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Improving Membranes Distillation for Desalination Technologies to the Environmental Impact of Brine Discharge in Context of Climate Change for the Caribbean Coastal Aquifers.

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Extended Abstract

There are many cities and countries around the world without enough freshwater, and its demand is growing while natural resources are limited. Some estimates show that nowadays four out of every hundred people suffer scarcity of drinking water [1] and the situation will get critical due to the effects of climate change. Drought has come to critical levels in the aquifers, rivers, lakes, etc. Moreover, costal aquifers are getting salinity intrusion, which increases the salinity and pollution [2]. Ninety-eight percent of the water on the planet is salty water, whereas 2% of water is freshwater, but the majority of freshwater sources are in ice and snow form or in groundwater, approximately 0.008% is easily accessible for human use [3]. Desalination technologies take an important place because they allow using salty water as a source of drinking water. In the last 20 years, the desalination capacity has been growing exponentially in a way that currently the number of desalination plants is twice as high as it was at the turn of century. Although these facilities produce approximately 96 million cubic meters freshwater from desalination technologies per day, they also generate almost 142 million m^3 of the high salinity discharge water (brine) per day [4] which has strong environmental impacts over aquatic life.

To produce fresh water, reverse osmosis (RO), the most common technology with nearly 70% of operational desalination capacity, has been widely studied. In the last decade, emerging technologies such as nanofiltration, forward osmosis and membrane distillation (MD) have also gained significant attention [4]. Several authors consider that MD is a good technology for using as support of RO or other methods, in particular, to treat brine and crystallizer module. Additionally, they have reported high energy efficiency [5]. Recent works have included surface modifications with silver nanoparticles (AgNPs) to counter temperature polarization and biofouling. AgNP can intensely absorb energy at some ranges in UV-Vis spectrum (close 400 nm), which produces an increment of temperature on the membrane surface. This is known as plasmonic resonance and it can reverse the gradient in the border layer together with increment in vapor flux, additionally it has a strong antimicrobial effect [10,11,12].

This work studies the performance of polyvinildenefloride (PVDF), fiberglass (FG) and Polytetrafluoroehtylene (PTFE) membrane distillation modified with AgNPs, in a desalination process for drinking water in a vacuum membrane distillation (VMD) cell. The study uses a model of the boundary layer theory for understanding the effect of AgNPs over the surface of MD in the context of temperature polarization, which has been reported by several authors [10]. In this study, AgNP were deposited by dip coating process over PVDF, FG hydrophilic and PTFE hydrophobic commercial membranes as substrate. Membranes were characterized by SEM, EDS, contact angle, and Pore size distribution. By using a thermal camera and a UV lamp, the performance of the heat delivery was measured. The presence of AgNP 50–150 nm and increase in absorption of energy over membrane were verified.

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