TACKLING UNCONVENTIONAL SHALE PLAYS

Yannick Harvey, TETRA Technologies, USA, examines best practices for oilfield water management.

In recent years, water management in support of unconventional resource plays has become more than just a matter of environmental responsibility. With the price of oil still recovering from the lows of recent years, increasingly expensive fresh water resources and the economies to be gained through produced water recycling have become common boardroom topics. Another hot topic concerns an emerging awareness of the power of automation in the field of water management. This article explores some of the ways unconventional shale play water management practices and capabilities can be improved.

It begins with a plan

Across all North American shale plays, operators are focusing on applying best practices and best-available technologies to provide water to the point of use in the field. Dedicated water handling facilities are becoming more common in support of simultaneous area-wide operations, and the layout and provisioning of these facilities is one focus of the water management plan. Additionally, in response to modern fracturing practices that include higher pressures, longer laterals and new techniques such as zipper fracing and simultaneous well completions, operators are investing in water gathering and treatment infrastructure to reduce transportation, acquisition and disposal costs while maintaining the water resources they require to complete their projects.

TETRA Technologies has worked with customers to position critical water infrastructure in accordance with a water management plan that supports area operations.

Figure 1 represents the water infrastructure arrangement employed during a recent reuse project. This representative layout includes fresh water storage (1), a produced water trunk line system (2), gathering and treatment facilities for produced water (3), and produced water storage and blending tanks (4). The entire arrangement is strategically located in proximity to several active fraccing locations (5).

The planning that supports the development of this water infrastructure increasingly includes the provisioning of critical infrastructure with the company's automated systems and controllers.

Comprehensive water management

TETRA provides a range of services to transport, store, treat and recycle water for its customers. Those services were enhanced early in 2018 with the acquisition of SwiftWater Energy Services, a Midland, Texas-based water management company that had proven itself to be a valuable resource for operators in the Permian Basin. Consequently, TETRA is now in a better position to respond to the latest industry trends, including the increasingly popular use of non-potable and treated, produced water and the automation technology available today to optimise fluid processing. Today, the company offers the latest technology and expertise required to economically process alternative types of water, including subsurface saline water, produced water or effluent water.

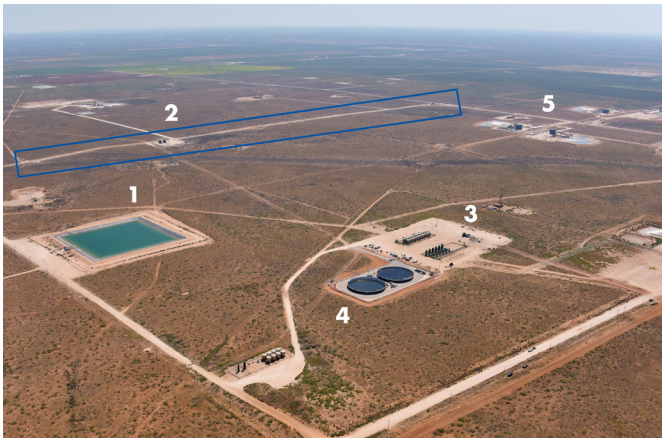

Figure 1. *Water management infrastructure. This representative layout includes (1) fresh water storage, (2) a produced water trunk line system, (3) gathering and treatment facilities for produced water, and (4) produced water storage and blending tanks. The entire arrangement is strategically located in proximity to several active fraccing locations (5).*

Figure 2. *Fully outfitted storage pit.*

Figure 3. *ORapt water/oil separation unit.*

Economics dictate that water sources should be located as close as possible within a given operating area. A key best practice at work across the industry is the utilisation of non-freshwater sources when possible, including produced water, low-quality water from underground brackish reservoirs, and wastewater from industrial, power and municipal plants. The challenge for operators is the wide variability in water quality and consistency, which necessitates careful planning, treatment and processing before use in fraccing operations. TETRA Technologies' systems have been developed specifically for handling the high variability inherent with non-potable water supplies, which makes it possible for operators to optimise water resources and minimise disposal volumes.

Optimised temporary and permanent transfer

In addressing the age-old problem of getting water from 'A to B', the company provides a range of solutions for operators. In addition to other fluid management services, construction services for water and wastewater pipelines up to 30 in. in diameter, along with repair services for existing pipelines are also avaliable.

Tetra provides fluid and water transfer solutions for hydraulic fracturing operations through 8, 10 and 12 in. lay-flat hoses, which meet the highest industry and environmental standards to help ensure no-leak operations. Experienced team leaders perform site assessments and hydraulic calculations before designing a plan that efficiently positions hose, manifolds, pumps, and road crossings in order to meet customer's needs while avoiding negative environmental impacts.

For 3 in., 4 in., and even larger poly pipe specifications, the company serves as a turnkey contractor for a wide variety of jobs. The high-density poly pipe is lightweight and flexible, provides resistance to abrasion and corrosion, and is welded with the latest fusion techniques. It can be positioned above ground or trenched and buried.

The most significant developments in the fluid transfer business, however, relate to the economies to be realised through automated technology. Automated pump systems offer cellular-based communication, pressure limit controls, remote monitoring, real time data access, and data logging to verify results. Lower fuel and labour costs, paired with demonstrably higher overall efficiency, have positioned automated solutions as a new standard in fluid transfer.

On-site water storage

TETRA's storage solutions ensure drilling and completion operations have a sufficient on-demand water supply onsite. The company offers above-ground storage tanks (ASTs) that are easy to assemble and engineered to the highest standards. The above-ground impoundments are reusable, versatile, and easy to relocate. The ASTs are polyethylene-lined and can be used in collaboration with the water transfer services or contracted separately.

The company's pit lining service utilises a wide range of polyethylene liner services (up to 60 mm) that fully comply with all applicable EPA regulations (Figure 2).

In addition to the pit lining services, the company provides a variety of secondary containment services to safeguard against costly leaks, spills, and accidents. The containment structures may be

constructed with earthen berms, formed by experienced personnel. Another option includes portable structures placed around tanks, pumps, and equipment, complete with the appropriate liner.

Water treatment

Water is the primary resource used in hydraulic fracturing and operators require the highest standards when formulating frac fluids. TETRA's advanced water treatment system generates an EPA-approved biocide, chlorine dioxide (ClO_2), to prevent and eliminate 100% of bacteria in fresh water, flowback and produced water. The system utilises a two-precursor method to produce ClO_2, which is then typically injected 'on the fly' into the target water stream for continuous treatment. Furthermore, since the system generates ClO_2 through the flow of water in the transfer line, the unit stops when the flow stops, ensuring a safe working environment. Other additives, such as BioRid® water treatment technology and TETRAClean™ oxidising technology, are fast-acting and quick to degrade after killing bacteria as frac water moves through the tanks. The advantage to this type of treatment as compared to batch treatment is that the chemicals treat 100% of the water and not just that portion of the water column in the frac tanks.

In unconventional shale plays, produced water is transferred to a centrally located gathering and treatment facility, where it is stored in above-ground storage tanks. On-site analysis is critical, but lessons learned and experience within the specific shale play pay dividends for operators. For instance, the company's experience in the Permian Basin allows technicians to anticipate produced water arriving at the facility with high levels of total dissolved solids (TDS) and total suspended solids (TSS). Additional components include dispersed oil and grease, heavy metals, radionuclides, dissolved gases, and bacteria, as well as traces of chemical additives used in production, such as biocides, scale and corrosion inhibitors, and emulsion and reverse-emulsion breakers.

An additional level of treatment is provided by oil recovery after production technology (ORapt™) water/oil separation units (Figure 3). These stand-alone, mobile units facilitate the separation with a chemical additive and deliver water with only trace amounts of oil at 50 - 100 ppm. The system allows operators to save money on disposal while making money through the sale of captured oil. In several cases, the volume of reclaimed oil has almost paid for the contract.

Water blending

Often there is not an endless supply of produced water aggregated in practical areas, so fraccing companies use a blend of local fresh and produced water. The latest, most sophisticated frac-fluid systems perform optimally with water that exhibits uniform TDS and chloride levels. Large spikes over or under the nominally required TDS and chloride levels hinder cross-linking performance and reduce cost-efficiency in the form of chemical over-usage, thus negating any savings realised through recycling produced water. The goal of blending, therefore, is to use all the available produced water, as it represents a known cost saving under the right circumstances. To be able to achieve this optimal reuse, the blended water must be of consistent quality and must remain stable in terms of TDS and chloride concentrations.

TETRA's automated frac-water blending system (Figure 5) is designed to provide accurate parameter-based blending and consistent blend quality, whether directly filling frac-water tanks or transferring water to another location. This system permits accurate and consistent blending of different sources of water in real time, removing the need for intermediate storage. Chemical injection ports are also available to be used for chemical addition upstream of the blending chamber. The typical automated blending setup is shown in Figure 4.

Case study

Recently, the use of automated pumping technology enabled one Delaware Basin customer to achieve 50% labour savings and up to 60% savings in fuel costs during transfer operations. Using four pumps, the company was able to reduce costs and increase productivity for its customer while affording constant system visibility and pressure protection. For this operator, the automated controls, system optimisation and event mitigation translated into significant bottom line savings.

Conclusion

In the Permian Basin and across all North American shale plays, the combination of operators, fraccing companies, frac-chemical schemes, and water qualities is ever changing. Some operators do not consider high-level blending accuracy to be necessary in their circumstances. Others demand it. However, all parties agree that the reductions in operating expenditures to be realised through automated control systems are significant. After all, dramatic reduction in fuel and labour costs paired with a rise in overall system efficiency speaks for itself.

These new technologies represent an opportunity for operators to identify previously hidden economies within already stretched-thin operating budgets. As has always been the case, developments drive the kind of savings that become the basis of real competitive advantage moving forward.

Figure 4. *Automated blending components. (1) Fresh water inlet; (2) Produced water inlet; (3) Automated blending controller; and (4) Blending manifold.*

Figure 5. *Automated blending controller and manifold.*

Total Water Management Solutions

Maximize Water Reuse. Minimize Costs.

TETRA's integrated water management technology provides real-time monitoring and automation for transfer, treatment, and storage of fresh, produced and flowback water. Our innovative technology maximizes the reuse of produced water, while mitigating environmental risk. Each project is specifically designed to your needs, using our proprietary planning and engineering software.

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