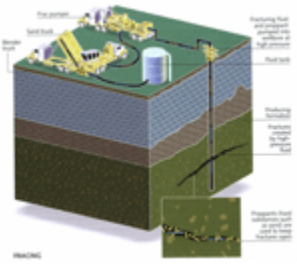
Contaminated Waste Water Reclamation Opportunities

Hydraulic Fracturing



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There are multiple fracture systems in the pressure pumping market. All of the systems utilize fresh water for their make-up and are typically the highest volume fluid. Proppant (Sand) and a polymer system are utilized. The polymer portion of the system is to provide viscosity or thixotropic characteristics (similar to paint) to carry the proppant into the reservoir. These systems are pumped at very high pressure and in some cases very rapid rates. This hydraulic horsepower actually cracks or fractures the gas or oil bearing zone and the fracture fluids enter the zone. The proppant is carried far back into the zone. Once the fracture is completed the pressure drops and the zone settles down on the proppant but does not close. The viscosity or thickness of the fluid dissipates and the water flows back to the surface over time. The proppant left behind provides a fracture or a path with a very low permeability for the gas and oil to flow to the well bore. Carbon dioxide or nitrogen energized fluids are also utilized for wells with low bottom hole pressure to prevent fluid loss.

A new fracture system was developed for the Barnett Shale that is somewhat different than the system discussed above. It is called a “slick water” fracture system and requires much more water. It has proven to be the most cost effective system to date in the Barnett Shale and is being expanded into Haynesville, Marcellus, Woodruff, Pieance, and Fayetteville Shales. Shortages or water has already surfaced in most of the Shale areas. Fresh water is utilized in a low cost but very effective “slick water” package. The system is basically a friction reducer so that high rates of water can be pumped into the well to hydraulically fracture the shale. Proppant or sand is utilized to hold the fracture open after the hydraulic pressure is removed. This allows the gas or oil to flow out of the zone and into the well. Fresh water has proven to be a benefit in the shales due to it dissolving out water soluble salts that were deposited with the shale. Dissolving these salts provides additional paths for the gas to flow through out of the shale or connections of the natural fractures. So massive volumes of fresh water are

essential to these shale plays, the slick water fracture provides the most cost effective production over time.

Hydraulic fracturing water issue of using millions of gallon as of fresh water to frac the wells only to have the water returned during the production phase of the well as a highly contaminated un-useable water that needs to be reclaimed or disposed of in disposal wells. By distilling water with TDS (total dissolved solids) of 100,000+ parts per million (ppm) about 70% of the water can be recovered as a fresh water actually superior in quality to the water originally utilized. The water usage for drilling and fracing the active wells in the Barnett Shale area equates to annual average water usage for at least 185,000 households. STW has identified solutions that may return approximately 70% as distilled reuseable water. This will help alleviate a large portion of the frac flowback water problem. The disposal of the flowback water is of great concern. The drilling and fracing process pollutes the millions of gallons of water used at each drill site with at least 26 chemicals including carcinogens such as benzene. Currently most of that water is hauled away to be injected into deep disposal wells. There is concern that, if done improperly, this highly polluted water will migrate into existing aquifers, reducing the supply of ground water in Texas.

Gas drilling requires a massive number of trucks to haul equipment and water to and from drilling sites. The oil and gas industry recognizes a need to reclaim the water minimizing the wear and tear on the roads and other impact on the environment. In reclaiming the water a major effect on the environment will be realized through the Oil and Gas Industry proactivity.

STW will utilize the technologies to reclaim approximately 70% of the returning water out of these shale wells so that it can re-use in the next well or even returned back to the environment. The volume of water going to disposal will be significantly reduced. Even the disposal volume can be reduced but it is significantly more expensive and a solid salt is generated. This “salt” is a mixture of inorganic salts and requires a use.

Oil and Gas Produced water

More than 250 billion gallons of produced water are taken out of Texas soil every year, 35% of which is unfit for use. (1) Texas is the nation’s largest oil and gas producer with greater than 216,000 active oil and gas wells. The state has more than 50,000 permitted oil and gas injection and disposal wells which service approximately 6 billion barrels of produced water each year. Water placed in disposal wells is lost forever. The same opportunities are available in every gas and oil producing state and country in the world.

The Shale zones are typically dry reservoirs without any formation or connate water, therefore the fracture water is what returns except for having the dissolved salts

discussed earlier and contaminated with the gas and hydrocarbons. In most gas and oil production, there is a reservoir or connate water in the zone. The water quality or total dissolved solids varies significantly in different parts of the world. In a large number of the oil fields in the USA, secondary or tertiary such as water floods and steam floods have been initiated. These are operations where water is utilized to maintain reservoir pressure, prevent subsidence, and sweep the zone to remove the oil from the zone. Most of these floods utilized a fresh water source as a supply water so that sufficient volumes are available. As these fields age, less water is required for the flood and so excess contaminated brines require disposal. This water could be reclaimed with the correct technology.

Produced water is mainly salty water trapped in the reservoir rock and brought up along with oil and/or gas during production, and is the most common oil field waste. In the year 2000, over 2 billion barrels of salt water in Texas were carefully disposed according to Texas Railroad Commission regulations. If just 10% of this amount were converted to fresh water, Texas would recover approximately 8.4 billion gallons (25,780 acre feet) of water annually and the potential benefits could be significant, with the treated reclaimed water available for many uses, including many agricultural and environmental applications, as well as re-use in hydraulic fracturing operations.

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Acid Mine Drainage

Acid Mine Drainage is the number one environmental water issue throughout most of the Appalachian Mountains. Coal was one of the largest industries in the region. Unproductive and unprofitable mines were abandoned. Over time a large number of these mining companies have gone out of business leaving the residual “dirty coal” and the water flowing from the mines as a responsibility of the states and federal government. Dirty coal is the coal that lies near the edge of the main coal seam and contains a high concentration of dirt.

As the mines fill up with water overtime, the excess water flows out. Due to contact with the minerals contained in the dirt, coal, salts and gases, the water tends to become acidic. This lower pH tends to dissolve more ions or salts such as iron, aluminum, calcium, and sulfate. Iron and other metals upon oxidation form insoluble salts such as iron oxide or rust. Once the acid mine drainage enters a river, lake or stream, the water precipitates these metal oxides. This forms an impervious film on the bed of the water destroying the marine ecosystem. In the picture below, the river is a nice blue color, but on the lower left corner - where the acid mine drainage has just entered into the stream - note the orange color on the rocks and bottom of the stream.

The Pennsylvania Department of Environmental Protection ("DEP") typically constructs passive treatment plants that require large acreage, where the process is oxidation in large lagoons allowing the solids to precipitate and altering the pH level by adding certain chemicals such as lime. The water leaving these systems will support the growth of plants and animals. This process is inherently more time-consuming and expensive, and because of the land requirements, not suitable for all locations.

STW can provide AMD treatment using a specially-designed mobile unit and sell the processed AMD to the producers. The state will retain ownership of the AMD, with STW having ownership rights to the processed water.

STW's mobile AMD unit can handle about 250 gpm or about 360,000 gallons per day. This mobile unit provides the same functionality as the current passive system, but in minutes compared to weeks and months and with a much smaller footprint. The state may provide incentives in the form of grants and/or subsidies that cover the cost of AMD processing. The DEP also has permits in place for the disposal of the filter-pressed sludge. STW is also reviewing all of the present passive system flow-rates and water quality for potential use as supply water to producers.