Critical impact of water management in today’s shale fields

Properly managing produced water is essential in U.S. shale fields. Customized solutions, optimized for long- and short-term applications, are increasing oil recovery and reducing disposal costs to maximize ROI.

FADY RIZK, Exterran

The process of extracting hydrocarbons has always included water management to some degree. Across the U.S., the boom in hydraulic fracturing to extract oil and gas from shale formations has turned it into a major specialization in its own right. Large quantities of fresh water are required, as part of the fracturing process, producing sizeable volumes of contaminated flowback in return. As the plays continue to develop, producers are left with increasing produced water, which cannot be re-injected back into the shale play formations as it would typically be done in conventional reservoirs. This poses the question of “what happens next” for operators on-site.

Having an efficient and effective water management strategy is critical for operators. According to a recent Wood Mackenzie study, the increase in hydraulic fracturing has resulted in as many as six barrels of water produced for every bbl of oil and it is estimated that water management could add as much as $6 to the price of producing a bbl by 2025.

RESPONSIBILITY AND MANAGEMENT

As the industry becomes more environmentally conscious, legislation increases and operators look to manage costs during shale production, then water sourcing, handling, and disposal become a more significant percentage of operating considerations.

There are a large number of factors that influence a successful water management strategy. According to research by Dunkel (SPE 184445), the most likely parameters of a successful plan include amount of water at source, local disposal capacity, variations in regional regulations, proximity to urban centers, and availability of public roads for transporting the waste water.

Additionally, differences in the formation depth, rock properties, and formation fluids require different hydraulic fracturing practices, which put different restrictions on the management of water. As a result of these variations, generalized strategies are no longer practical; customized solutions are now critical in today’s environment.

Part of the challenge with shale plays is that every situation is unique. Each region, client, and basin have different regulations. This, combined with the sheer volume of water now produced during shale extraction, has created an opportunity for specialized water companies who have the expertise, capacity and cost-effective technologies to heighten efficiency gains in water management. Companies such as Exterran have had success in this regard, handling up to 100,000 bwpd, their CGFT and EGFT solutions are flexible and scalable produced water management systems.

A FLUID APPROACH

Produced water typically comes back out of the well as saline water mixed with oil, iron, and solids. These contaminants must be removed if the water is to be recycled back into the process. Also, any residual bacteria will cause fouling in the well and too much iron and/or solids will eventually cause well blockages or damage to equipment. Specialized equipment

Fig. 1. A long-term facility capable of handling 100,000 bwpd. The system increases oil recovery, while reducing disposal costs and environmental impact, whether shipping offsite or reinjecting on location.
and chemicals are required in order to remove all of these elements, this water can then be recycled back into the process, limiting the need for huge volumes of fresh water for drilling.

As shale water strategies become more complex, three main models have emerged. The first addresses long-term, larger facilities with contracting companies on site, producing approximately 100,000 barrels of water per day (bwpd), Fig. 1. The second is best suited for short-term smaller facilities producing roughly 25,000 bwpd. Thirdly, a service business approach called “frac on the fly”, is a relatively new process which enables water to be recycled and reused with the use of mobile equipment at varying flowrates.

Whether a solution needs to be on-site permanently or semi-permanently, technologies need to cope with large volumes of contaminants in the water repeatedly. To properly manage this constant treatment, highly specialized pieces of equipment must be used to ensure solids are removed, and the water is run through flotation units. One such solution is Exterran’s Revolift product line, which uses a patented micro-bubble flotation system to float the oil and iron to the surface as the bubbles attach to the hydrocarbon molecules. This floating method cuts out a lot of maintenance associated with other separation methods, as the tank itself suffers less degradation.

If the produced water needs further solids removal, due to stringent requirements, a tertiary phase of processing is needed. Typically, in these situations, filtration, such as Exterran’s Sabian Black Walnut Shell Filter can be employed. As produced water flows through the filter, oil and solids are trapped in a media bed of ground walnut shells, removing even the smallest traces of oil and solids that remain. Comprised of three main modules; de-sanding, flotation and filtration, Exterran’s shale play solution remains highly mobile, allowing operators to move it from well to well as required, Fig. 2. Their system removes contaminants that can achieve a target water quality of >250 mV ORP and <5 ppm oil-in-water, total suspended solids, and iron.

Saving on auxiliary equipment, downtime, and space on site, all of these three modules are mobile, can be trucked out to sites, are seamlessly integrated, and monitored on site or remotely. Ultimately, this solution provides an enhanced and very efficient approach to produced water treatment and recycling.

**OPERATING MODELS**

The shale drilling boom and hydraulic fracturing made water management issues an even more important environmental consideration. In addition, the complexity, variations per site and potentially costly aspect of these operations, make it critical for operators to partner with experienced specialists who understand the challenges of water management. These experts can help address the increased volumes with economies of scale for optimum cost-efficiency and performance. Such specialists utilize expertise in the field, tailored lab studies, and equipment design to assist in recovering oil and reducing disposal costs, whether shipping offsite or reinjecting on location.

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**Fig. 2.** A short-term facility producing 30,000 bwpd, provides a rapid ROI by decreasing disposal costs, increasing oil recovery from water and providing water suited for reuse.