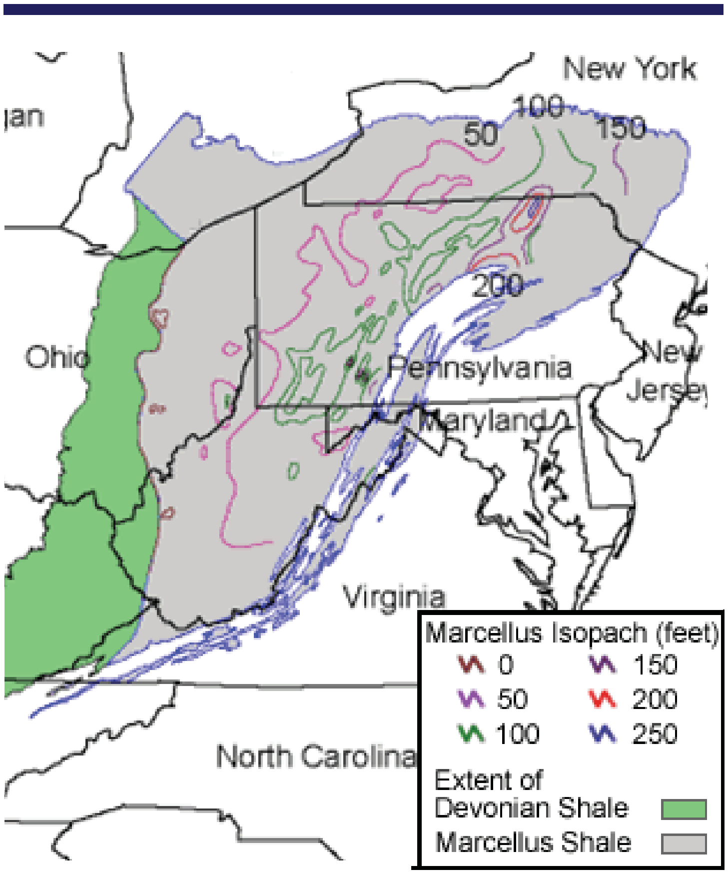
Zero Discharge Water Management for Horizontal Shale Gas Well Development

The West Virginia Water Research Institute (WVWRI) is developing and field-demonstrating a process to treat return frac water (RFW) from Marcellus horizontal well development that will allow an increased recycle rate while decreasing the demand of local water resources and disposal requirements.

Background

Shale gas production depends on the creation of permeability within an otherwise nearly impermeable rock formation. Hydraulic fracturing (fracking) technology teamed with horizontal drilling has facilitated exploitation of the huge gas reserves in the Devonian Marcellus Formation of the Appalachian Basin. Fracking uses large volumes of water to create several, long fractures in the shale formation. Sand along with small amounts of additives that may include friction reducers, scale inhibitors, biocides and surfactants are pumped with the water and left to prop open the fractures, thus providing multiple, permeable flow paths for the natural gas.



Regional map showing the
Marcellus Shale Play shown in gray.

Current fracking practices involve withdrawals from near-by surface waters and disposal of produced flowback water at the downstream end of the operation. The use of the large volumes of water often stresses local fresh water supplies, and the water flowing back from the well after fracturing is a briny mixture, creating a water disposal problem.

The WVWRI project team has undertaken the task of recovering and converting the briny water into a suitable, partial replacement of the fresh water that is currently used as the fracturing fluid of choice. Recycling produced water for fracking would lower transportation costs, environmental conflicts and the risk of interruption in the well development schedule. To be feasible, recycling the flowback water must be economically treated to meet industry standards for dissolved and suspended solids to prevent scaling in the injection train and clogging of pore space in the formation.

Project Goal

The project goal is to design a treatment system that meets the current needs of the industry while providing a level of environmental protection and adaptability to future water quality and quantity criteria. The successful development of a treatment technology for recycling RFW will advance shale gas development through improved economics and decreased environmental impacts. Improved economics will be achieved by reducing the amount of trucking and disposal of RFW and costs associated with these activities. By recycling the RFW for subsequent fractures, the need for fresh water and its associated costs will be reduced. The better you treat the RFW, the higher the blend ratio with fresh water, the less dependence and strain on local water resources, and the less impact on local infrastructure and surrounding environment.

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Project Overview

The objective of this two-phase project is to test and evaluate a mobile, on-site alternative treatment option to reduce total dissolved solids (TDS) and total suspended solids (TSS) to the extent that the resulting water can be recycled for additional frac operations. Treatment process option costs will be measured against reduced water sourcing, transportation and disposal costs.

Phase I

The testing and review of various technologies during Phase I of the project allowed the WVWRI project team to identify and improve upon existing treatment technologies that showed potential for on-site treatment and reuse of the RFW. Gas drilling industry standards for acceptable recycle water quality continue to evolve with current primary needs of high-rate filtration operations (processing up to 6,000 barrels/day) achieving solids removal well below 20 microns and a reduction in sulfates and heavy metals. Industry also requires a treatment system that operates with minimal human intervention, requires little maintenance, occupies a small footprint, and transports easily from site to site. Upon review of laboratory test results and multiple discussions with industry representatives, a multi-media filtration system provided the additional mobility, lower capital and operation costs and an extended range of throughput ability sought by industry.

Phase II

Phase II of the project takes the technology identified during Phase I to the design stage. Design, fabrication and field deployment of a mobile treatment unit (MTU) utilizing the multi-media filtration unit is the focus of Phase II of the project. Two FilterSure multi-media filtration treatment systems will be housed inside an 8-foot wide by 40-foot long customized ISO shipping container along with all necessary utilities and data acquisition instrumentation to monitor and operate the unit. The container is mounted on a mobile chassis and customized for well-site access and application providing a small footprint, easy mobility between well pads and quick disconnect and set-up for subsequent fracture treatments.

Finished Mobile Treatment Unit (MTU) with front and back stairs including handrails.

The MTU will operate in the field for a period of 2 to 4 months. During this time, real-time monitoring of basic water characteristics will be conducted along with regular sampling to monitor water quality parameters such as TSS, TDS, sulfates and metals. After the field-testing phase is completed, modifications to the treatment system, if any, will be made and the unit readied for full-time use.

One of two 90 gpm FilterSure filtration units. Electrical control panel is shown in the background.

Project Funding and Support

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- FilterSure Inc.
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West Virginia Water Research Institute

Dedicated to the preservation and restoration of the natural environment through research and outreach with industry, government agencies, academia, and the public.

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