Sourcing, Disposal and Reuse of Water for Hydraulic Fracturing

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Abstract

Hydraulic fracturing (fracturing) operations require large volumes of water, and produce large volumes of saline flowback wastewater. The issues related with sourcing raw water and disposing of the flowback are site specific and depend greatly on the local regulations in place. In an ideal situation, fracturing operations would consist of the ability to source sufficient fresh water for all the fracturing needs and disposing of all the flowback produced. This ideal scenario rarely exists, therefore the options for decreasing the source water volume requirements and the volumes of flowback to be disposed of need to be addressed. This presentation will outline the factors involved in determining a water management plan for fracturing; understanding the various types of fracturing solution, as well as the impacts of source water chemistry, the geochemistry of the formation, and if deep well disposal is to be used, the water chemistry in the disposal formation.

Changing the type of fracturing solution that is being used will change the volumes of water that are required for fracturing operation. Slick water fracture solutions can require up to 150 000 m^3 of source water per well fractured, while a cross-linked gel based fracture solution can decrease the source water requirement by an order of magnitude. The cross-linked gel based fractured solutions that require lower volumes of source water are highly affected by water chemistry and therefore strict limits on source water quality are imposed in these types of fracturing operation. Either a fresh water source must be used or the source water will require pretreatment. Strict source water quality requirements also limit the potential for flowback reuse as fracture water. Conversely, slickwater fracturing solution is not as affected by source water quality, allowing higher TDS waters to be used without pretreatment. This also allows for the flowback to be more readily reused in fracturing operations.

Examining whether flowback reuse is a viable option requires an understanding of both source water chemistry and the formation chemistry. During fracturing operations, water is injected into the well where it blends with the connate water and dissolves solids from the formation. The resulting flowback is a mix of source water chemistry and formation chemistry. This new flowback water typically contains alkaline earth metals, which can produce scale when mixed with source waters containing carbonates and sulphates. Treatment of the flowback needs to not only satisfy the basic requirement of the fracturing fluid (TDS, pH, TSS, chloride, hardness, alkalinity), it needs to ensure that the blending of flowback water with source water will not lead to added precipitation or scale formation.

Flowback can also be expected to contain residual component of the fracture fluid, including the cross-linked gels, polymers and proppant. Any of the residual fracture solution components in the flowback can have adverse effects on reuse and treatment of the flowback. The flowback treatment system must be designed such that one component of the flowback does not affect the removal of another. A common occurrence in flowback treatment system is the polymer or the cross-linked gel coats the internals of treatment systems causing system failure or increasing treatment system down times.

Preparing a water management plan for hydraulic fracturing operations is a complex matter that needs to account for the availability of source water, the type of source water, the type of hydraulic fracturing fluid to be used, and the availability of disposal options for the flowback. Each of these factors is interdependent and therefore must all be addressed along with economic factors to determine the optimal management strategy.