Options for Managing Produced Water

a report by
John A Veil
Manager, Water Policy Program for Argonne National Laboratory

Worldwide, the oil and gas industry generates more than 70 billion barrels of produced water per year. Within the US alone, between 15 and 20 billion barrels of produced water are generated each year. Management of these large quantities of water can be costly, and can determine whether wells are profitable or not. Companies must consider many different options for managing produced water. Produced water management technologies and strategies are described here in terms of a three-tiered water management or pollution prevention hierarchy – i.e. minimisation, recycle/reuse and disposal.

Tier 1 – Minimisation

In the water minimisation tier, processes are modified, technologies are adapted or products are substituted so that less water is generated. When feasible, water minimisation can often save money for operators and result in greater protection of the environment. Examples of water minimisation approaches and technologies are shown in *Table 1*.

Tier 2 – Recycle/Reuse

For the water that is produced following implementation of water minimisation approaches, operators move to the second tier, in which produced water is reused or recycled. The most common way to reuse produced water is to re-inject it to a producing formation to enhance production. Re-injection for enhanced recovery occurs in tens of thousands of injection wells throughout the US and elsewhere.

Water is a scarce commodity in many parts of the world. Substantial efforts are ongoing to develop economic methods to treat produced water, most of which is quite salty, and put it to a new use. Some produced water, particularly the water associated with coal-bed methane production in the Rocky Mountain region of the US, has low salinity. That water may be suitable for reuse without any treatment. Examples of water reuse and recycle technologies and some of the specific uses are shown in *Table 2*.

John A Veil is the Manager of the Water Policy Program for Argonne National Laboratory in Washington, DC, where he holds the rank of Senior Scientist. He analyses a variety of energy industry water and waste issues for the Department of Energy. Before joining Argonne, Mr Veil managed the Industrial Discharge Program for the State of Maryland Government, where he had statewide responsibility for industrial water-pollution-control permitting through the National Pollutant Discharge Elimination System (NPDES), Underground Injection Control (UIC) and oil control programmes. He also served as a faculty member of the University of Maryland, Department of Zoology for several years. Mr Veil has published many articles and reports and has made numerous presentations on environmental and energy issues. he has a BA in Earth and Planetary Science from Johns Hopkins University, and two MSc degrees – in Zoology and Civil Engineering – from the University of Maryland.

Table 1: Produced Water Minimisation Technologies

Approach	Technology
Reduce the volume of water entering the wells	Mechanical blocking devices (e.g. packers, plugs, cement jobs) Water shut-off chemicals (e.g. polymer gels)
Reduce the volume of water managed at the surface by remote separation	Dual-completion wells (downhole water sink) Downhole oil/water separators (DOWS) Downhole gas/water separators (DGWS) Sea-floor separation modules

Table 2: Produced Water Reuse and Recycle Technologies

Technology	Specific Use
Re-injection for enhanced recovery	Water flood
Injection for future water use	Aquifer storage and recovery
Injection for hydrological purposes	Subsidence control Stream flow augmentation
Agricultural use	Irrigation Livestock watering Wildlife watering Managed wetlands
Industrial use	Dust control Make-up water for drilling fluids Power generation (e.g. boiler make-up water, cooling water) Other
Drinking water and other domestic use	Developing low-cost treatment modules for arid regions

Table 3: Produced Water Disposal Technologies

Technology
Discharge
Underground injection
Evaporation
Offsite commercial disposal

Tier 3 – Treatment/Disposal

When produced water cannot be managed through minimisation, reuse or recycling, operators must dispose of it. Prior to disposing of produced water, operators employ different treatment processes and technologies. Depending on the nature of the water body receiving the discharge, the parameter of greatest concern can be related to either the organic content (oil and grease) or the salt content (salinity, conductivity). For example, the salinity of produced water discharged

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to the ocean is not a parameter of concern, but the oil and grease concentration is regulated. Different types of treatment technologies are employed to remove and control these two key parameters: *Table 3* lists produced water disposal technologies, *Table 4* lists treatment technologies designed to remove salt and other inorganics from produced water and *Table 5* lists treatment technologies designed to remove oil and grease and other organics from produced water.

New Source of Produced Water Information

In June 2007, Argonne National Laboratory opened the new Produced Water Management Information System (PWMIS) website (http://web.evs.anl.gov/pwmis). PWMIS has three main functional components. The technology description module contains 25 fact sheets that describe the technologies listed above. The regulatory module summarises produced water regulatory requirements from federal and state agencies in the US, and gives links to the agency websites. The technology identification module asks a series of questions to the user. Depending on the answers given, PWMIS suggests a short list of options that can be considered for the user's facility.

> Companies must consider many different options for managing produced water.

Table 4: Produced Water Technologies for Removing Salt Content

Technology	Sub-category
Membrane processes	Reverse osmosis Filtration Electrodialysis
Ion exchange	N/A
Capacitive de-ionisation	N/A
Thermal distillation	N/A

Table 5: Produced Water Technologies for Removing Oil and Grease Content

Technology	Sub-category
Physical separation	Hydrocyclone Centrifuge Filtration
Coalescence	N/A
Floatation	N/A
Combined physical and extraction processes	N/A
Solvent extraction	N/A
Adsorption	N/A

Conclusions

Many options are available for managing produced water. In the future, as water supplies become scarcer, produced water may be used as an alternative source of water. ■

Statement of Interest

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