Produced Water Treatment and Reuse to Mitigate the Environmental Impact of Oil and Gas Production

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Produced water generated during oil and gas production is primarily disposed of through deep-well injection, which is costly, has limited receiving capacity, and induces seismicity. Produced water reuse is vital to the environmental sustainability of oil and gas production and has many enriching benefits, such as providing an alternative water supply for industrial uses, irrigation, rangeland restoration, and stream augmentation. Produced water treatment is crucial for safe reuse; however, conventional technologies are too expensive or incapable of treating highly saline produced water. Membrane distillation is a promising treatment process that utilizes thermal energy to transport vapor through a hydrophobic membrane while preventing wastewater from contaminating the distillate. The objective of this project is to develop an innovative vacuum membrane distillation (VMD) system to treat highly saline and contaminated produced water at a lower cost and greater efficiency than conventional technologies. A prototype system was designed and laboratory experiments were conducted using ceramic membranes, which are robust, resistant to fouling/scaling, easily cleanable, and recoverable. The system successfully treated produced water from the Permian Basin in New Mexico, removing more than 99.9% of salts and metals, with a high water production rate of 178 liters of distillate per day using 1 m2 of membrane surface area. This project demonstrates VMD as an effective, scalable, low-cost treatment method for produced water reuse. Membrane distillation can be powered by solar thermal energy and used for treating brackish water, seawater, and wastewater in rural and remote areas that lack access to electricity and water.

Awards Won:
First Award of $5,000