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SOLAR ENERGY TECHNOLOGIES OFFICE

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Supercritical Treatment Technology for Water Purification

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Project Sponsors

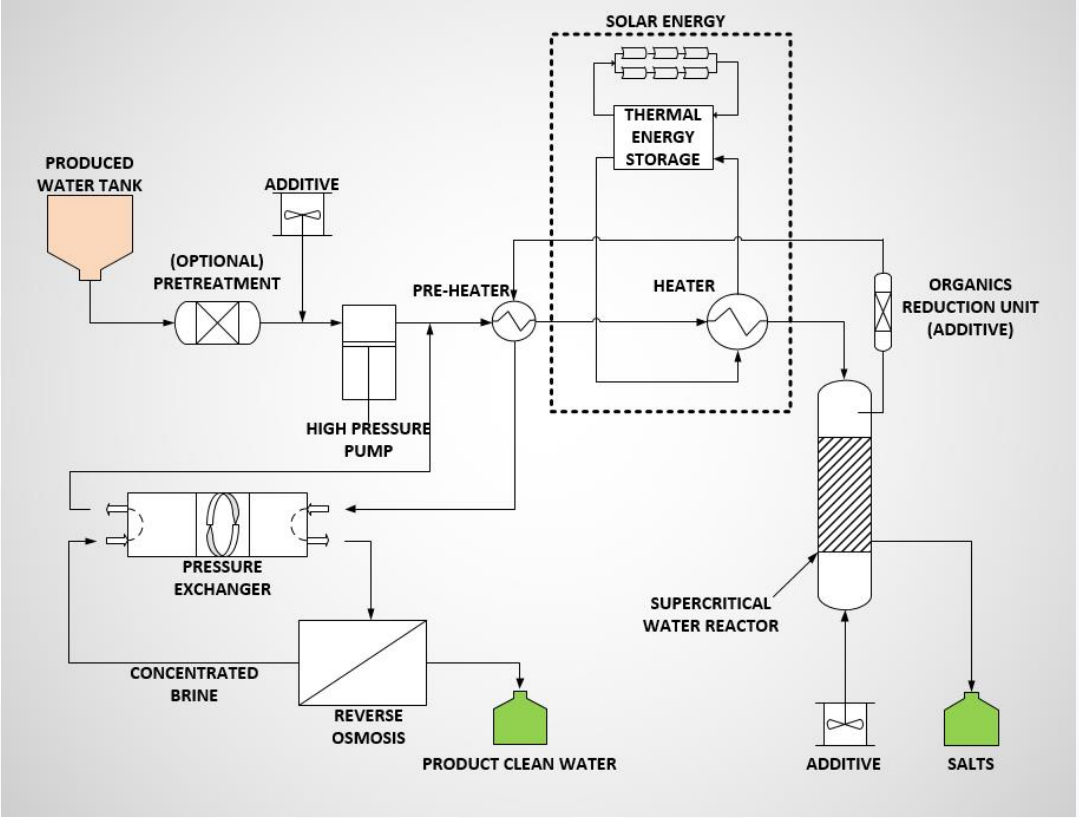
- U.S. Department of Energy
  - Office of Energy Efficiency and Renewable Energy
  - Technology Manager: Mark Lausten
- University of North Dakota
- Envergex LLC
- Doosan Heavy Industries
- Creedence Energy Services

Background

- Oil and gas flowback and produced water (FP) is estimated from 0.5 – 3.8 million gallons per well
  - 90+% of FP water is derived from naturally occurring formation brines. FP contains 50,000 to 300,000 mg/L and organics ~2,000 mg/L
  - Over 1.1 million active oil and gas wells in the US
- Deep well injection is most common method of FP disposal
- Recycling of FP water for fracking is limited
- RO and evaporative method are inadequate for treating high TDS brine
- Supercritical Water (SCW) treatment can handle the very high TDS brine. We proposed an enhanced SCW technology **S**upercritical **W**ater **E**xtraction – **E**nhanced **T**argeted **R**ecovery (SWEETR™)

Approach

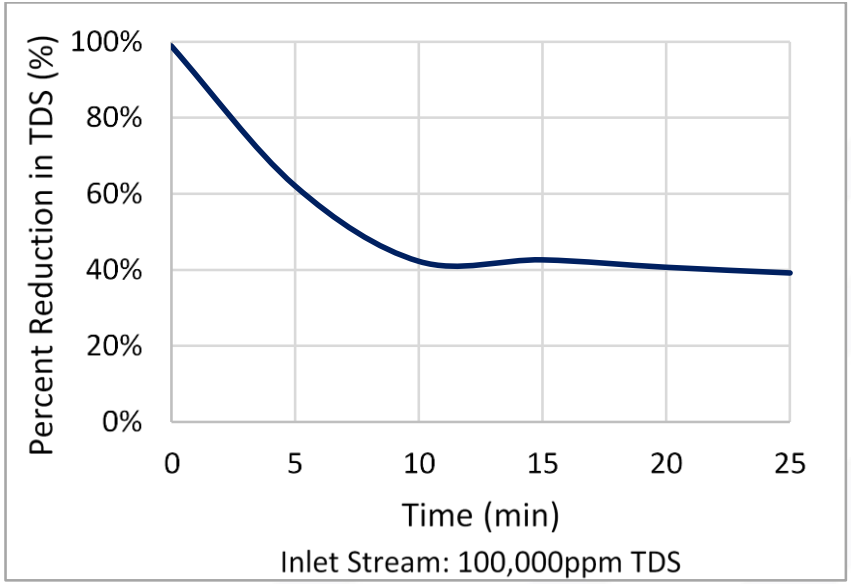
- Separate saltwater into a pure water stream and recover valuable solids while destroying organics producing zero liquid discharge (ZLD)
  - Reducing overall energy penalty for SCW desalination and reduce scaling on equipment
  - Develop modular technology and combine with reverse osmosis (RO) to improve economics
  - Utilize solar energy as method of added heat



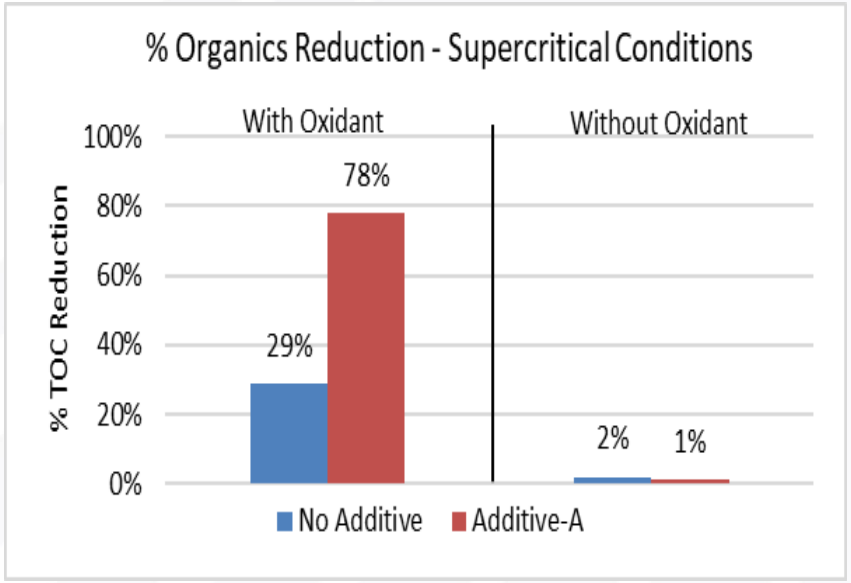
Project Goals

- Evaluate the feasibility of using SWEETR™ for desalination of hypersaline brine
- Determine the effectiveness of our novel additives to reduce energy requirement for supercritical desalination, reduce corrosion and fouling of heating exchanger surfaces, and allow separation and recovery of solids
- Identify ways of integrating SWEETR™ with commercial technologies like reverse osmosis
- Evaluate the application of using solar thermal energy for a modular SWEETR™ system
- Scale-up and demonstrate the feasibility of achieving ZLD using SWEETR™ technology from hypersaline solutions

Preliminary Results



- Water treated to only the quality required for input to RO system reduces overall system cost



- Catalyzed destruction of organics with additives: 90+% destruction targeted

Impact

- Oil and gas industry: desalination of produced waters
  - Cost and environmental impact: mitigates cost of disposal (i.e. deep well injection) and costs of clean water acquisition.
  - Good first entry point due to higher margins.
- Seawater Desalination: Reverse osmosis
  - This technology would treat effluent recycling to the RO unit, resulting in ZLD
- Levelized cost of water treatment (LCOW) target of $\$1.50/m^3$ for a small modular system

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