

## HARTENERGY

## 2018 Water Management Techbook

## A New Approach to Reuse

Water recycling system replaces disposal with reuse in the water chain.

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Kaizen Fluid Systems

aizen Fluid Systems has combined modern technologies to create an electromechanical water recycling system. An electromechanical system converts extracted solids, liquids and/ or gases into useful commodities, virtually eliminating the need for any type of disposal. The process removes or destroys all chemicals, silts, clays, chlorides, bacteria, fungi and parasites, all of which are total dissolved solids (TDS) and total suspended solids (TSS). The system returns pure, clean and clear water that is very close to distilled quality, which may be used for many additional purposes.



The process resulted in pure water that was near-distilled water quality and was ideal for fracturing, drilling use or discharge into the environment without any worry of discharge violations.

A producer in the oil and gas industry approached Kaizen asking for a solution to purify the mass volumes of its produced and flowback water. The producer had worked previously with at least 16 water management companies without success in search of not only an economical solution but one that would allow it to maintain compliance with all state and Environmental Protection Agency (EPA) guidelines. The solution for the producer also would need to reduce and/or eliminate the costly expense of storage and transporting the water for disposal.

The producer's corporate mandate was to procure a system whereby it would have the option to use the clean water for fracturing or drilling operations as needed, and either discharge or evaporate the balance into the environment well within current and proposed state and EPA guidelines. To meet state and EPA guidelines, the water needed to be free of chemicals, metals, salts and virtually all TDS and TSS. Solids extracted needed to meet state and EPA guidelines for disposal or reuse, and the operator needed to ensure naturally occurring radioactive materials concentrations remained within guidelines for conventional disposal wells.

Kaizen had a system in place for other producers that delivered results that were significantly lower than the EPA and state guidelines. After further discussions with the operator, Kaizen agreed to perform a site visit to evaluate the operator's specific needs, pull produced water samples and complete the laboratory analysis to determine the best practice to meet the requirements. The producer's water sample had a TDS of 318,000 mg/l, a TSS of 297 mg/l, a turbidity of 226 mg/l, a pH of 4.4 mg/l with barium at 11,600 mg/l, iron at 102 mg/l, magnesium at 1,820 mg/l, strontium at 7,270 mg/l and zinc at 6.7 mg/l. All other constituents were within reasonable concentrations for produced water.

Kaizen determined that to provide water pure enough for discharge into the environment while complying with the state and EPA guidelines, it would process the water in a systematic order using nine of its portfolio technologies. By following a systematic procedure, Kaizen extracted the solids, which are all benign and usable and therefore have no disposal costs. This procedure included destroying all chemicals and changing the ionic metals back into their oxide form, thus rendering them benign. Then, all of the chlorides were extracted from the brine stream in either a concentrated heavy brine form for drilling operations or as high-quality dry salts ready for other commercial or industrial use. The process resulted in pure water that was near-



Kaizen's dewatering cylinder works as part of the separation process for produced water. (Photo courtesy of Kaizen Fluid Systems)

distilled water quality and was ideal for fracturing, drilling use or discharge into the environment without any worry of discharge violations.

Having completed the process, the produced water underwent substantial improvement in quality. An industry-respected third-party laboratory report showed the following results:

- Barium reduced to 0.115 mg/l from the original 11,600 mg/l;
- Iron reduced to 0.01 mg/l from 102 mg/l;
- Magnesium reduced to 0.1 mg/l from 1,820 mg/l;
- Strontium reduced to 0.113 mg/l from 7,270 mg/l;
- Zinc reduced to 0.0039 mg/l from 6.7 mg/l;
- Aluminum reduced to 0.0031 mg/l from 3 mg/l; and
- All other metals were at a fraction from their start point;
- Turbidity reduced to 0.18 mg/l from 226 mg/l;
- TDS reduced to 144 from 318,000 mg/l
- Chlorides reduced to 3.98 mg/l from 181,000 mg/l; and
- TSS reduced to 5.4 mg/l from 297 mg/l.

The pH can be adjusted with accuracy to any level specified to meet the producer's specific needs.

To accomplish these results, Kaizen has developed a protocol whereby all water is processed in real time, except for buffer capacity, before entering the company's equipment at certain intervals in the equipment and at the discharge stage. Therefore, the process greatly reduces the need for any large volume storage or transportation (thus reducing producer costs and environmental concerns) while processing any volume of water at a site. This also allows Kaizen to monitor and control each phase to ensure each step is meeting predetermined process standards.

The Kaizen process is completed in two stages, with pH adjustment, solids removal, chemical destruction and metals removal completed using eight of the company's technologies in the first stage and nonconventional desalination in the second stage. The first stage is designed to remove all impurities from the produced water input stream, creating a pure brine for the second stage feedstock. This process allows Kaizen to keep all resultant fluids and solids pure, clean, nontoxic and nonhazardous.

The water discharged is high grade and close to distilled quality, suitable for reuse in operations,



Kaizen Fluid Systems' separation equipment works to eliminate TDS and TSS from produced water. (Photo courtesy of Kaizen Fluid Systems)

agriculture or discharge into the environment and completely mitigates the need for any use of imported potable water by the producer. Vaporization can be used if wanted as there is no risk of any chemical discharge into the environment due to the water's purity.

The company's process can handle any concentration of TDS from 1,000 mg/l to 500,000 mg/l entrained in the water column as long as the column can be pumped, is somewhat fluidic and will flow. The concentration of the contaminants will affect the speed at which any specific treatment train can process; however, there is no limitation on the chemical toxicity or TDS concentration with the process. This is a unique feature as all other systems are restricted in most cases by TDS levels.

Water with lower TDS or chemical properties may require a simpler process. Kaizen's technologies are customizable and can function independently for specific tasks or be placed in sequence for complex water purification needs. Systems are fully scalable and have the capability of purifying virtually any discharge stream of fracture fluid or produced water as generated within the oil and gas industry with a minimum size of 50 gal/min.

In many cases there is no need to remove TDS or other components found in produced or fracture water. For this reason Kaizen can deploy only the required pieces of equipment to the site for the specific needs of the producer. The company also can supply complete systems capable of purifying high (more than 400,000 ppm) TDS produced water to potable standards. The system also can precondition water before, after and during fracture operations or process a fixed volume of produced water at any site and make it suitable for its designated use. The electromechanical process typically reconfigures undesirable compounds into useful products and does not generate a toxic waste stream.