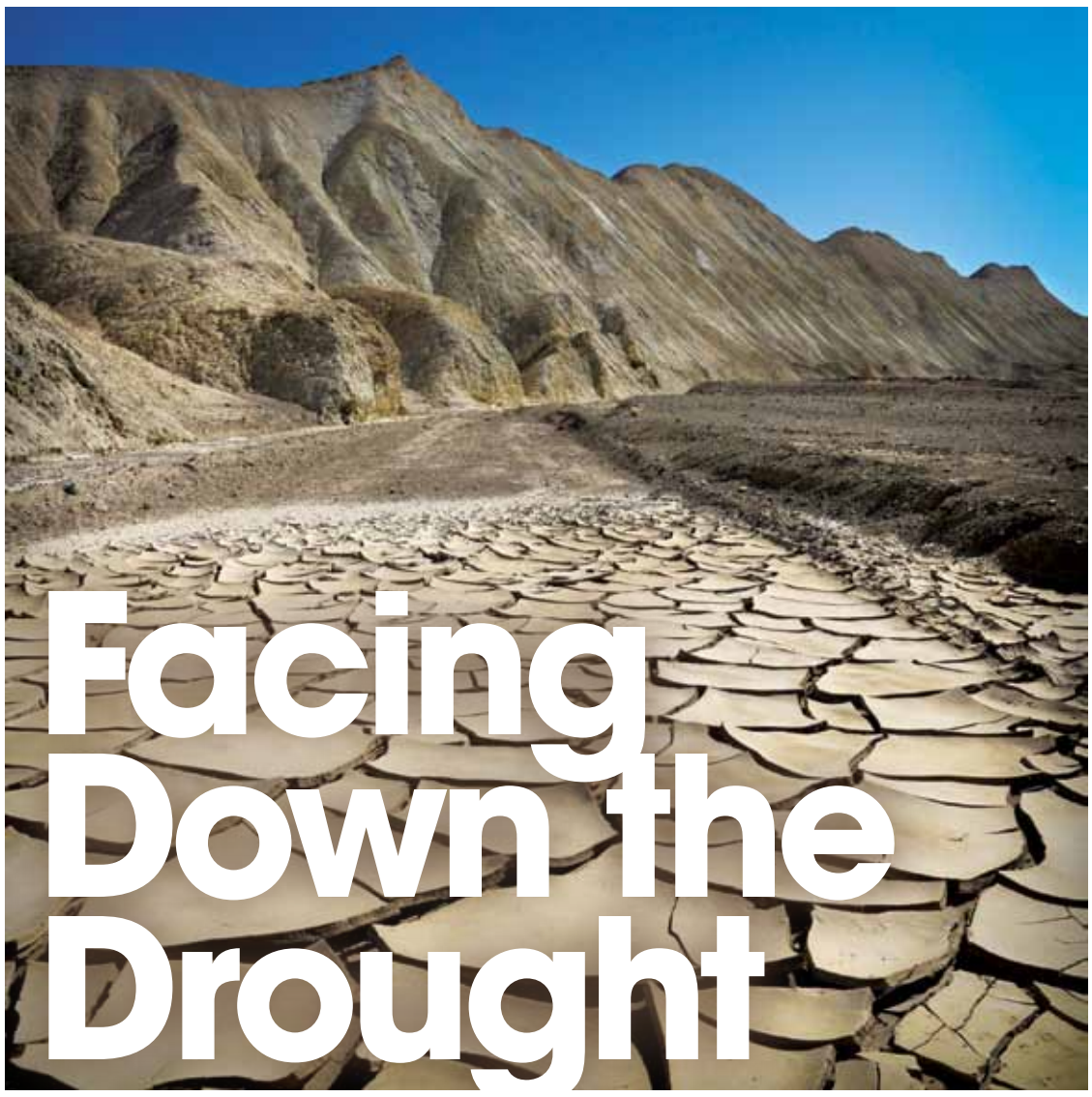

Facing Down the Drought

By Lee Portillo

Electrolysis & UF treatment recycles produced water for cyclic steam stimulation & irrigation

California is enduring its worst drought in decades. The Central Valley is the agricultural hub of the Golden State, and without access to sufficient water for irrigation, its major industry is under threat. Recently, growers lost about $2.2 billion in revenue and more than 17,000 jobs. Farmers in the San Joaquin Valley are thirsty for water resources and also are facing increasing competition from other water-intensive industries, like oil and gas and manufacturing. Today, agriculture accounts for 80% of the state's water use, but water consumption in the oil and gas industry is on the rise. Oil and gas operations use 280 billion barrels of water and produce more than 3.3 billion barrels of wastewater per year.

The wastewater left contaminated by oil and gas operations must be disposed of as hazardous waste, and this represents a significant line item in oil and gas operators' budgets—as much as $26 per barrel of water disposed. With water-intensive industries paying a premium for water, new methods for treatment and recycling are becoming economic. Due to these conditions, there is a substantial market for treating and recycling polluted water instead of using "new" freshwater. By recycling, operators benefit twofold. First, they reduce the cost of sourcing freshwater, and second, they eliminate the logistical costs of water management, such as storage, trucking and disposal.

Cleaned & Reused

What if produced water from oil and gas operations could be cleaned and reused for other major California industries like agriculture? Treating and recycling water could open a new water source for farmers currently battling extreme drought. Putting their technology to the test, OriginClear and membrane provider TriSep started applying their combined solutions in oil fields in California. Their goal was to efficiently and effectively tackle the water management inefficiencies compounding the drought's impact in the Central Valley.

The companies saw an opportunity to combine their electrolysis and ultrafiltration (UF) membrane technologies to treat California's produced water for reuse in crop irrigation and other industries. Produced water is notoriously difficult to clean. There is no singular method for proper cleanup, and many processes require multiple steps to effectively combat the wide variety of contaminants present in produced water. Current technologies being tested employ a variety of techniques, including hydrocyclones, induced gas flotation, walnut shell filters and ion exchange.

Site Testing

The partners completed preliminary testing of water cleanup technology at a cyclic steam simulation heavy oil production site in Bakersfield, Calif., from February to May 2015. Following testing, the produced water showed high removal efficiency and was deemed suitable for both cyclic steam generation systems and agricultural irrigation. The recovered water was of such high quality that it also could be reused on site as feed into the chemical softening system, as well as in other areas of oil and gas operations.

Third-party analysis showed a 99.8% reduction in turbidity as well as undetectable levels of effluent contaminants such as oil and grease and less than 5 parts per million of total suspended solids. Testing also found a total recoverable petroleum hydrocarbons reduction of 92%, and a 99.6% reduction in motor oil range constituents. The treatment method was shown to be economically viable in water-stressed regions, like California. As water quality regulations become increasingly strict and water becomes ever more scarce, treatment schemes such as this will be useful.

OriginClear and TriSep plan to conduct further research and development to make this treatment method a viable solution for applications around the world.

Breaking Down the Process

OriginClear utilized three electrolysis technologies (electrocoagulation, electroflotation and electro-oxidation) to separate and lift contaminants from the produced water. The electrolysis is a primarily chemical-free, low-energy, closed-loop process.

In the first stage, electrocoagulation, wastewater moves through high-mass-transfer reactors where metal ions modify pollutant surface charge. Contaminants, such as suspended solids, non-soluble oil and grease, clump together and easily separate. Electroflotation is the next step. It separates the broken oil emulsion with a "cloud" of gases in a flotation tank to create a "mat" of floating waste that can then be mechanically separated from the clean water below and raked off. Finally, electro-oxidation disinfects the water and demineralizes any remaining contaminants. The electrolysis technology provides up-front de-oiling and bulk suspended solids removal. The UF membrane removes any remaining oil and suspended solids to acceptable reuse levels for oil production. Because UF membranes operate via size exclusion, the majority of non-dissolved contaminants are removed during this final step. In the case of reuse for irrigation, a final brackish water reverse osmosis desalination step is needed. w&wd

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