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Frack Water Treatment Challenge

Electro coagulation may provide the answer to treating wastewater from fracking operations.

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As the United States moves toward energy independence, combinations of renewable and non-renewable fuels are paving the way. From wind and solar to biofuels, the environmental and energy industries are driving growth in power generation and the economy.

The shale gas industry is on track to contribute $118 billion to the U.S. economy by 2015. Industry projections have shale gas accounting for 60 percent of U.S. production by 2035 (IHS Global Insights).

A central element of the shale gas recovery process (HVHF – High Volume Hydraulic Fracturing) is water. As of year-end in 2009, 31 states allowed hydraulic fracturing with a collective 500,000 wells nationwide. Each well requires 2 to 4 million gallons of water for the hydraulic fracturing process.

The rate of water usage is higher in shale gas recovery than in any other energy initiative, such as in steam-electric power plants. The ability to reduce the amount of water by recycling and reusing it will be essential to preserving the environment. Local governments, communities and the energy industry itself are actively seeking innovations that will help preserve resources, keep the environment safe and produce the energy needed.

As the shale gas industry continues to grow, the need to reconcile the economic benefits with environmentally safe procedures is paramount. Justified concerns from communities, legislators and the energy industry continue to increase around how to deal with higher volumes of wastewater needed in the natural gas recovery process.

Specifically, the need is to provide treatment options that are proven to be successful, solve capacity shortfalls and meet all disposal requirements for each geographic region. At this pivotal moment in time, proven technologies and new innovative ideas are needed to ensure processes with positive environmental impact are implemented to help set our nation on a path for long-term energy independence.

Water is the center of attention

At the center of the hydraulic fracturing (aka "fracking") debate is how to treat, transport and dispose of the increased wastewater volumes with current limited capacity as the industry expands.

Overall concerns range from water supply protection to the treatment of fracking flowback, produced water and material extracted from the reservoir. Academics and industry experts agree that the infrastructure in place today is not equipped to effectively handle the growing wastewater treatment needs of increased natural gas recovery.

In fact, at a New York State General Assembly hearing in early 2013, David Carpenter, director of University at Albany's Institute for Health and the Environment, noted that wastewater treatment facilities are not capable of fully treating fracking wastewater (source: WSKG, InnovationTrail.org).

There is no question that HVHF increases volume and wastewater treatment capacity demands. Shale states on the east coast (North Carolina, New York and Virginia) must learn from states to the west (Colorado, Ohio, Wyoming and Texas) about proven technology innovations that work.

Wendell Berry, a modern day Thoreau, reminds us "Whether we and our politicians know it or not, Nature is party to all our deals and decisions, and she has more votes, a longer memory, and a sterner sense of justice than we do."

These significant wastewater concerns can only be resolved through innovation, technology and human coordination. Natural shale gas recovery is the largest wastewater treatment challenge of our time.

Water treatment without chemicals

For a range of wastewater treatment needs, electrocoagulation (EC) technology is a viable option. The technology itself has been successfully used for decades. The need for increased usage now is to help preserve and reuse our natural water resources. Droughts, natural disasters, municipal water needs and shale gas recovery will continue to put increased strain on our water resources and existing treatment facilities.

For states in the western United States, EC technology has had positive environmental impacts while solving many existing concerns of wastewater and frack fluid treatment. States such as Texas, Wyoming and Colorado have successfully used EC technology for the treatment of a wide-range of industrial wastewater – including frack water.

The EC process consists of introducing electrical current into a waste stream to destabilize contaminants that are suspended, emulsified, or dissolved in the waste stream. EC decreases the levels of constituents such as calcium, magnesium and silica, which can either be naturally occurring or chemical additives from industries, including the hydraulic fracturing process. Algae and bacteria can be in various concentrations depending on the water source can also be removed.

During the introduction of electricity, a current is passed through a metal electrode, oxidizing the metal to its cation (positive ion), simultaneously, water is reduced to hydrogen gas and the hydroxyl negative ion (OH-). EC thus introduces metal anions electrochemically, using sacrificial anodes (usually iron or aluminum). Due to the electrical charge, the contaminants become hydrophobic and precipitate out or can separate into phases. No chemicals are used in the process, making it one of the cleanest and ecologically sound forms of water treatment available.

EC technology has been proven to work with 99.7 percent accuracy with frack water with wide ranging applications including municipal water treatment, agriculture, paper industry and oil/petroleum. Within the fracking process, sludge is substantially reduced using EC technology, since no chemicals are added.

In addition, depending on the application for the effluent waste water, EC technology can be followed by other processes such as biological treatment, membrane technology or carbon absorption.

Closed loop water treatment

The use of electrocoagulation technology benefits communities, environmentalists, local governments and the drilling industry itself. For the fracking process, the use of closed-loop, customizable on-site units bring innovation to an industry in enormous need.

Each on-site system is modular and designed to remove minerals that are native to each shale region, in addition to the added chemicals that are used in the fracking process. For example, each of the five active fracking counties in Pennsylvania has different minerals and elements in their geological formations. With EC technology, the on-site flow-back water treatment system can handle those diverse criteria at the drilling site where the water can then be reused.

In addition, this technology eliminates the need for injection wells, a significant environmental concern for the environmental community.

Moreover, on-site units do not require costly transportation systems. Using an EC system, the transportation needs are reduced to moving the treated wastewater to repurpose in another industrial use, such as agricultural or by local municipalities. Current methods require tractor trailers to transport contaminated wastewater to water treatment plants that are often times, up to 30 miles away – and then back again.

Each EC system is customized to treat the specific waste characteristics of the water. Once an onsite evaluation is conducted and pilot testing is completed, the EC system can be configured and be in use on-site within five to seven days.

EC is considered a green engineering technology as no chemicals are used to treat wastewaters. The benefits for the environment are positive with significantly reduced operating costs compared to other alternative technologies. This is due to the system's low power requirements, low maintenance and minimal operator attendance. Additionally, the units process wide variations of waste streams and treat multiple contaminants to produce consistent and reliable results.

Water and electricity

EC is the process of destabilizing suspended, emulsified or dissolved contaminants in aqueous medium by introducing a direct electrical current into the medium. The electrical current provides electromotive force to drive the chemical reactions.

When reactions are driven or forced, the elements or compounds will approach the most stable state. Generally, this state of stability produces a solid that is either less colloidal or less emulsified (or soluble) than the compound at equilibrium values. As this occurs, the contaminants form hydrophobic entities that precipitate and can easily be removed by a number of secondary separation techniques. EC neutralizes ions and particle charges, thereby allowing contaminants to precipitate. Colloids are then destabilized and aggregated and subsequently removed by sedimentation or filtration.

Coagulation is one of the more important physic/chemical operations used in water treatment. This process is used to cause destabilization and aggregation of smaller particles into larger particles.

Under current wastewater treatment methods, a cocktail of chemicals is needed to treat large amounts of wastewater producing increased amounts of solids, which increase production costs and can create environmental problems when they are ultimately disposed. The negative impact on the environment is high using existing treatment methods.

EC can often neutralize ions and particle charges, thereby allowing contaminants to precipitate. Colloids can be destabilized and aggregated and subsequently be removed by sedimentation or filtration. The amount of solids is substantially much less and environmentally friendly.

This technology has been proven as one the more effective methods to treat large amounts of wastewater. The range of treatment is between 300 liters/hour to 600,000 liters/hour, depending on the site-specific, customized design of the modular units.

EC systems are part of a comprehensive treatment plan, as 75 percent of the water treatment is completed by this technology. For the remaining 25 percent, additional polishing systems would be added to meet the state and local discharge requirements.

Repurposed water

To achieve success in reconciling the economic benefits of shale gas recovery with positive environmental impact, we must choose to implement systems that conserve water. Providing clean, remediated, reusable water in commercial, municipal and private use conserves our precious water reserves and ensures our commitment to preserving the environment while achieving energy independence.

The adoption of improved drilling and treatment systems will maintain momentum towards a diverse energy economy including natural and renewable energy. Perhaps Wendell Berry said it best, "The care of the Earth is our most ancient and most worthy, and after all our most pleasing responsibility. To cherish what remains of it and to foster its renewal is our only hope."

Sidebar: Benefits of Electrocoagulation

- Positive Environmental Impact
- Treated Water Can Be Reused
- Meets Discharge Limits
- No Chemicals Used
- On-Site Treatment Helps Solve Capacity & Volume Problems at Regional Facilities
- Cost-Effective

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