The Use of Reverse Osmosis in Water Injection Processes

Aly AbdelDaim (CHE) Mostafa Mohamed (CVE) Fayez Barakji (COE) Buraq Basam (ELE)

Situation

In the petroleum industry, pressurized water injection processes are used to enhance the oil recovery process . By injecting water into the reservoir, any remaining oil is flushed out. Pressurized water injection requires a large volume of pure water to be continuously injected in the petroleum drilling site; making the process one of the largest industrial consumers of pure water.

- After the injection process is over, the oil is separated from the contaminated water which is then filtered and dumped into the ocean
- We intend to purify this contaminated water by using reverse osmosis to be re-injected back into the water injection process

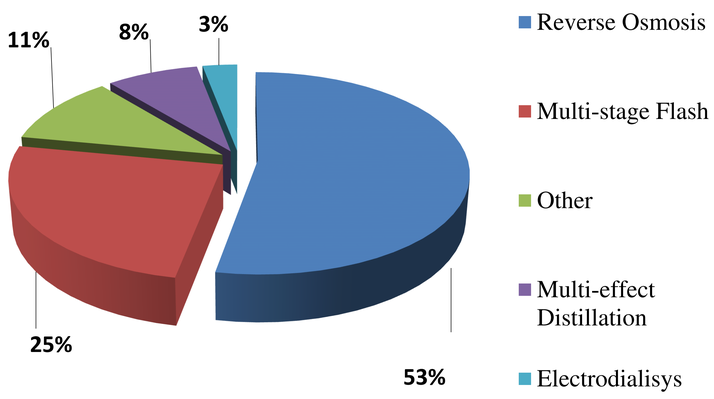

Figure 1: Comparison of purification processes worldwide [1]

Problem

- Separation Efficiency
  To avoid rock pores from getting blocked, the injected water must be in its purest form.
- Energy Efficiency
  The amount of energy required to implement reverse osmosis in water injection is large.
- Cost Efficiency

Solution

- Nanotechnology could be utilized in the construction of the semi-permeable membrane to improve purification. Options include:

  Constructing the spiral membrane's surface out of nano-sized grains to increase surface roughness and thereby enhance the capability of impeding contaminants [2]

  Creating nano sized pores for tubular membranes enhances contaminant selectivity [2]

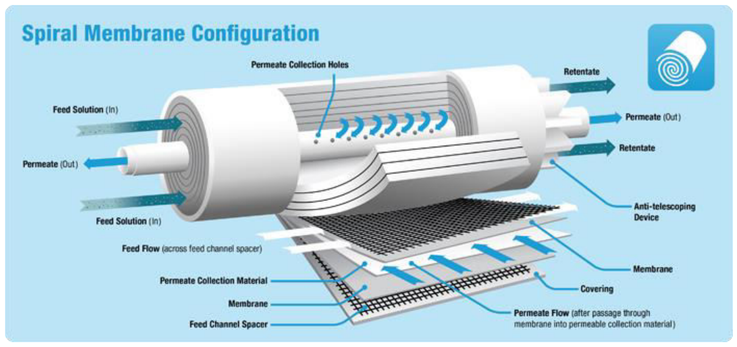

Figure 2: Spiral membrane configuration [2]

- To ensure that the process is running in the most energy efficient manner, an energy recovery system is used

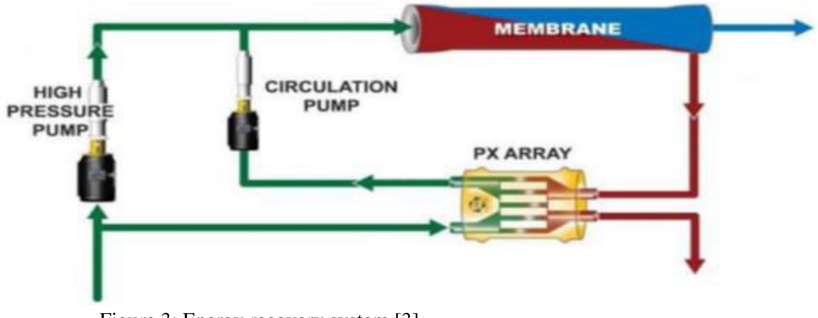

Figure 3: Energy recovery system [3]

- A computer integrated system can be used to watch over the plant, keep track of the water being pumped and constantly check water purity levels.

Evaluation

- The creation of a semi-permeable membrane that is comprised of nano-sized openings is feasible:
  Spiral membranes produce a high level of purity
  Titanium oxides and alumoxane membranes are cheap and have very high affinities toward water molecules
- Turbines can recover 90% of energy but constructing a recovery turbine that could withstand the pressure is challenging [4]
- Operatives capable of handling the computer integrated system are essential

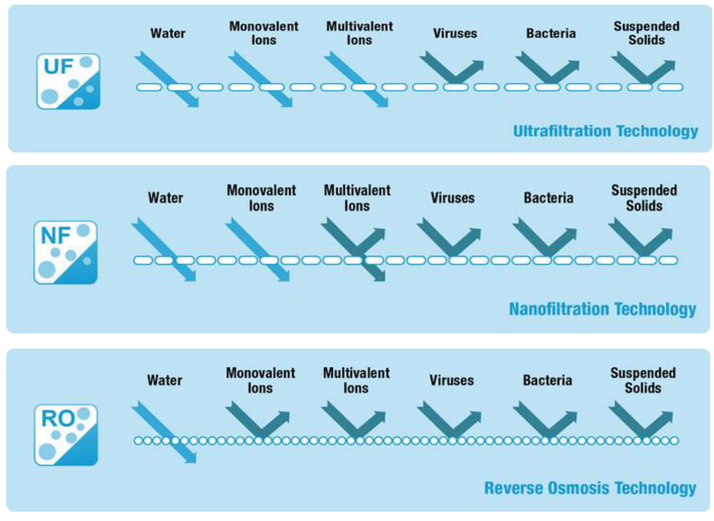

Figure 4: Comparison of different filtration technologies [1]

References

[1] M.G. Buonomenna, "Nano-Enhanced Reverse Osmosis Membranes" *Desalination,* Vol. 314, pp. 73-88, April 2013. [Online]. Available: Sciencedirect: http://www.sciencedirect.com.ezproxy.aus.edu/science/article/pii/S0011916413000118. [Accessed July 8 2014].
[2] B. Jean-yves, J. Rose, R. Mark, " Nanotechnologies: Tools for Sustainability in a New Wave of Water Treatment Processes," *Integrated Environmental Assessment and Management*, Vol. 2, no. 4, pp. 391-395, Oct 2006.[Online]. Available: Proquest: www.proquest.com . [Accessed June 22 2014]
[3] B. Liberman, "The importance of energy recovery devices in reverse osmosis desalination," October 2011. [Online]. Available: https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R363/C8.pdf [Accessed: July 8, 2014].
[4] Flowserve Corporation, "Energy Recovery Devices," flowserve.com, [Online]. Available: http://www.flowserve.com/Products/Energy-Recovery-Devices. [Accessed: June. 22, 2014].