

PROGRAM facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Petroleum Systems Analysis and Planning

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PRODUCED WATER MANAGEMENT COSTS – CONTEMPORARY ESTIMATES

Background

Management methods for water produced in conjunction with crude oil and natural gas [produced water comprises 98% of the *waste stream*] are being increasingly scrutinized. A growing interest in new disposal options is driven largely by the realization that beneficial uses for the produced water exist, especially in the water-poor western U.S., although fundamental environmental concerns must also be considered. Efforts are underway by the U.S. Department of Energy to move a significant volume of produced water from being a *waste* product to being a by-product [of oil and natural gas production] with value. Traditional methods such as deep well injection and evaporation are becoming less preferred as management options as beneficial use of the resource is entirely precluded. DOE requires improved data to support the future direction of their research. The costs associated with the newer water management techniques are often fraught with ambiguities and even when known, the costs can be difficult to access.

Many treatment options exist and the choice of the proper management method for a particular water (or some category of waters) is not always simple. Management costs are often presented as ranges; determining where a specified water falls within that range determines its economic feasibility, yet such a determination is difficult. Jackson and Myers have compiled some produced water management cost estimates in terms of dollars per barrel. These are presented in the following table.

Produced Water Management Costs

Management Option	Estimated Cost (\$/bbl)
Surface discharge	0.01-0.80
Secondary recovery	0.05-1.25
Shallow reinjection	0.10-1.33
Evaporation pits	0.01-0.80
Commercial water hauling	1.0-5.50
Disposal wells	0.05-2.65
Freeze-thaw evaporation	2.65-5.00
Evaporation pits and flowlines	1.00-1.75
Constructed wetlands	0.001-2.00
Electrodialysis	0.02-0.64
Induced air flotation for deoiling	0.05
Anoxic/aerobic granular activated carbon	0.083

Source: Jackson and Myers (2002, 2003)



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Aside from the many wide ranges, the underlying cost bases are sometimes missing. The ranges support neither the application of existing technologies, nor the targeted research necessary to improve management strategies and associated costs. Technology and process cost representations must identify key cost elements, so that focused efforts to reduce costs can be rationally initiated and/or continued.

The Process

Given the increasing need for alternative management methods, the U.S. Department of Energy's National Energy Technology Laboratory initiated a project to more quantitatively determine the costs of managing and treating produced water. Since beneficial use is of significant interest, the ability of a treatment technology to yield water of a specific quality from a given raw input stream is being evaluated. The analysis utilizes multiple data sources including published literature, company literature, and interviews with produced water generators, technology manufacturers, and other technical experts.

Produced waters are characterized by their quantity and location, as well as their quality. Technologies are defined by their set-up, operational, and maintenance requirements. Management costs of handling, treatment, and disposal are all considered. A set of key elements (e.g. pumps or power consumption) that can be influenced by site variables (e.g. climate or electric rates) is defined for each step in the management process.

The approach is to create one database for management processes and technologies, and another for the produced water variables. A "target water quality database," using the end use criteria of the waters, will be used to define the management objectives. Uses of the databases include:

- Determining best management options by for a given produced water and chosen target water (beneficial use) with a key element breakdown.
- Producing a non-attainment target water residual that can be used as the input water for treatment train evaluations in order to meet some chosen beneficial use objective.
- Determining the optimal beneficial use for a specified produced water and pre-selected management option.

Results will be presented on both a technical compliance and cost basis, and key elements will be identified.

Anticipated Results and Benefits

The produced water databases under construction and creation of an evaluation procedure will provide a comprehensive process for determining the utility of existing management methods. The output, especially key cost elements, will aid in focusing research designed to make produced water management for beneficial use more economical. The activity is expected to be completed summer 2005.