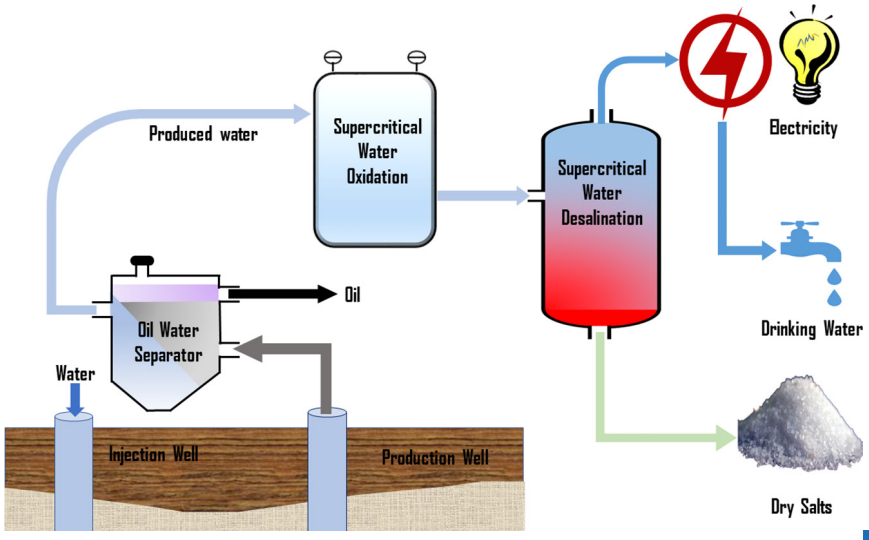

Los Alamos NATIONAL LABORATORY

Tech Snapshot

Earth and Environmental

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NEXT GENERATION TREATMENT OF PRODUCED WATER GENERATED DURING OIL & GAS EXTRACTION

An Energy-Efficient and Low-Cost Technology

SUMMARY

In the United States alone, more than 50 million barrels of produced water are generated every day across approximately 900,000 wells. The industry and regulators are increasingly concerned that produced water, when re-injected underground, may be contributing to increased seismic activity and/or contamination of groundwater aquifers. Los Alamos National Laboratory's supercritical water desalinization and oxidation (SCWDO) technology has the potential to efficiently treat billions of gallons of the foul water produced from Oil and Gas extraction, with zero net energy input. We are seeking partners through a license or a Cooperative Research and Development Agreement (CRADA) with an interest to further develop the technology to an integrated pilot-scale system.

MARKET APPLICATION

The demand for technologies and solutions that can remove pollutants at a cost that permits profitable oil and gas production are at an all-time high. Early customer discovery in this market segment has informed Los Alamos of significant interest for reliable and scalable solutions that treat and reuse produced water at a lower cost than what is being used today in the industry. The global Total Addressable Market for produced water treatment was $9.1B in 2021 and projected to grow to $14.8B by 2030. The oil and gas segment is the largest segment within the produced water treatment market with 72% of global revenue. The Serviceable Obtainable Market targeting US natural gas producers is approximately $2.0B (2022).

BENEFITS

This platform technology can potentially provide a licensee or collaborator the ability to use the heat generated by the oxidation of the organics present in produced water to provide a highly energy-efficient single treatment process to desalinate and clean the water to drinking water standards thereby making billions of gallons of water available for municipalities, agriculture, and other consumptive uses. Multiple applications and products could be created from it. Potential Benefits include:

- Significantly reduce produced water treatment and disposal cost
- Significantly reduce the energy required for treatment
- Produce potable water
- Treats organics and salts in a single treatment process
- Energetically self-sufficient - uses the organic compounds present in produced water as the energy source
- Substantially reduce the onshore injection of produced water into the subsurface environment
- Valuable mineral salts can be selectively separated and captured
- No requirement for expensive pre-treatment steps

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WHY WE ARE BUILDING NEXT GENERATION TREATMENT OF PRODUCED WATER GENERATED DURING OIL & GAS EXTRACTION

In support of the Department of Energy/NNSA mission to address problems of national importance, Los Alamos National Laboratory set out to develop and demonstrate a one-step treatment technology to produce drinking quality water in a safe and reliable manner from non-traditional water sources. These include deep-aquifer brines containing high salt concentrations, industrial and municipal waste waters with varying organic content, and produced water generated by the oil and gas industry. Our goal is to help industry create a system and process to treat and reuse billions of gallons of produced water and to repurpose that water for the benefit of users outside of the oil and gas economy.

WHAT'S BEHIND OUR TECHNOLOGY

Supercritical water at high temperatures and pressures behaves as a non-polar fluid and as a result salt solubility decreases to meet drinking water standards. In addition, under supercritical conditions any organic compounds can be effectively eliminated via wet oxidation, which releases a significant amount of heat that can be used within the process to improve overall energy efficiency of the supercritical desalination process. We have combined the two complementary functions of supercritical water oxidation and desalination to efficiently treat non-traditional water sources, including produced water from oil and gas extraction. Given a low percentage of organic content in the produced water, the technology can be energetically self-sufficient. Funds for development were provided from the Laboratory-Directed Research and Development program, and for demonstration from the Laboratory Technology Evaluation and Demonstration program.

OUR COMPETITIVE ADVANTAGES

Existing methods of treating produced water are expensive, inefficient, energy-intensive, and can rarely produce water that can be used for agricultural, industrial, or municipal purposes. There is currently no economical option that can deal with the industry challenge of treating wildly variable streams of waters. Each stream of water contains a unique salinity and mix of impurities, including organics, heavy metals, particulates, and radionuclides. This variability forces operators to cobble together a patchwork of sub-optimal solutions ranging from filters to ion exchange and electrochemistry. In cases where waters are particularly briny or high in organics, the situation is even worse, because many solutions don't work in harsh conditions. The proposed process is a single energy-efficient process that uses the energy from oxidation of the organics present in produced water to reduce the energy demand for the desalination function. The process can be configured to produce clean water and solid salts as outputs or clean water and a concentrated brine. The treatment cost is significantly lower when compared to direct disposal. Additionally, value-added coproducts, such as valuable mineral salts, can be selectively separated.

OUR TECHNOLOGY STATUS

We are currently at a technical readiness level of 3 (laboratory bench-scale prototype) and have successfully tested synthetic produced water samples from the San Juan basin and Permian basin and demonstrated production of potable water. We are in the process of testing produced water samples collected from multiple basins. We have filed a provisional patent on the technology, and we are seeking a commercialization partner to license the technology or participate in a Cooperative Research and Development Agreement (CRADA) to further develop the technology to an integrated pilot-scale system. We welcome management & service companies, equipment manufacturers, oil and gas companies, entrepreneurs, and investors to contact us.

PUBLICATIONS AND IP

'A novel approach for produced water treatment: Supercritical water oxidation and desalination' Sharan et al., *Desalination*, 2022, **532**, 115716.

Patent pending.

National Nuclear Security Administration