H2prO HD Treatment Enhanced Produced and Flowback Water Reuse in the Marcellus Shale
Location: Butler County, Pennsylvania

With a minimal number of disposal wells available in Pennsylvania, it is costly to dispose of produced and flowback water from the Marcellus shale. Operators are looking for effective, economic, and environmentally safe methods to treat this water for reuse and eliminate the costs associated with sourcing, transporting, and storing fresh water for use in hydraulic fracturing.

An operator in Butler County, Pennsylvania was trucking pit water from one impoundment to another in a residential area. The flowback and produced Marcellus water had significant amounts of bacteria as well as dissolved iron, hydrogen sulfide (H$_2$S), and iron sulfide, which resulted in poor water quality and a pungent odor. The destination impoundment for these fluids already contained a substantial amount of fresh water for use in multi-well fracturing operations. The fresh water had very low bacteria levels and did not require treatment, but adding the untreated produced and flowback water to the impoundment would have contaminated the entire volume of water.

After reviewing multiple potential treatment strategies, Baker Hughes suggested its H2prO™ HD system that generates chlorine dioxide (ClO$_2$), an environmentally preferred biocide, as the ideal treatment. Several traditional chemical treatment options that only target a specific contaminant were rejected based on the presence of multiple contaminants in the water.

A mobile H2prO HD system treated the 76,000 bbl of water at a rate of 20 to 25 bbl per minute as it was being transferred from the storage pit to working tanks. The water was then hauled via truck to the residential impoundment location.

**Results**
- Saved operator USD 640,000 in disposal costs and another USD 25,000 by reducing biocide-loading requirements during frac operations
- Increased percentage of produced water reused for fracturing operations
- Improved HSE with environmentally responsible biocide
- Netted an eight bottle log reduction in bacteria while oxidizing iron sulfide and hydrogen sulfide to eliminate odor and improve clarity

**Challenges**
- Marcellus operator was trucking pit water from one impoundment to another
- Water contained significant amounts of bacteria, iron sulfide, and hydrogen sulfide, which resulted in dirty water with a pungent odor
- Customer specified a six bottle log reduction in bacteria

**Baker Hughes solution**
- Recommended H2prO HD (ClO$_2$) service as an environmentally preferred solution to eliminate bacteria, as well as scavenge hydrogen sulfide and oxidize iron sulfide
- Treated the pit water using an H2prO HD mobile ClO$_2$ generator as the water was transferred at 20 bbl per minute from the storage pit to working tanks
- Directly injected the treatment into the transfer line without impeding normal transfer operations and flow rates
Periodic water sampling occurred during transfer and treatment as well as post-treatment to ensure the water quality requirement was met and to test for ClO₂ residuals.

The H2prO HD treatment delivered an eight bottle log reduction in bacteria and oxidized the iron sulfide and H₂S to improve water clarity and eliminate the odor. The ClO₂ treatment enabled the operator to reuse a greater percentage of the produced and flowback water in hydraulic fracturing operations. Plus, by removing the contaminants from the water, the operator was able to maintain the same fracturing fluid formulation.

The H2prO HD service saved the operator nearly USD 640,000 in disposal costs and an additional USD 25,000 by reducing biocide loading requirements during fracturing operations. Providing a beneficial treatment program for reuse kept these fluids within the water cycle. Treating this water before transporting it preserved the quality of the five million gallons of fresh water already contained in the impoundment—eliminating the need for additional treatment of the water in the impoundment before it was used in frac operations.