

## Publications

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### Journal Publications

1. J. Swaminathan and J.H. Lienhard V, **Design and operation of membrane distillation with feed recirculation for high recovery brine concentration**, *Desalination*, accepted 22 July 2018.
2. E.W. Tow, D.M. Warsinger, J. Swaminathan, A.M. Trueworthy, G.P. Thiel, S.M. Zubair, A.S. Myerson, and J.H. Lienhard V, **Comparison of fouling propensity between reverse osmosis, forward osmosis, and membrane distillation**, *Journal of Membrane Science*, 556: 352-364, 15 June 2018.  
D.M. Warsinger, J. Swaminathan, L.L. Morales, and J.H. Lienhard V, **Comprehensive condensation flow regimes in air gap membrane distillation: visualization and energy efficiency**, *Journal of Membrane Science*, 555:517-528, 1 June 2018.
3. D. M. Warsinger, E. W. Tow, L. A. Maswadeh, G. B. Connors, J. Swaminathan, and J. H. Lienhard V, **Inorganic fouling mitigation by salinity cycling in batch reverse osmosis**, *Water Research*, Feb. 2018, 137:384-394, 15 June 2018.
4. J. Swaminathan, H. W. Chung, D. M. Warsinger, and J. H. Lienhard V, **Energy efficiency of membrane distillation at high salinity: evaluating critical system size and optimal membrane thickness**, *Applied Energy*, 211:715-734, 1 Feb. 2018.
5. S. Fletcher, M. Mioti, J. Swaminathan, M. Klemun, K. M. Strzepek, and A. Siddiqi, **Decision making under multiple uncertainties: Urban water supply infrastructure planning**, *Journal of Water Resources Planning and Management*, 143:40–61, Apr. 2017.
6. D. M. Warsinger, E. W. Tow, J. Swaminathan, and J. H. Lienhard V, **Theoretical framework for predicting inorganic fouling in membrane distillation and experimental validation with calcium sulfate**, *Journal of Membrane Science*, 528:381–390, 15 Apr. 2017.
7. H. W. Chung, L. D. Banchik, J. Swaminathan, and J. H. Lienhard V **On the present and future economic viability of stand-alone pressure-retarded osmosis**, *Desalination*, 408:133–144, 15 April 2017.
8. H.W. Chung, K.G. Nayar, J. Swaminathan, K.M. Chehayeb, and J.H. Lienhard V, **Thermodynamic analysis of brine management methods: zero-discharge desalination and salinity-gradient power production**, *Desalination*, 404:291–303, Feb. 2017.
9. J. Swaminathan, H.W. Chung, D.M. Warsinger, and J.H. Lienhard V, **Membrane distillation model based on heat exchanger theory and configuration comparison**, *Applied Energy* 184:491–505, Dec. 2016.
10. M.I. Hassan, A.T. Brimmo, J. Swaminathan, J.H. Lienhard V, H.A. Arafat, **A new vacuum membrane distillation system using an aspirator: Concept modeling and optimization**, *Desalination and Water Treatment*, 57:12915–12928, June 2016.
11. D.M. Warsinger, A. Servi, S. Van Belleghem, J. Gonzalez, J. Swaminathan, J. Kharraz, H.W. Chung, H.A. Arafat, K.K. Gleason, and J.H. Lienhard V, **Combined Air Recharging and Membrane Superhydrophobicity for Fouling Prevention in Membrane Distillation**, *Journal of Membrane Science*, 505:241-252, May 2016.
12. J. Swaminathan, K.G. Nayar, and J.H. Lienhard V, **Mechanical vapor compression-membrane distillation hybrids for reduced specific energy consumption**, *Desalination and Water Treatment*, 57(55):26507–26517, Apr. 2016.

13. J. Swaminathan, H.W. Chung, D.M. Warsinger, J.H. Lienhard V, **Simple method for balancing direct contact membrane distillation**, *Desalination*, 383:53–59, Apr. 2016
14. J. Swaminathan, H.W. Chung, D.M. Warsinger, F. Al Marzooqi, H.A. Arafat, and J.H. Lienhard V, **Energy efficiency of permeate gap and novel conductive gap membrane distillation**, *Journal of Membrane Science*, 502:171–178, Mar. 2016.
15. H.W. Chung, J. Swaminathan, D.M. Warsinger, and J.H. Lienhard V, **Multistage vacuum membrane distillation (MSVMD) systems at high salinity**, *Journal of Membrane Science*, 497:128–141, Jan. 2016.
16. D. Warsinger, J. Swaminathan, L. Maswadeh, and J. H. Lienhard V, **Superhydrophobic condenser surfaces for air gap membrane distillation**, *Journal of Membrane Science*, 492:578–587, Oct. 2015.
17. D. M. Warsinger, J. Swaminathan, E. Guillen-Burrieza, H. A. Arafat, and J. H. Lienhard V, **Scaling and fouling in membrane distillation for desalination applications: A review**, *Desalination*, 356:294–313, Jan. 2015.  
Under review
18. J. Swaminathan, E. W. Tow, R. L. Stover, D. M. Warsinger, J. H. Lienhard V, **Effect of practical losses on the energy efficiency of batch seawater reverse osmosis**, *Water Research*, 2018.
19. H. W. Chung, J. Swaminathan, L. D. Banchik, and J. H. Lienhard V, **Economic framework to relate net power density and leveled cost of electricity of pressure-retarded osmosis system**, *Desalination*, 2018.

## Patents and Patent Applications

1. D. M. Warsinger, J. Swaminathan, A. Servi, and J. H. Lienhard V, **Maintenance of air layers for fouling prevention on submerged surfaces**, US Patent Application No. 15/157,663, May 2016.
2. J. Swaminathan, D. M. Warsinger, H. W. Chung, and J. H. Lienhard V, **Metal spacer enhanced permeate gap membrane distillation for energy efficient desalination**, US Patent No. 9,956,528 B2, issued on 1 May 2018.
3. J. Swaminathan, D. M. Warsinger, H. W. Chung, R. K. McGovern, and J. H. Lienhard V, **Multi-effect conductive gap membrane distillation**, US Patent Application No. 15/211,424 filed 15 July 2016.
4. D. M. Warsinger, J. Swaminathan, and J. H. Lienhard V, **Hydrophobic air-gap membrane distillation**, US Patent No. 9,751,047 issued on 5 September 2017.

## Selected Conference Presentations

1. J. Swaminathan, R. L. Stover, E. W. Tow, D. M. Warsinger, and J. H. Lienhard V. **Effect of practical losses on optimal design of batch RO systems**, *IDA World Congress on Desalination and Water Reuse*, Sao Paulo, Brazil. 15–20 Oct. 2017. (oral presentation and paper).
2. J. Swaminathan, E. W. Tow, Y. Roy, and J. H. Lienhard V. **Nanofiltration for high permeability textile dyeing effluent recycling**, *IDA International Water Reuse and Desalination Conference 2016*, Nice, France. 25–27 Sept. 2016. (oral presentation and paper).
3. J. Swaminathan, H.W. Chung, D.E.M. Warsinger, and J.H. Lienhard V, **Experimental investigation of high efficiency single-stage membrane distillation configurations**, *IDA World Congress on Desalination and Water Reuse*, San Diego, Aug. 2015. (oral presentation and paper). **Received Best Presentation Award**
4. J. Swaminathan, D.M. Warsinger, H.W. Chung, and J.H. Lienhard V, **Zero Liquid Discharge Desalination For Hydraulic Fracturing**, *Proc. American Water Works Association Annual Conference and Exposition*, Anaheim, CA, 7–10 June 2015. (poster). **Received First Place Best Poster Award.**

5. J. Swaminathan, and J. H. Lienhard V, **Energy efficiency of sweeping gas membrane distillation systems**, *Indian Society for Heat and Mass Transfer - American Society of Mechanical Engineering (ISHMT-ASME) Heat and Mass Transfer Conference 2013*, Kharagpur, India. (oral presentation and paper).
6. D. M. Warsinger, J. Swaminathan, J. H. Lienhard V **Effect of module inclination angle on air gap membrane distillation**, *International Heat Transfer Conference (IHTC-15) 2014*, Kyoto, Japan. (oral presentation and paper)
7. J. Leung, J. Swaminathan, A. Crawley, A. Kassner, **Reduced CVR is associated with cortical thinning in pediatric patients with sickle cell disease**, *Radiological Society of North America 2012 Scientific Assembly and Annual Meeting*, Chicago IL USA. (poster).