Text accompanying the PowerPoint presentation titled: "**Please, Pass the Salt: Can the Oil Industry Benefit from Desalination Wastes?**" presented at the TIPRO mid-winter policy meeting in Fort Worth, Texas, on January 13, 2004, by Jean-Philippe Nicot, Research Scientist at the Bureau of Economic Geology, The University of Texas at Austin, John A. and Katherine G. Jackson School of Geosciences.

Note: Assumptions were made about volume of fresh water produced relative to volume of concentrate. In this presentation, **the volume ratio is assumed to be around 5** (1 volume of concentrate is generated for every 5 volumes of fresh water produced). This ratio is facility-specific, depends on many factors, and can be lower or much higher.
For a quick read, see important sections highlighted in bold.

Introduction

Slide 1: Please, Pass the Salt: Can the Oil Industry Benefit from Desalination Wastes?

This presentation is part of a research project that the Bureau of Economic Geology (BEG) is doing in collaboration with the Texas Water Development Board (TWDB). TWDB is the State agency in charge of helping local governments to oversee water resources. The presentation is divided into three parts:

- statement of the problem relative to water resources in Texas,
- description of a small subset of possible solutions (desalination), and
- discussion of opportunities for the oil industry and possible benefits for both parties (water utilities or other fresh-water generators/distributors on one side and oil industry on the other side).

Texas Water Resources

Slide 2: The Problem

What is the problem in Texas relative to water resources? The population is expected to almost double in Texas over the next 50 years (from 21 million people in 2000 to 40 million in 2050). This growth will put extreme stress on current water resources, which will not be sufficient to cover the demand if no additional resources are added. This is especially true during drought periods. Needs for water as compiled by the TWDB will not grow as fast as the population. Current estimates show an increase in demand from 17 million acre-ft in 2000 to 20 million acre-ft in 2050 (1 acre-ft is the amount of water that would be needed to cover 1 acre with 1 foot of water, or about 325,000 gallons; 1 acre-ft also represents the annual consumption of a few households). Growth in demand is tempered because conservation measures are assumed to be applied at a large scale. They are already in place in many cities, and they often times make good economic sense. For example, it is in the farmers' best interest to use as little irrigation water as possible for the same amount of crop. Another measure would be for cities to reduce leakage from pipe networks. Nevertheless, even if the total demand is projected to grow only slightly, municipal demand is anticipated to almost double from 4.3 million acre-ft to 7.1 million acre-ft (despite average individual reduction of water consumption by more than 10%). **In any case, new sources of water have to be found.**

Slide 3: Water Use by Category

The diagram illustrates values presented in Slide 2. Municipal consumption will almost double while total water demand increases only slightly. Most of the limited increase in total demand is driven by the increase in municipal demand aided by a decrease in irrigation demand. Irrigation is mainly groundwater, especially for the Ogallala region, whereas municipal needs are largely covered by surface water. Mining demand, which includes oil industry use but also coal mine dewatering operations of the eastern part of the state, would increase from 150,000 to about 250,000 acre-ft. Many towns and cities especially in the eastern part of the state rely on surface water from rivers or dams, but some cities such as San Antonio or El Paso rely heavily on groundwater to fill their municipal needs.

Slide 4: Per Capita Water Use (year 2000)

Average municipal water consumption per capita varies across the state almost by a factor of 2. Dallas and El Paso had a per capita water use of 260 and 144 gallons/day, respectively. For those two cities, the numbers are expected to change very little. Those large differences depend on many factors such as climatic conditions but also socioeconomic factors. **The average of 180 to 200 gallons per day per capita is a good number to remember** when doing ballpark estimations of water needs for small communities likely to be interested in desalination.

Slide 5: Uneven Predicted Water Shortage

Not all cities are created equal relative to the availability of water resources. A water shortage may be due to either a limited amount or insufficient quality. This is particularly true for those cities in West Texas such as El Paso. Municipalities are trying to expand their water resource base by conventional methods such as buying land and developing well fields but also trying new approaches such as reuse of waste water (for example, Harlingen) or desalination.

Slide 6: Counties with Unmet Needs in 2050

This map shows the counties with water needs in 2050 if nothing is done to augment water reserves. All or only part of the county may show a water deficit in 2050. Those counties appear across most of the state but for different reasons. East Texas has a lot of small communities whose future plans include setting up new well fields or acquiring more rights for surface water.

In conclusion, there is a need to develop more sources of water. One solution is desalination.

Desalination

Slide 7: A Solution: Desalination (1)

Desalination, also called desalting or desalinization, is a process by which solutes are removed from the water to yield fresh water. For users not too far from the ocean, the source of water can be seawater, but for inland locations it is more likely to be brackish water from either an aquifer or surface water. A water is considered fresh if it has less than 1,000 mg/L of solutes. Brackish water contains between 1,000 and 10,000 mg/L. In the desalination process, a small fraction of the water becomes even more enriched in solutes typically by a factor between 3 and 10. Several cities already use desalination as a major means to meet water needs: Fort Stockton, in

West Texas, and Sherman, in North Texas, use groundwater and surface water as feedwater, respectively.

Slide 8: Current Desalination Plants in Texas

A map of the current desalination plants shows that they are present in all parts of the state. Their total production capacity is approximately 40 millions gallons per day spread over about 100 plants. Municipal use accounts for more than half of this total. Most of the plants are small. Those, for the most part, produce small volumes in the tens to hundreds of thousands of gallons per day, except for a few pioneers such as the City of Fort Stockton in West Texas (maximum production there is 3.8 million gallons per day subsequently blended with water from another source). Texas desalination facilities produce a waste stream of about 5 to 10 million gallons per day.

A medium-sized desalination plant would produce about 25 to 30 million gallons per day of fresh water, enough to cover water needs of more than 100,000 people. To estimate the approximate size needed for a city, you can remember that typical consumption in dry years is about 200 gallons per day per capita. The population of a typical county seat of 5,000 inhabitants would need an installation generating 1 million gallons per day of fresh water, exclusive of other needs. An installation like this one may produce on the order of 200,000 gallons per day of waste (~130 gpm).

Slide 9: A Solution: Desalination (2)

The major problem facing desalination is the fate of the concentrate. Most of the world production from desalination plants is in the Middle East along the coast, and a common way to dispose of the concentrate is to send it back to the ocean. This is also the plan for the few desalination plants scheduled for construction along the Texas Gulf coast. This is probably the most economical way to dispose of the waste, although in the Texas case, pipelines would probably have to be built to the open ocean to keep the waste from entering Laguna Madre. Another popular way of disposing of the waste, as currently done in the Fort Stockton desalination plant, is to use evaporation ponds. However, the ultimate fate of the residue still has to be dealt with. Another solution is to inject the waste into the subsurface.

According to current regulations, injection would have to be done through Class I injection wells. The City of El Paso is currently seeking approval for a Class I injection well to dispose of future desalination wastes. **A goal of this study is to find out if there is an interest in the oil community in accepting desalination concentrates (assuming it can be done legally through Class II injection wells). It should be noted that this presentation does not deal with the fate of produced waters but rather with the idea of adding desalination concentrates to the produced water stream loop.**

Opportunities for the Oil Industry

Slide 10: Opportunities for the Oil Industry

What are the opportunities for the oil industry? **The current concentrate volume is small compared with the produced water volume** (5 to 10 million gallons per day compared with ~600 million gallons per day) **but may be locally important close to a desalination plant** (a facility providing water for 5,000 people may generate 200,000 gallons per day of concentrate to dispose of). **Desalination concentrates** of slightly brackish water are likely to be below 10,000 to 20,000 mg/L, **may appear "fresh" relative to some produced waters,** and may require less treatment before injection than produced waters. **Desalination can also bring an extra source of revenue**.

Slide 11: Favorable Conditions

We are entering an era where water is treated as a commodity. The State of Texas gives power to local governments (for example, Conservation Districts) to manage water, facilitating agreements with local oil operators.

Slide 12: Groundwater Conservation Districts

A map of Conservation Districts, current as of September 2003, shows that districts cover at most a few counties and most likely only one county.

Slide 13: Potential Challenges

Technical challenges of injecting desalination wastes into oil-producing formations are not unlike those of injecting water from a source different from that of the formation water. The oil industry has a long history of dealing with such issues.

Slide 14: Conclusions

The current desalination waste stream accounts for less than 1 percent of state-wide produced water volume. It may grow in the future to a few percent. There is no technical difficulty in injecting desalination waste along with produced waters. Additional revenue is created. However, a case-by-case evaluation of benefits and suitability is needed.

Slide 15: Contact Information

Sigrid Clift, BEG, Austin, TX: 512 471-0320
JP Nicot, BEG, Austin, TX: 512 471-6246
Ali Chowdhury, TWDB, Austin, TX: 512 936-0834
And Web sites, regularly updated, to visit:
http://www.twdb.state.tx.us/desalination/Desal/Index.asp
http://www.beg.utexas.edu/environqlty/grndwater/index.htm

Slide 16: Questions, Comments

Quotation by Governor Rick Perry illustrating the State of Texas commitment to desalination: "…and we must not only improve water conservation, but desalinate the saltwater that splashes upon our coast each day." (State of the State Address, February 11, 2003).

References:

Texas Water Development Board, 2002. Water for Texas. Accessible at http://www.twdb.state.tx.us/publications/pub.asp