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RENEWABLE ENERGY STORAGE AND UTILIZATION FOR WATER PRODUCTION

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The inevitable escalation in economic development has serious implications on energy and environment nexus. The International Energy Outlook 2016 (IEO2016) predicted that the Non-Organization for Economic Cooperation and Development (non-OECD) countries will lead with 71% rise in energy demand in contrast with only 18% in developed countries from 2012-2040. In GCC countries, about 40% of primary energy is consumed for cogeneration based power and desalination plants. In the past, many studies were focused on renewable energies based desalination processes to accommodate 5 fold increases in demand by 2050 but they were not commercialized due to intermittent nature of renewable energy such as solar and wind. We proposed highly efficient energy storage material, Magnesium oxide (MgO), system integrated with innovative hybrid desalination cycle (MEDAD) for future sustainable desalination water supplies. The condensation of $Mg(OH)_2$ dehydration vapour during day operation with concentrated solar energy and exothermic hydration of MgO at night can produce 24 hour thermal energy for desalination cycle without any interruption. Combined system mathematical model was developed and simulation was conducted in System Advisory Model (SAM) and FORTRAN. It was showed that, Mg(OH)2 dehydration vapour condensation produce 120°C and MgO hydration exothermic reaction produce 140°C heat during day and night operation respectively correspond to energy storage of 81 kJ/mol and 41 kJ/mol. In addition, the hybrid MEDAD cycle can boost water production to more than 2 fold as compared to conventional desalination processes at same operating temperature due to excellent thermodynamic synergy. We believe that the proposed energy storage driven desalination cycle is the most sustainable solution for future water supplies.

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. His area of research includes energy storage materials, desalination, cooling, heat and mass transfer and system economic analysis. He is working on integration of desalination processes for overall system performance improvements. They proved that the Hybridization of Adsorption Cycle with Multi-effect Desalination or Membrane Distillation can improve water production to 2-3 folds. Their innovative hybrid MED+AD cycle won GE-ARAMCO global water challenge award for high efficiency and lowest water production cycle <$0.5/$m^3$. He is also working on economic analysis of single and hybrid systems and their developed primary fuel cost model is widely accepted in the industry. He also has expertise on complex system modelling and simulation. He holds four international patents. To date, he published 30 peer-reviewed journal papers and over 70 conference papers. 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 and Africa region. He is a Member of many professional organizations namely; International Desalination Association (IDA), The International Water Association (IWA) and American Society of Mechanical Engineer (ASME).

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