

Oil & Natural Gas Projects

Exploration and Production Technologies

An Integrated Water Treatment Technology Solution for Sustainable Water Resource Management in the Marcellus Shale

Goal

The goal of this project is to provide the integrated approach necessary to address the increasing water resource conflict between natural gas production and the interests of water stakeholders located within shale gas basins. The objectives are to demonstrate that the novel, recently-patented AltelaRain® technology can be successfully deployed in the Marcellus Shale Basin to treat frac flow-back water, and that this technology can be operated within state and federal regulatory requirements in a cost-effective manner.

Performers

Altela, Inc.
BLX, Inc.
CWM Environmental, Inc.
Argonne National Laboratory

Background

U.S. shale gas production has increased 14-fold over the past decade and reserves have tripled. Tapping this resource with hydraulic fracturing (using pressurized liquids to fracture subsurface rock) and other techniques pioneered by NETL and its research partners has played an increasingly important role in greater U.S. domestic oil and natural gas production over the past decade.

The water resources needed to hydraulically fracture the Marcellus Shale and the potential effects of hydraulic fracturing on surface and subsurface water sources have become key concerns for state legislatures, land owners, and the public. This is especially true as the number of issued permits continues to increase and drilling expands to new areas of the Appalachian Basin.

Frac water contains significant amounts of constituents such as salt, metals, sulfates, and chlorides. Additionally, this water contains certain ingredients that are 'proprietary' in nature and not disclosed on manufacturers' safety data sheets (MSDS). The U.S. Environmental Protection Agency (EPA) has recommended that publicly owned treatment works (POTWs) no longer accept natural gas frac water. New regulations specifying frac water treatment guidelines are creating distinct challenges for the shale-gas industry. These challenges exist because no single-stage treatment technology capable of economically treating frac water to discharge water quality standards has been fielded. Without such a technological solution, industry's ability to meet these new regulatory requirements will be severely tested. If industry cannot identify a solution, these new regulations may have the unintended consequence of curtailing the nation's natural gas development because of related increased exploration and production costs. This would have a direct effect on the national security of the United States. A multi-disciplinary approach is needed that integrates proven water treatment technology with sustainable water resource management.

The AltelaRain® system cleans flow-back and produced water using a unique non-pressurized, inexpensive plastics-based distillation process that can reduce the water volume that needs to be treated as a waste product by up to 90 percent. The impurities concentrated in the remaining 10 to 25 percent fluid volume are disposed of by conventional methods, such as deep well injection. The technology substantially reduces the volume of hauled fluid, the number of waste-fluid hauling trucks miles (and related wear and tear on roads), and hauling and wastewater disposal costs. Unlike other distillation technologies, the Altela process is not driven by electricity—only 2 percent of its energy is electricity—making it ideal for rural onsite well water treatment.

Impacts

A successful project will highlight the benefits associated with employing best water resource management practices for the

reclamation and re-use of this wastewater. By demonstrating the availability of such an industrial 'best-practices' approach, a transformational solution can be created. This remedy would not merely minimize potential impacts of natural gas development to the water supply but rather expand and create opportunities for water re-use/conservation.

The expected impacts and benefits of a successful project include the following:

- ▶ Demonstrates a viable new technology – The project will determine if the recently patented AltelaRain® technology can successfully treat highly polluted frac water and reintegrate it into the water supply for re-use.
- ▶ Provides key field data – The project will provide key field and longevity data to regulators, the oil/natural gas industry, and other stakeholders which will demonstrate that highly contaminated frac water can be economically treated and successfully reused in accordance with existing regulatory requirements and water quality standards.
- ▶ Provides key life cycle analysis – The project will determine critical life-cycle costs and benefits associated with deploying the AltelaRain® technology.
- ▶ Reduces water-hauling truck mileage – The project could reduce the number of water tanker truck miles driven across Pennsylvania by eighty percent because of the reduced need for hauling frac water to off-site disposal facilities.
- ▶ Provides strong environmental benefits – The proposed technology mimics nature's rain cycle and is inherently environmentally friendly. There are no pre- or post-treatment chemicals requiring handling or disposal. The pure distilled water stream generated can be reused in numerous beneficial applications. This demonstrates that the oil and gas industry can be a supplier instead of solely a consumer of freshwater.

Accomplishments

A customized Altela ARS® 4000 system—designed to meet specified process requirements to remove all contaminants from the frac flow-back water and the water generated from natural gas production—was installed directly at a BLX well-pad located in Indiana County, Pa. Onsite operations and water quality testing of the field-deployed (mobile AltelaRain® 4000) system were conducted by CWM Environmental, Inc. Argonne National Laboratory provided life-cycle and cost-benefit analyses.



Altela ARS® 4000 system at the demonstration site in Indiana Co., PA.

As of March 1, 2011, over 275,360 gallons of Marcellus Shale frac flow-back water have been treated and purified at the well-site, resulting in the production of 182,380 gallons of clean distilled water. The concentrated water generated during this time period equals 69,150 (1,646 barrels), representing an approximately 75% volume reduction in the original amount of

brackish water. According to recent water analyses performed by a certified water quality lab, the specific conductance of the untreated dirty water (PW) was 42,400 $\mu\text{mhos/cm}$; the specific conductance of the clean water (DW) was 30 $\mu\text{mhos/cm}$ – a 99.93% reduction in the dissolved solids (TDS; salts). All of the clean water produced at the demonstration site was able to be beneficially re-used by well operators for additional stimulations and can be discharged to surface waterways, thus reducing the economic and environmental impacts of clean water usage.

The average treated water cost per barrel over the demonstration period was approximately 20 percent lower compared to the previous total conventional disposal costs at the site. As a result of the demonstration project, larger towers were designed for the system and four AltelaRain® 600 modules were sold and installed in Williamsport, Pa. to treat approximately 100,000 gallons of produced and flow-back water per day. This commercial installation is a 50 fold increase in capacity over the demonstration unit and represents the first of many planned facilities to be developed in the Marcellus Shale Basin and similar shale gas basins throughout the United States.

Regulatory environment approvals for implementation of the AltelaRain® water treatment technology solution in Pennsylvania's Marcellus Shale Basin were obtained. Numerous Pennsylvania Commonwealth agencies responsible for both federal and state regulatory requirements have jurisdiction over the deployment and operation of this system demonstration. In each case, where applicable, Altela has received approval or satisfied related permit/regulatory exemptions with respect to deploying and operating the system.



Altela ARS® 4000 water treatment towers at the demonstration site.

In summary, the demonstration system successfully met all of the goals outlined for the project:

The operation passed Pennsylvania Department of Environmental Protection (PA DEP) regulations and proved it can be placed at the wellhead and operated within PA DEP regulatory frameworks.

The water quality of the treated distilled water met or exceeded all requisite PA DEP water quality discharge requirements.

The price per barrel of treated water was less than conventional trucking and disposal.

Accelerated commercialization of the technology increases technology transfer.





AltelaRain® 600 unit module and water treatment towers.

Current Status (April 2011)

Field demonstration concluded on schedule on April 10, 2011. Final field-based water samples were collected and are currently being tested at an independent water quality laboratory. A final report is being developed and will be presented that summarizes the efficacy of the system, related treatment economics, including a life cycle analysis and benefits summary and analysis.

Project Start: October 1, 2009

Project End: April 30, 2011