Produced Water Reclamation and Reuse: Development and Implications of Short Treatment Trains

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Communities and industries around the world are experiencing significant challenges in securing and treating water, reclaiming water from waste streams, and managing brines and residuals generated during treatment and desalination of impaired water. Many industries require large volumes of water for manufacturing of goods or energy, thus competing with communities for limited water resources. Yet, many of these industries lack the knowledge or means to increase water use efficiency and treatment for internal reuse. These challenges are having, and will continue to have, immense impact on societies and ecosystems, and we must continue, with urgency, to explore new ways to prudently manage our water resources.

Specifically in the upstream oil and gas (O&G) industry, treatment of wastewater generated during O&G exploration and production is critically needed for internal reuse (fracking), environmental protection (before discharge to the environment), and for other advanced reuse applications (irrigation, livestock watering, other industrial uses). The high cost of O&G wastewater treatment, especially during times of low O&G cost, leads operators to dispose produced water and fracturing flowback into deep wells, resulting in seismic activity, or discharge partially treated produced water, which may compromise the environment.

Membrane processes provide a good treatment solution for this and other industrial wastewaters because of their relatively small footprint, consistent product water quality, and recent advancement in materials used and energy management/recovery in membrane systems. Some membranes have very good desalination capabilities (e.g., reverse osmosis, nanofiltration, membrane distillation), but almost all of them require extensive pretreatment to protect the membranes from fouling or scaling associated with the contaminants present in the feed water.

In this presentation I will provide an overview of desalination processes and pretreatment (physical and biological) processes that we have investigated in the last seven years for treatment of O&G wastewater and other industrial waters. These include biologically active filters (BAF), membrane bioreactors (MBR), and close-circuit nanofiltration desalination (CCD-NF) for treatment and pretreatment of produced water. The advantages, limitations, and research needs will be highlighted, alongside economic and life cycle assessment of some of these processes.

Bio Sketch

Dr. Cath is a professor of environmental engineering at the Colorado School of Mines. His main field of research is membrane and biological processes for wastewater treatment, desalination of saline and hypersaline brines, reclamation of impaired water for potable reuse, and energy from water and wastewater. Dr. Cath is a PI on many research projects focusing on the integration of membrane contactor processes in seawater and brackish water desalination, in domestic and industrial wastewater treatment (including oil & gas wastewater), and in life support systems. Additional research focus is on data-science integration in control systems for early detection of system failure, techno-economic analysis and life cycle assessment of water-energy systems, and decision support tools to select efficient and low energy treatment technologies for a broad range of water and wastewater applications. Prof. Cath is the director of the Advanced Water Technology Center (AQWATEC), Co-Director of the Colorado Center for a Sustainable WE^2ST, and he holds a joint appointment at the National Renewable Energy Laboratory (NREL).