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TECH TALK

Is plasma technology the green answer to treating non-reusable flowback?

BY GARY BEERS • FOR ENERGY PIPELINE

In Colorado, many oil/gas companies utilize efficient water management practices by reusing produced water in hydraulic fracturing. Typically, produced water from producing wells is routed to use in fracking and, after repeated treatment, reused four to five times before the build-up of organics and salts render further treatment too costly. This can be considered non-usable flowback and commonly is disposed in injection wells.

What if non-reusable flowback could be treated and generate two end-products: distilled water and salt?

The benefits of this treatment option would include: a valuable water source, a valuable salt resource, and elimination of the need for disposal in an injection well.

PLASMA TECHNOLOGY TREATS FLOWBACK FROM HYDRAULIC FRACTURING IN MARCELLUS SHALE REGION

Since April 2017, a pilot plant (Figure 1) has employed plasma arc technology to treat organic and salt laden flowback with the resultant commercial by-products: distilled water and salts. Specifically, the treatment process involves (Patent Number 9440164, 2016):

» pressurizing and heating wastewater.

» flash evaporator produces steam and brine water.

» steam is collected as distilled water (commercial value).

» brine water is crystallized (plasma arc) to destroy organics and to produce a solid mass (salts).

The operation of the plamsa arc can be gauged to produce different types of salt masses. For example, salts that can be used to make de-icing solutions. If there is no market for the salt, then salts will be completely crystallized (vitrification) to a glass-like mass and disposed in a landfill.

This facility is located within one of the largest wastewater recycling operations in southwestern Pennsylvania (Reserved Environmental Services). Based on this initial success, the first commercial plant with this technology is planned for construction in 2018 and will be capable of treating 6,000 bbls/day (AquaSource Technologies Corporation, 2017).

The Pittsburgh Business Times awarded one of its inaugural Innovation Awards, on Dec. 7, 2017, to Dr. Shyam Dighe (founder and owner of AquaSource Technologies) who developed the application of plasma technology and incorporated this process into the pilot plant. There is a solid foundation behind this application. Dighe has over 30 years of experience in diversified areas of research in the fields of chemical and high-temperature plasma engineering, including being the founder of the Westinghouse Plasma Corporation (which he purchased in 1999). Further, he holds over 30 patents including several for the core processes in the pilot plant.

This approach appears more expensive than the other two common approaches for treating produced water with high total dissolved solids (Figure 2). The approaches identified in Figure 2 are:

» RO — Reverse osmosis.

Figure 1: Pilot Plant (AquaSource Technologies Group, Pittsburgh Business Times)

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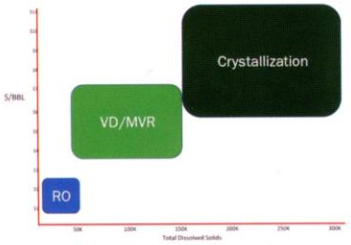

» VD/MVR — Vacuum distillation with mechanical vapor recompression.

» Crystallization — Removal of salts with a process - such as plasma technology.

Certainly, a more useful economic comparison can be done based on life-cycle costs, since there are hauling and disposal costs associated with RO and VD/MVR – while the distilled water and salt by-products of crystallization should generate revenue.

PLASMA ARC TECHNOLOGY

During the past decades, attempts to generate plasma in liquids have been successful and various approaches to treat wastewaters have been proposed (In-Liquid Plasma: A Novel Tool in the Fabrication of Nannoparticles and in the Treatment of Wastewaters, RSC Advances, October 2017, S. Horikoshi and N. Serpone).

The operation of plasma arc is simple. A high-energy, electrical arc is created between two electrodes with a resultant temperature in the range of 5000 to 12,000 oF. Since this temperature is 2 to 10 times higher than typical combustion equipment, the arc is highly efficient in the destruction of wastes with minimal or no pretreatment. One of the earliest photographs of an actual plasma arc in a liquid solution is provided in Figure 3.

A possible environmental concern about the use of this technology to treat wastewaters is the extent and quality of gaseous emissions. The degree of significance for this concern is dependent on the chemical content of the wastewater.

A GREEN OPTION FOR MANAGEMENT OF NON-REUSABLE FLOWBACK

During the coming year, oil companies in the Rocky Mountain Region should have high interest in the operation of the above, proposed pilot plant, employing plasma technology, to treat non-reusable flowback from hydraulic fracturing in the Marcellus Shale region in western Pennsylvania.

An onsite facility to reduce non-reusable flowback to distilled water, recyclable salts, and possibly vitrified material for disposal in landfill is an attractive environmental option to transporting to and disposal of this liquid in injection wells.

Figure 2 (left): Relative Costs of Technologies (R. McCurdy, Chesapeake Energy, 2017)
Figure 3 (below): Generation of Actual Plasma Discharge in Aqueous Solution (JSPS Quarterly, No. 13, 2005)