
ENERGY
PIPELINE
COVERING THE ENERGY INDUSTRY IN THE ROCKY MOUNTAIN REGION
EARTHQUAKE!
Earthquakes in Colorado are not common and yet the possibility of quakes caused by humans is of concern
URSA RESOURCES
Garfield County opts to work with oil, gas company in well pad siting process
HAZMAT TRAINING
Firefighters practice hazardous material operations with Halliburton
EXECUTIVE PROFILE
Meet Stan Dempsey, President of Colorado Petroleum Association
AUGUST | VOL 3 | ISSUE 12
$4.99
852667724351

TECH TALK

# Isn't produced water too salty for irrigating crops?

BY GARY BEERS • FOR ENERGY PIPELINE

For over 50 years, **GARY BEERS**, has worked in numerous fields of environmental science as a consultant, regulator and educator. This career included senior management position with major consulting, nonprofit and public organizations. He has founded several successful firms to capture emerging resource management markets. One of his latest ventures, EnviroScienceINFO, provides content for public media.

In the oilfields of the Westerns states, many dryland farmers and cattle ranchers wish produced water from oil/gas wells could be locally used as irrigation water. Even after the removal of residual hydrocarbons, the produced water contains too much salt (i.e., sodium) with a concurrent imbalance of sodium, magnesium and calcium ions (as measured by the Sodium Adsorption Ratio) to be a useful water resource for irrigation. The problem is the continued use of this sodic water for surface irrigation degrades soil structure with the result that the soil "cements up" and infiltration capacity is reduced. Thus, water is retained in the soil and unavailable to roots of plants.

However, under a unique modification to traditional subsurface drip irrigation, hundreds of acres of rangeland in Wyoming have been converted to highly productive land yielding crop (i.e., grasses, alfalfa), livestock, and wildlife benefits when irrigated with produced water from coalbed methane wells. This conversion process began in 2005 and has maintained a record of sustained success.

Subsurface drip irrigation is a widely-recognized, water-efficient system for irrigating crops. Typically, parallel arrays of plastic tubing, with emitters, are installed at a shallow depth (less than 16 inches) in the field and water is delivered into or below the root zone.

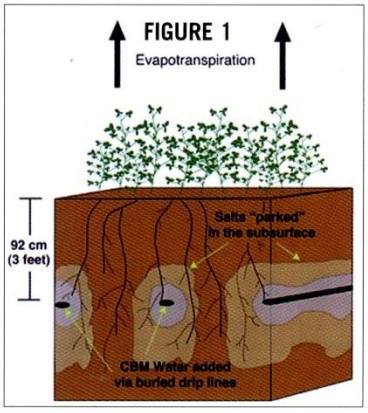
About 10 years ago, in Wyoming, inventive agricultural experts designed and developed a unique version of subsurface drip irrigation that utilizes sodic water from coalbed methane wells (BeneTerra LLC, see beneterra.com). Under this patented process, the drip line system is installed at a deeper depth (about 36 inches) and the produced water is delivered through "horizontal injection" to fields of 50 to 200 acres. The physical arrangement consists of pumping produced water from CBM wells to a lined holding pond, located next to a field, where degassing of carbon dioxide occurs. From this pond water is acidified to a pH of 6.0 by in-line addition of sulfuric acid.

The water is filtered before being pumped into the buried array of drip lines.

The unique aspect of this system is that the burial of the drip lines at a deeper depth creates a thicker buffer zone between the water source and the soil layer where roots can intercept the rising water. This zone provides the opportunity for the native levels of calcium and magnesium present in the soil to offset the effects of the sodium in the introduced produced water. To enhance the availability of calcium, the aforementioned acidification dissolves additional calcium in the buffer zone. As shown in Figure 1, these processes essentially park sodium below the root zone while the water rises to the root zone (i.e., crops with deeper roots such as alfalfa). In situations where the ground water surface is at a shallow depth, the relative introductions of water to the root zone from precipitation and from the drip lines must be monitored and adjusted, since an excess of the combined water will flush the salts further down into the ground water. No surface irrigation is used with this approach.

The Environmental Protection Agency, U.S. Geological Survey, state of Wyoming, BeneTerra, and others conducted detailed studies of the subsurface soils and ground waters where coalbed methane waters were introduced as irrigation waters through subsurface drip irrigation systems in Wyoming's Powder River Basin. Their conclusions did not find any significant environmental drawbacks to this irrigation approach.

Under this approach, produced water is recycled to two beneficial uses – providing water directly to the root zone during growing months and maintaining the subsoil by



additional flushing of salts below the root zone during non-growing months. This approach to the beneficial use of produced water is permitted as a disposal method (Class V well) under Wyoming's Underground Injection Control (UIC) Program.

## DOES THIS SDI APPROACH MAKE "CENTS"

During the 10- to 12-year life span of this unique subsurface drip irrigation system, expenses and benefits are incurred by the coalbed methane operator and landowner – for example:

- initial installation of the deep SDI system cost ($4,000 to $6,000 per acre) about twice as much as a traditional subsurface drip irrigation system.
- operation and maintenance costs ranges from $0.06 to $ 0.24 per barrel (42 gallons) of water delivered by the subsurface drip irrigation system.
- produced water delivered through the subsurface drip irrigation system is applied a rate in the range of 70 to 110 barrels (2,940 to 4,620 gallons) per acre per day.
- the value of non-irrigated land would increase by 200 percent to 300 percent when converted to irrigated land under a subsurface drip irrigation system.
- under subsurface drip irrigation systems, alfalfa crop yield increased about 60 percent.
- produced water from established coalbed methane wells could be evaluated as a long-term water supply and be valued at $300 to $500 per acre-foot per year ($0.04 to $0.06 per barrel per barrel per year)

How the landowner takes advantage of the deeper subsurface drip irrigation system and produced water supply is the key to the overall success of this approach.

Certainly, at a basic level, the landowner can house the deeper subsurface drip irrigation system and to undertake additional agricultural practices to maximize evapotranspiration rates from the field – which focuses on a role as a partner for produced-water disposal. Under this option, most of the initial and ongoing expenses for the subsurface drip irrigation system would be carried by the coalbed methane operator and, thus, the cost to the operator would be relatively high when compared to other disposal options. This approach supports the current opinion that the initial installation cost is the primary barrier to implementation of this innovative subsurface drip irrigation system.

At a more advanced level, the landowner may perceive the produced water as a "new," suitable long-term water supply and undertake agricultural practices to significantly increase crop yields and associated benefits (i.e., livestock, wildlife). Under this option, the initial and ongoing expenses for the subsurface drip irrigation system would be carried by the landowner and, thus, the cost to the coalbed methane operator would be relatively low for conditioning and delivery of the water. This approach would encourage wider use of this innovative subsurface drip irrigation system.

A life cycle costing is needed to identify the expenses over the "new" water supply and agricultural land life cycles in order to make the right choice for the beneficial use or disposal of produced water. ♠