Abstract

A design for obtaining pure water from a saline or brackish source through air gap distillation is evaluated in this study. This thesis investigates and validates the emerging AGD technology and provides methods to considerably improve its performance.

The aforementioned distillation process occurs between two parallel plates, namely the evaporator and condenser plate. The project focuses on decreasing resistances to mass transfer between the two plates thereby increasing the clean water permeate output and improving energy efficiency of the system. This is achieved by evaporation of the thin saline film (<1mm) over the evaporator plate. The work proposes and experimentally validates few different techniques to achieve the same such as surface modification of evaporator and condensation plates. One of the other critical goals is to increase the energy efficiency of the system by decreasing heat loss to surrounding by insulation and energy recovery from condensate through a cooling channel. This study also concentrates on providing experimental backing on obtaining thin films on condensation plates via open condensation experiments.

The lab scale setup successfully demonstrated the distillation process and achieved a GOR of 1.65 and permeate flux of 1.36 LMH with an effective evaporator area of 0.0304 m^2. The above results were achieved at an air gap thickness of 3mm with feed inlet and cooling water inlet temperatures at 70^0C and 26^0C. Experimentally obtained Recovery Ratio was 4.59% and pure water salinity was measured to be 0.03 mS/cm or 15 ppm. This work also provides insights to practically achieve comparable performance to larger sized AGD systems by proposing techniques to achieve a very thin air gap.