DEVELOPING A NEW WATER RESOURCE FROM PRODUCTION WATER

David R. Stewart*
Stewart Environmental Consultants, Inc.
3801 Automation Way, Suite 200
Fort Collins, CO 80525
Voice: 970 226 5500
Fax: 970 226 4946
dave.stewart@stewartenv.com

This paper will discuss a project in northern Colorado regarding the potential of the development of a new water resource. The paper will discuss a full scale plant demonstration on technology for treating oil production water to meet environmental standards and the subsequent development of this water as a new water resource for the western states. The paper will discuss the water quality testing results as well as the economic analysis for the subsequent sale of this water to environmental and commercial entities for beneficial use.

Introduction

Stewart Environmental Consultants, Inc. has been working on both oil production water as well as coal bed methane water for treatment and a proposed beneficial use of this water as a new water resource. This idea of beneficial use has been discussed by others but until our facility was built in Colorado, had never been actually completed.[1]

In 2003, Interior Secretary Norton announced a new Federal initiative to assist communities in addressing chronic water shortages in the West. In this initiative, areas where shortages are most likely were identified. To a large extent, these areas coincide with the states that produce oil and natural gas. The top producing states are Colorado, Texas, Louisiana, Alaska, Oklahoma, and California.

In 2002, 2.1 billion barrels of oil and 196 trillion cubic feet of natural gas were produced in the United States (API). These activities resulted in nearly 22 billion barrels of produced water.[2] Produced water is water that is generally mineralized and contains particulate and dissolved organics and brought to the surface with oil and gas operation.

PRODUCED WATER REMAINS A LARGELY UNTAPPED WATER RESOURCE

Despite individual efforts by the oil and gas industry to beneficially reuse produced water, and an increasing trend toward reuse and recycling, by far the most common method of disposal is subsurface injection in a Class II injection well. This disposal method is very costly and treats water as a liability rather than an asset. There appears to be several reasons why previous reuse efforts have had limited success, including:

- Unfamiliarity of the oil and gas industry with the intricacies of water marketing.
- Uncertainties related to the duration of the produced water supply.

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[1] Water Rights and Beneficial Use of Produced Water in Colorado, Wolfe, Dick and Graham, Glenn, Ground Water Protection Council, Produced Waters Conference, 2002

[2] DOE – NETL, Produced Water from Oil and Natural Gas Operations – Setting the Context, Water Program 063, http://www.netl.doe.gov/technologies/oil-gas/publications/AP/Program063.pdf#search=%22produced%20water%20in%20the%20us%20water%20program%22

- Fluctuating oil and gas prices and the resulting fluctuation in the willingness to make capital investments in recycling technology.
- Wide differences between the desire for rapid development of recycling by private industry, once a "go" decision has been made, and the slow pace of development for public water infrastructure.
- The relatively poor source water quality of produced water and the need for extensive treatment.
- Risks associated with environmental and public exposure to treated produced water.
- The relatively low value placed on water, particularly in relation to the high value of oil and gas.
- Focus of time and capital by the oil industry on their core business – finding oil.
- Clean Water Act limits the discharge of produced water to surface water in the West.

In short, although there are significant technical, economic, environmental, and legal barriers to produced water development, the primary barriers are the institutional and communication differences between the private oil and gas industry and the publicly dominated water industry.

BENEFITS OF PRODUCED WATER DEVELOPMENT

Despite the barriers to development of produced water, the benefits are substantial and are both economic and technical.

The economic benefits of produced water treatment include:

- Adding a new water resource to the shrinking number of water resources available in the water-short West.
- Water is becoming an increasingly valuable commodity that is both transportable and in demand.
- Dramatically reduce the volume of produced water injected into disposal wells and eliminate this as a cost of producing oil and gas. This will reduce the energy loss due to this operation by as much as 20 percent.
- Minimize the cost and risk of the environmental impact of producing oil and gas by dramatically reducing the total use of chemicals in the recovery and treating process.
- Make better use of natural and financial resources by lowering the cost of environmental compliance.
- Reduce the demand for surface water resources by domestic and industrial users, which conflict with the maintenance of endangered species and wild rivers.
- Reduce some or all of the costs associated with the underground disposal of produced water including maintenance, acidizing, drilling new disposal wells, regulatory and administrative activities.

The technical benefits of produced water treatment include:

- Improve the efficiency of thermal oil recovery by decreasing the amount of steam required to heat the water along with the oil in the reservoir.
- Reduce the potential for reservoir damage by disposal injection.
- Reduce the recirculation of injected water into the oil producing horizons.
- Lower the energy demand for oil field operations through reduced water production and handling.

PRODUCED WATER RECOVERY WILL INCREASE DOMESTIC OIL PRODUCTION

In many oilfields, injected produced water flows to producing areas and increases the water content of recovered oil. For example, in the San Ardo Oilfield in California where produced water is reinjected, the water cut was less than 1 percent in the 1940s, but now is nearly 95 percent. Thus, water removal is the key to increasing production. If the reservoir could be dewatered, an estimated 150 million barrels of additional oil could be developed from this oilfield alone.

In reservoirs with thermally enhanced recovery, produced water reuse will also reduce heat requirements. By increasing the steam quality, the amount of steam required can be substantially reduced. Because these heat requirements represent a significant cost and recoverable oil reserves are based on production economies, more oil may be recoverable from existing oilfields.

EXAMPLES OF PRODUCTION WATER PROJECTS

There are three examples of production water projects that have been or are nearing completion.

Wellington Colorado Production Water Plant

The first project is near Wellington, Colorado. This project is treating oil production water as a new water resource. This new water resource will be used to augment shallow water aquifers to prevent injury to senior water users. The oil company is embarking on this project to increase oil production. A separate company will then purchase and utilize this water as an augmentation water source. This water will eventually be used to allow the Town of Wellington and northern Colorado water users to increase their drinking water supplies significantly. In this example, the Town of Wellington can increase their water supply by 300 percent due to this new water source.

The economic reason for this plant is as follows:

1. The cost of the production water treatment plant is approximately $2,000 to $3,000 per ac-ft of capacity. The operational costs for this plant is approximately $350 per ac-ft.
2. The cost of the reverse osmosis plant for the drinking water portion of the plant is $2,000 to $3,000 per ac-ft.
3. For the two plants, the cost for capacity is $4,000 to $6,000 per ac-ft.
4. The market for this water is $20,000 per ac-ft for the non-tributary water and the market for the finished water is an additional $15,000 per ac-ft.
5. Therefore, for an investment of $4,000 to $6,000 per ac-ft, the return is close to $35,000 per ac-ft.

We believe that the economic value will only increase in the future. This is due to the lack of water in the western United States.

San Ardo Oil Field

Another example of the beneficial use of production water is the San Ardo field near Monterey California. Research of this production water system is being conducted by Kennedy/Jenks Consultants of San Francisco, California. This oil field is currently utilizing 50,000 barrels per day for steam, but has over 100,000 barrels per day of water available for beneficial reuse. The end users of this water could be agriculture, groundwater recharge for salt barrier intrusion and environmental reclamation.

Coal Bed Methane Production Water

A third example would be the coal bed methane production waters that are being developed in the west. These waters need to be removed in order to develop the resource of the coal bed methane. This is a difficult water to dispose of due to the organics and mineral content of the water. Technologies have been developed to treat this water, but the beneficial use of this water has not been researched or developed. Potential uses of this water are for municipal augmentation of a new water resource, industrial and agricultural interests as well as environmental enhancement through the creation of wetlands and in-stream flows.

An example of this would be the Atlantic Rim area near southern Wyoming and northern Colorado. This water could be discharged to the tributaries of the Colorado River. Currently, a majority of this water has been classified as non-tributary by the two states. This will allow the potential for movement through interstate transfers of this water. For example, this water could be sold to downstream users on a lease basis.

The cost of treatment of this water for CBM production water has been estimated between $0.25 to $1.00 per barrel. The cost of deep well injection has been as high at $2.00 per barrel. This translates into a cost of $2,000 to $8,000 per ac-ft for treatment and $16,000 per ac-ft for disposal. The market price for this water is close to $20,000 per ac-ft for a long term lease. If the energy companies are currently paying $2.00 per bbl for disposal, then treatment would lower their overall costs. In addition, the first activity at a CBM facility is dewatering phase. If the water could be sold at this point, then the cost of development is greatly reduced.

A NEED FOR PRODUCED WATER RESEARCH

I believe that there is a real need for production water research. Presently, there is a lack of information on the amount of effort required to produce this water. I have been working on this effort in Colorado for over 5 years. Most of this time was spent obtaining regulatory approvals and working on the legal aspects of our project.

There are two bills in the US Congress that can be of assistance in this area. The first is HR 5110, which is authored by Colorado Congressman, Mark Udall. This bill asks for funding of this important new water resource. The second bill is by Senator Domenici of New Mexico. This bill is currently in committee but it is hoped that it will be able to move through the system within the next year. Both of these bills call for assistance in the regulatory areas of this program as well as funding of technical research.

CONCLUSIONS

Production water can be a new water resource for the western United States. This has been proven true for several areas in Colorado, Wyoming and California. There are several reasons that this should move forward:

1. Economically, this approach will be beneficial to the energy companies as well as the water providers.
2. The technology for treatment of these waters has been proven. There are issues with several aspects, but overall the technology exists for this type of production water treatment.
3. Communication of this issue is the largest hurdle to providing this new water resource. We need the energy companies and the water providers to communicate needs and requirements in order to make this new water resource a reality.