Free surface electrospun polyvinylidene fluoride membranes for direct contact membrane distillation

Jeremy M. Mortrud, James M. Roska, Patrick S. Hogan, Harjot S. Gill, Gevork Kazaryan, and Keith M. Forward *
California State Polytechnic University, Pomona
e-mail: kmforward@cpp.edu

***Abstract* — Water scarcity is a problem that affects 2.7 billion people around the world. By the year 2025, water scarcity is expected to affect nearly 2/3 of the world's population, particularly in regions that do not have the economic stability to provide solutions to this problem. The use of current technologies such as reverse osmosis, multistage flash distillation, electrodialysis reversal and membrane distillation are commonly used methods of water purification. For this research, the use of direct contact membrane distillation (DCMD) has been chosen due to its low operating costs in comparison to processes such as reverse osmosis which operates at high temperatures. The current process for manufacturing DCMD membranes is expensive, inefficient, and does not allow for the optimization of desirable membrane properties. Through this research an alternative method of fabricating membranes will be completed through the means of free surface electrospinning. This process will allow for the control of desirable properties such as fibre diameter, pore size, and membrane thickness. In this study, we produced DCMD membranes using polymeric solution of 22 wt% Polyvinylidene Fluoride (PVdF) in Dimethylacetamide (DMAc). In the free surface electrospinning setup there is a solution bath with a partially submerged rotating wire spindle and a voltage of 40 kV was applied. The electric field caused charge to accumulate on the surface of the solution droplets, leading to the formation of electrohydrodynamic jets. Electrospinning was performed in an environment with relative humidity ranging from 60-80 RH%. In the presence of high humidity, water absorbs into the polymeric jet causing the PVdF to separate between the hydrophilic and hydrophobic phases. The gelled fibers were collected on a grounded rotating drum and left at room conditions to solidify. The performance of the produced membranes was evaluated using an in-house built DCMD apparatus and the membranes were characterized by taking thickness readings and scanning electron micrograph (SEM) images.**