFESSOR STEPHEN GRAY

## CURRICULUM VITAE

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Prof Gray has had a focus on water and membrane research for over 20 years, and was part of the CSIRO teams that developed MIEX™ resin and that conducted the Melbourne Water Climate Change Impact study. He has established Victoria University's water research program in 2006 that includes water treatment, water resource management, IT, ecology, psychology and economics.

He is part of research teams that are working towards commercialisation of membrane distillation from Victoria University research, have introduced ceramic membranes to Australian end users via a demonstration plant, and is currently assessing technology from a WaterRA project on reverse osmosis integrity monitoring for IP protection. He also recently led a project with Origin Energy to develop silica removal technology for their coal seam gas brines.

### RESEARCH INTERESTS

- Water Treatment, Sustainable Water Systems and Membrane Technology
- Membrane processes and interactions with process chemistry
  - Small scale water treatment systems
  - Direct potable reuse
  - Validation of water recycling systems
  - Brine management using high recovery reverse osmosis
  - Membrane distillation
  - Organic fouling of membranes
  - Silica fouling, and
  - Ceramic membranes, metal membranes & nano-composite membranes

### RECENT RESEARCH PROJECTS

Small scale direct potable reuse for the Australian Antarctic Division (AAD) involved design and demonstration of the direct potable reuse plant with low operator involvement and on-line validation. Both pathogens and chemicals of concern were monitored, and water quality objectives for product and discharges waters were reliably met. The plant included ozone – ceramic microfiltration (MF) to avoid issues with fibre breakage and to reduce MF fouling and thereby the need for CIP of the MF membranes. AAD will transport the plant to Davis Station, Antarctica in the summer of 2016/17. It is the first direct potable water recycling plant in Australia. The project was delivered in collaboration with the University of Melbourne, Australian Antarctic Division, Veolia, AECOM, RMIT University, Curtin University, TasWater, Coliban Water and the Australian Water Recycling Centre of Excellence.

Demonstration of ozone-ceramic membranes for water recycling. Treatment of secondary wastewater by ozone-ceramic MF was demonstrated at pilot scale, with net present value calculations showing similar lifetime costs for both ozone-ceramic MF and ozone-polymer UF. Residual ozone dosed onto the ceramic membrane was shown to be a requirement for stable, high flux operation. Ceramic membranes are now being considered by an Australian Water authority for application in water recycling.

Nanocomposite membranes for increased abrasion resistance was demonstrated in laboratory testing on flat sheet and hollow fibre PVDF membranes. While there has been much work on nanocomposite membranes

previously, this was the first work to report increased abrasion resistance for nanocomposite membranes, as well as a change in PVDF crystalline structure upon addition of nanoparticles. The increased abrasion resistance has benefit for high wear applications such as seawater pre-treatment.

## **OTHER AWARDS/ACHIEVEMENTS**

- Named as a “Thought Leader” in Lux Research's international review of water research, one of only 30 international researchers recognised as such (2013)
- CSIRO Collaborative Cluster Project, Cluster Project Leader, Advance membrane technologies, 2007 - 2010
- Victoria University Vice Chancellors Peak Award For Excellence in Research and Research Training (2014)
- Victoria University Citation Award for Excellence in Research and Research Training Research Team (Food Research; 2012)
- Victoria University Peak Award for Excellence in Research and Research Training Research Team (Water Resources; 2011)

## **PROFESSIONAL AFFILIATIONS**

- Vice President Aseanean Membrane Society (2016 – present)
- Water Research Australia, Board Member (2011 – present)
- Membrane Society of Australasia (MSA), Board Member (2008 -2010)
- Australian Water Association (AWA) (member)
- International Water Association (IWA) (member)
- International Desalination Association (IDA) (member)
- AWA Desalination Special Interest Group, Co-coordinator and Victorian Representative (2008 – 2011)

## **EDITORIAL ROLES**

- Journal of Water Reuse and Desalination (IWA), Editor, 2011- present
- Water Research, Associate Editor, 2008 - present
- Desalination, Editorial Board Member, 2010-present

## **SELECTED RECENT PUBLICATIONS**

1. Zhang, Jianhua; Duke, Mikel C.; Northcott, Kathy; Packer, Michael; Allinson, Mayumi; Allinson, Graeme; Kadokami, Kiwao; Tan, Jace; Allard, Sebastian; Croué, Jean-Philippe; Knight, Adrian; Scales, Peter J.; Gray, Stephen R. 2017. Small Scale Direct Potable Reuse (DPR) Project for a Remote Area. *Water* 9 (2) (2017) 94
2. Jianhua Zhang, Adrian Knight, Mikel Duke, Kathy Northcott, Michael Packer, Peter J. Scales, Stephen R. Gray, A new integrated potable reuse process for a small remote community in Antarctica. *Process Safety and Environmental Protection*, 104 (2016) 196-208
3. Jianhua Zhang, Kathy Northcott, Mikel Duke, Peter Scales, Stephen R. Gray (2016) Influence of pre-treatment combinations on RO membrane fouling, *Desalination*, 393, 120-126
4. Jianhua Zhang, Marlene Cran, Kathy Northcott, Michael Packer, Mikel Duke, Nicholas Milne, Peter Scales, Adrian Knight, Stephen Gray (2016) “Assessment of pressure decay test for RO protozoa removal validation in remote operations.” *Desalination*, 386, 19-24
5. Mayumi Allinson, Graeme Allinson, Kiwao Kadokami, Daisuke Nakajima, Peter Scales, Adrian Knight, Jianhua Zhang, Michael Packer, Kathy Northcott, Stephen Gray, A simplified but extensive organic micro-contaminant assessment method for recycled water, *AWA Ozwater15*, Adelaide 12-14<sup>th</sup> May, 2015, paper 132
6. Noel Dow, Jesús Villalobos Garcia, Leslie Niadoo, Nicholas Milne, Jianhua Zhang, Stephen Gray, Mikel Duke, Demonstration of membrane distillation on textile waste water: assessment of long term performance, membrane cleaning and waste heat integration. *Environmental Science: Water Research and Technology*, 3 (2017) 433-449

7. Takahiro Fujioka, Hitoshi Kodamatani, Hidenobu Aizawa, Stephen Gray, Kenneth P. Ishida, Long D. Nghiem, Role of membrane fouling substances on the rejection of N-nitrosamines by reverse osmosis, *Water Research*, 118 (2017) 187-195
8. Matthew B. Stewart, Darli T. Myat, Michael Kuiper, Richard J. Manning, Stephen R. Gray, John D. Orbell, A structural basis for the amphiphilic character of alginates – Implications for membrane fouling. *Carbohydrate Polymers*, 164 (2017) 162-169
9. Harry F. Ridgway, John Orbell, Stephen Gray, Molecular simulations of polyamide membrane materials used in desalination and water reuse applications: Recent developments and future prospects. *Journal of Membrane Science*, 524 (2017) 436-448