Design and Implementation of a Sustainable Permeate Gap Membrane Distillation System for Water Purification in the Turkana Basin of Kenya

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Reverse osmosis (RO) has proven an effective method of water purification and has been widely implemented in much of the industrialized world. However, high production and energy costs of the system are prohibitive to many lesser developed nations, which lack capital and energy infrastructure. In order to remedy this problem, a solar powered, sustainable permeate gap membrane distillation (PGMD) system was designed and tested as an alternative to RO. Polytetrafluoroethylene (PTFE) membrane samples were tested, utilizing simulated Turkana Basin contaminant water samples, at variable hot feed temperatures and data for both conductivities and flow rates of resulting permeate water were collected. The MD system demonstrated solute rejection comparable to or exceeding those produced by RO at all tested temperatures. Additionally, a direct relationship between permeate flux and hot feed temperature was observed. Following membrane performance evaluation, sustainable solar heating and charcoal evaporative cooling systems were designed and built utilizing locally sourced materials for the region. Field testing of the PGMD system illustrated that the heater and cooler were capable of achieving the necessary temperature gradients for efficient permeate flow. This data is being used to optimize the permeate output of the PGMD system which is currently being implemented in the Turkana Basin of Kenya. The system is currently producing potable water at a rate of 200L/hour and a cost of 0.35 cents/Liter, representing an approximate 80-fold decrease in cost as compared to RO. Ideally, this system will be disseminated, providing affordable drinking water to other “water-poor” regions of the world.

Awards Won:
Second Award of $2,000
King Abdulaziz &amp
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