Fine Particle Filtration

Equipping an oil & gas company for high-variable waters

By John Patrin & Aaron Johnson

Studies show that upstream oil and gas industries produce more water than they do oil and gas. This, combined with new water-intensive technologies such as hydraulic fracturing in new shale developments and enhanced oil recovery, is driving demand for advanced water treatment solutions.

Removal of solids from produced water is challenging due to the water's widely varying characteristics. For example, problems often arise from water incompatibilities; precipitates can form despite measures to prevent scale formation, and chemicals used to skim the residual oil often result in colloidal suspensions and complex conglomerations of oily solids that carry through the system, adversely affecting filter performance. Advanced water treatment systems must be able to handle produced water's varying characteristics in order to effectively remove the solids prior to disposal or reuse. Conventional filtration systems, such as cartridge filters and bag filters, typically are less equipped to handle high solids in the presence of oil and grease, requiring frequent replacement, which becomes very expensive.

Oil and gas producers are looking for more efficient filtration systems that reduce costs, increase uptime, protect downstream assets, reduce waste and enable water reuse. Advanced water treatment systems must be cost-effective while addressing growing concerns about environmental impact. The following case study highlights how one major oil and gas production company switched to a new, cost-effective advanced filtering technology to meet its business goals.

Old Problems, New Solution

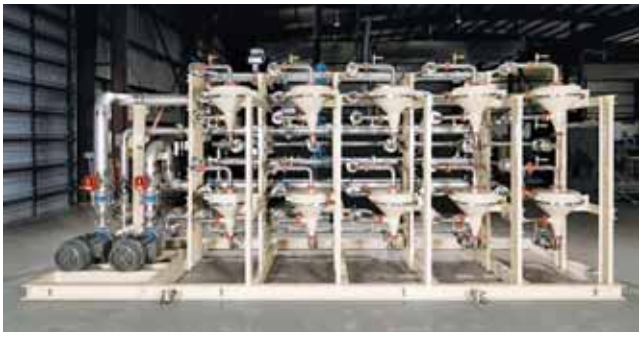
For more than 30 years, a major oil and gas company headquartered in Texas had been using bag filters in its centralized injection sites to remove solids from produced water prior to injection. Over the long term, produced water brought to the surface from crude oil and natural gas wells varies field-to-field and well-to-well, but generally is predictable. Water produced from hydraulic fracturing, however, is much more variable. After the completion of new oil and gas wells, hydraulic fracturing flowback water returns to the surface in just a few weeks' time and shows a rapid decline in quantity and quality. Flowback water often contains very high total dissolved solids and is characterized by the presence of sand, clay, polymers and metal ions associated with the drilling and completion of the new well.

In 2010, the oil and gas company planned a major facilities upgrade that included a search for a new produced water filtration system that would manage highly variable waters. The filter of choice would be self-cleaning, low maintenance, cost-effective and have high water recovery.

The Test Cycle

The oil and gas company established a test cycle in its production facility in Erie, Colo., in order to determine which filtration system would be purchased for long-term use. Each test system would undergo a strenuous, standalone cycle over a two-week period. At the end of the test cycle, the filtration system that yielded the best results then would undergo additional trials at their locations in Vernal, Utah and Wamsutter, Wyo.

Three self-cleaning filter systems were tested in rugged conditions. The oil and gas company's overarching goal was to filter solids to less than or equal to 25 µ prior to well injection, while retaining 99.5% water recovery. The Tequatic Plus fine particle filter from Clean Filtration Technologies LLC was found to outperform the other systems, including a worst case scenario involving flowback and produced water with high oil content. The oil and gas company noted that the other two filtration systems did not



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The produced water filter skid featured an earlier version of the Tequatic Plus fine particle filter.

Table 1. Independent Laboratory Testing

Insoluble Solids Before and After Tequatic Plus Filter				
Sample/ Filter	Solids Pre-Filtration (mg/L)	Solids Post-Filtration (mg/L)	Difference (mg/L)	Reduction (%)
No. 1 / 20 µm	116	38	78	67
No. 2 / 20 µm	66	33.5	32.5	49
No. 3 / 15 µm	57	24.4	32.6	57
No. 4 / 15 µm	45.6	11.8	33.8	74

provide sufficient uptime due to mechanisms that required more frequent cleaning and maintenance cycles, resulting in less filtered water. The Tequatic Plus filter, on the other hand, required minimal maintenance and was found to reduce exposure to hazardous chemicals such as hydrogen sulfite, benzene, toluene, ethylbenzene and xylene. It therefore was selected as the filtration system to proceed to the next level of trials for three days each in Utah and Wyoming.

High Water Recovery & Solids Removal

To satisfy the 99.5% water recovery rate, the filtration system was configured to recirculate the water and drain the concentrated solids periodically into a cone bottom settling tank. A 2-in. unit fitted with a 20-µ filter ran eight hours per day for two weeks and was subjected to the full range of produced water. Other parameters included a filtrate flow rate of 10.5 gpm, a feed pressure of 20 psi and a pressure drop across the filter of 1 to 3 psi.

In every pilot test, the filter removed solids to less than or equal to 20 µ prior to well injection, while retaining more than 99.5% water recovery. In Utah, both 20- and 15-µ filters were successfully tested, with insoluble solids removal between 49% and 74%, according to an independent laboratory (see Table 1.). It provided a consistent supply of quality filtrate without fouling, chemicals, filter changes or backwash cycles. These results were provided at the company's desired filtrate flow rates.

The selected filter outperformed the competition in Colorado and reproduced the results at two other locations, confirming the reliability of the filter in variable conditions. The oil and gas company's goals were achieved, including a significant reduction in suspended solids, high water recovery, low maintenance, and reduced safety and environmental concerns. Reduced environmental concerns were realized by minimizing the handling, waste and disposal of bag filters commonly associated with produced water systems, and exposure to hazardous gases encountered during filter replacement. At the end of the pilot test, the company selected Tequatic Plus as its filtration system.

Sustainability & Lower Operational Cost

The filtration system also was able to enhance sustainability for the oil and gas company by offering up to 99.5% water recovery, helping to conserve important water resources. In addition, the filter operates with a low pressure drop across the filter media, which promotes energy efficiency. Less maintenance and exposure to chemicals and hazardous gases also enhanced operator safety.

Furthermore, the housing for the selected filter is based on fiber-reinforced polymer composites and a light resin transfer molding process, which enables the filter to be produced cost-effectively and to operate in a broad range of corrosive environments and applications.

The Tequatic Plus fine particle filter delivered a more cost-effective solution than traditional self-cleaning filters by consistently and cost-effectively removing very high and highly variable solids from water sources in a reliable, single-unit operation. A summary of benefits cited by the oil and gas company include high uptime, lower consumables costs, minimal maintenance, lower labor costs, no need for chemicals and no fouling or backwash issues. The company also freed up staff time for other activities, further improving productivity. These and other benefits led to an overall lower total cost of ownership. **iWWD**

John Patrin is strategic marketing manager for Clean Filtration Technologies LLC, Dow Water & Process Solutions. Patrin can be reached at jcpatrin@dow.com or 952.838.3950. Aaron Johnson is application development leader for Dow Water & Process Solutions. Johnson can be reached at amjohnson@dow.com or 989.636.5817.

Figure 1. Filter Process