Leaping Hoops and Hurdles-

Overcoming regulatory, policy, and physical constraints to achieve beneficial uses with Produced Water



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International Petroleum Environmental Conference, New Orleans, LA November 8, 2016

Operated by Los Alamos National Security, LLC for the U.S. Department of Energy's NNSA

What makes produced water reuse such a complex challenge?



It's complicated.

- Changing concept of what is a <u>waste</u> vs. a <u>resource</u>
- The "Rules"
- Ownership (the ugly, the bad, and the good.....)
- Management issues



Change is happening....on multiple fronts.

Outline

- Adaptation
- Policy Changes
- Regulatory framework
- Water characteristics inventoried, into GIS
- End-users evaluated, into GIS
- Time factors-extraction, reinjection
- Factors related to oilfield operations (time, quality, distances, volumes)
- Systems management factors
- Waste management factors
- Waste market development
- Economic, social, and environmental evaluations
- Research needed

Adaptation

- Does reuse of PW help our other water systems (the 1% factor)?
- Is the investment worth it?
- Who pays when we turn it into a useable product?
- What about water rights and ownership?
- What about waste disposal?



Policy Changes



....Can lower the bar for reuse

.....Would balance environmental issues, infrastructure needs, economics, social issues

...Would encourage industry to change, and enable a positive outcome on many fronts

PW reuse is positively viewed by multiple entities

Water Rights issues



- In most Western states, there is no water right associated with produced water
- In some states, it can be regulated when there is a hydrological connection with surface or fresh water
- Presents an opportunity as a "new" water source
- Drawing interest in fully allocated regions
- Some states have not yet addressed ownership or liability

Regulation changes

- Some improvisation occurring
- New case of recycling a waste product
- Storage and handling
- Storage is not disposal
- Time frames
- Leaks
- Emissions



Reducing fresh water use and taking trucks off the road is the goal.

Who has jurisdiction over PW?



New Mexico Regulatory Framework for Reuse



Improved water management

- Companies interested in "total management systems" as service providers
- Research leading to better understanding of quality, quantity, and location
- However!
 - Some regions have ongoing injection for EOR, leading to an overestimation of produced volumes over time.
 - Some regions have poor constraints on quality data over time. Salinity may change with extraction.
 - Locations for extraction may not coincide with locations for uses



Produced Water Quality Web Map – Lea County, NM



Treatment Challenges

- Desalination
- Oil fouling of systems
- Mineral scale removal
- Solids management
- Transportation
- Just-in-time delivery



Treatment Challenges





Elimelech, M. and Phillip, W.A., Science, 333, 2011, 712-717.

No defying the laws of physics

Work required is calculated using the change in free energy. Estimates of the minimum work of separation typically assume ideal behavior. The minimum work is then given essentially by the entropy of mixing term. [for example analyses see Y. Cerci, Exergy 2: 15–23 (2002)]

Advances in handling for reuse

Contiguous leases or ownership allow for long-term infrastructure investment; mobile investments also improve access



 Lay-flat hoses replace permanent pipelines





- Modular facilities are flexible
- New tank designs support gravity flow, conserve energy

Transportation Networks



Treatment Success



- Treat for use in hydraulic fracturing
- Simple process
- Rapid progress
- Mobile systems
- Integrated infrastructure
- "Cheaper than fresh water"

Treatment for reuse

(0)

Treatment for reuse

- Oil-water separation
- pH balancing (acids, bases)
- Coagulants, lime softening
- Slant-fin gravity settling
- Filter press
- Filtration
- Microbicides
- Landfill disposal
- Reinjection
- Limited storage times
- NO SALT REMOVAL!



Waste Management

- Reinjection will keep a place in reuse
- Salt management options can be developed-need a market, transport, rules for handling
- Volumes and types of wastes will be different (more solids, less liquids)
- Could mean more landfill space is needed (spent lime, mineral solids)
- Could mean more salt contamination problems



Innovations

Change the system, not the water

- Slickwater frac job chemistry
- Corrosion resistant cooling towers

Reduce the cost of desalination

- Energy recovery devices for pressurized RO systems
- Solar desalination/ low energy desal
- Vapor membrane systems
- R&D
 - Agricultural use (non food crops first)
 - Fruit and nut tree irrigation
 - Growing algae (coproducts)
 - Turn salts into industrial products



Thinking forward....

- Research is needed on how to bring new ideas for water use and reuse into the future, rapidly.
- Investments in new infrastructure will help.
- We need to help our regulators understand how new systems and designs for water use and reuse can fit in regulatory frameworks,
- How to develop markets for waste products make it economic!
- And how to be efficient with our use of water and energy resources on all fronts



Web Links

Produced Water Database:

http://octane.nmt.edu/gotech/Water/producedwater.aspx

Report Website

• <u>https://nmwrri.nmsu.edu/?page_id=4864</u>

Acknowledgements

Many thanks to:

- Bob Sabie and Kwabena Sarpong, New Mexico Water Resources Research Institute
- Martha Cather, New Mexico Petroleum Recovery Research Center
- Devon Energy-Brian Kuh, Jeff Sawyer, Ken Nichols and others
- Katie Zemlick, Bruce Thomson, University of New Mexico
- Fountain Quail Inc.
- Pei Xu, New Mexico State University
- Katie Lewis, Texas A&M Agrilife

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