Muhammad Wakil Shahzad et al., J Chromatogr Sep Tech 2017, 8:7(Suppl)
DOI: 10.4172/2157-7064-C1-037

Membrane & distillation processes integration to achieve maximum recovery

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The economics of seawater desalination processes has been continuously improving because of desalination market expansion. Lower operating cost has been achieved by efficient operation strategies and better recoveries and the capital investment dropped many folds due to competent system designs and material development. Presently, reverse osmosis (RO) processes are leading in global desalination with 53% share followed by thermally driven technologies 33%, but in GCC their shares are 42% and 56% respectively due to severe feed water quality. In RO processes, intake, pretreatment and brine disposal cost 25% of total desalination cost at 40-45% recovery. We presented a tri-hybrid system to enhance recovery from RO retentate up to 85%. The proposed hybrid desalination cycle consist of two major systems, RO process and multi-evaporator adsorption system (ME-AD). They are arranged in series for maximum recovery from pre-treated feed. The conditioned brine leaving from RO system supplied to proposed multi-evaporator adsorption cycle driven by low temperature heat source such as solar energy or industrial waste heat. Detailed mathematical model of overall system (from one to four-evaporator adsorption cycle) is developed and simulation has been conducted in FORTRAN. The final brine reject concentration from tri-hybrid cycle can be increased from 166ppt to 222ppt if RO retentate concentration varies from 45ppt to 60ppt. The proposed tri-hybrid cycle is the highest recovery, 85%, and lowest specific water cost, 2.20 kWh/m3, reported in the literature up till now. The detailed process schematic of hybrid system is shown in Figure 1.

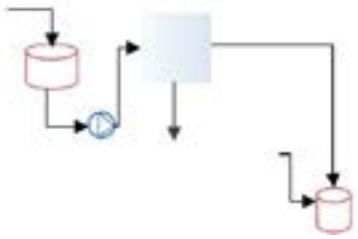

Figure1: *Membrane & thermal distillation hybrid processes flow schematic.*

Biography

Muhammad Wakil Shahzad is working as a Research Scientist in the Water Desalination and Reuse Center of King Abdullah University of Science and Technology. He worked as Research Fellow in the National University Singapore (NUS) in 2014 and as a lecturer at UET (Pakistan) from 2008-2009. He is working on thermal systems for cooling and desalination and their hybridization such as; Multi-effect Desalination, Adsorption Cycle and Desiccant Dehumidifier for overall system performance improvements. He is also working on economic analysis of single purpose and cogeneration systems. They developed a model for primary fuel cost apportionment in dual-purpose plants based on energy analysis that is widely accepted in the industry. He also has expertise on complex system modelling and simulation. He holds three international patents on hybrid cycles for desalination and cooling. To date, he published 18 peer-reviewed journal papers and 50 conference papers. Their innovative hybrid MED+AD cycle won "GE-ARAMCO global water challenge" award 2015 for high efficiency and lowest water production cycle <$0.5/m3. He also received two best paper awards in international conferences. He is selected as a regional coordinator for International Desalination Association Young Leader Program (IDA-YLP) for Middle East & Africa region for 2015-2017.

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