

WATER TREATMENT TECHNOLOGY FACT SHEET



THERMAL EVAPORATION/ DISTILLATION

Process Description

Modern distillation/evaporation processes being utilized in the shale gas industry include the use of Thermal Vapor Recompression (TVR) and Mechanical Vapor Recompression (MVR). In principle, both technologies distill water in a similar overall process but differ in how increases to steam pressure and temperatures are applied. With TVR, steam jet ejectors are used to raise the pressure and temperature of vapors whereas; with MVR, mechanical compressors are used instead of steam jet ejectors.

Click on Vendor's name for Profile sheet.

Treatment Company	Thermal Distillation/ Evaporation	Shale Gas Basin				
		Marcellus	Barnett	Haynesville	Fayetteville	Woodford
	212 Resources	✓	✓			
	Fountain Quail	✓	✓		✓	
	Aquatech	✓	✓		✓	
	Veolia	✓				
	INTEVRAS	✓	✓			
	GE Water & Process Tech.		✓		✓	
	Total Separation Solutions			✓		

With MVR for instance, heat generated during the thermal evaporation and distillation process is derived from the compression of vapor rather than the direct exchange of heat produced from steam produced in a boiler. This approach effectively reduces the temperature required to boil water relative to the atmospheric boiling point and subsequently, reduces the energy demands of the treatment process. In the shale gas industry, mechanical compression is more widely used and is therefore, focused on in the remaining discussion.

KEY CONSIDERATIONS

- TDS concentrations of 60,000 -80,000 mg/L will result in fresh water recovery rates of approximately 70% - 85%.
- To include, transportation, power consumption, labor and treatment, cost estimates range from \$3.00 to \$5.00 per Bbl.
- Currently, thermal processes, such as MVR, are the only practical treatment option for treating flowback and produced water with TDS concentrations above 40,000 – 45,000 mg/L.

Technical Capabilities

The thermal evaporation/distillation process is most effective at desalinating brine, removing inorganic compounds, such as heavy metals and nitrate; total dissolved solids, hardness (calcium and magnesium); and in some cases, organic material such as bacteria, through the boiling process. When using MVR, the treatment of raw water (or brine) with TDS concentrations of 60,000 - 80,000 mg/L will result in fresh water recovery rates of approximately 70% - 85% at flow rates exceeding 2,500 BPD.



Fountain Quail MVR NOMAD Facility
ALL Consulting

Note: Information is from vendor, however specifications may have changed. Contact vendor for updates.

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Technical Limitations

MVR systems are capable of treating produced water with high TDS concentrations, but in general, levels above 80,000 mg/L – 100,000 mg/L result in loss of water recovery (or increased brine concentrate) and an increase to treatment costs due to the additional energy required for treatment. Based on available data, MVR systems are limited to treating unblended water with TDS concentrations of 150,000 mg/L with a water recovery rate of approximately 50%, although some newer technologies are indicating higher water recovery rates are obtainable. Problems associated with this technology include fouling with organic deposits and corrosion within the heat exchanger that is caused by the recirculation of brine, which is used for heat recovery in the evaporator. Pre-treatment of the feed water (e.g., flocculation, cartridge filtration, settling) is required to minimize such issues.

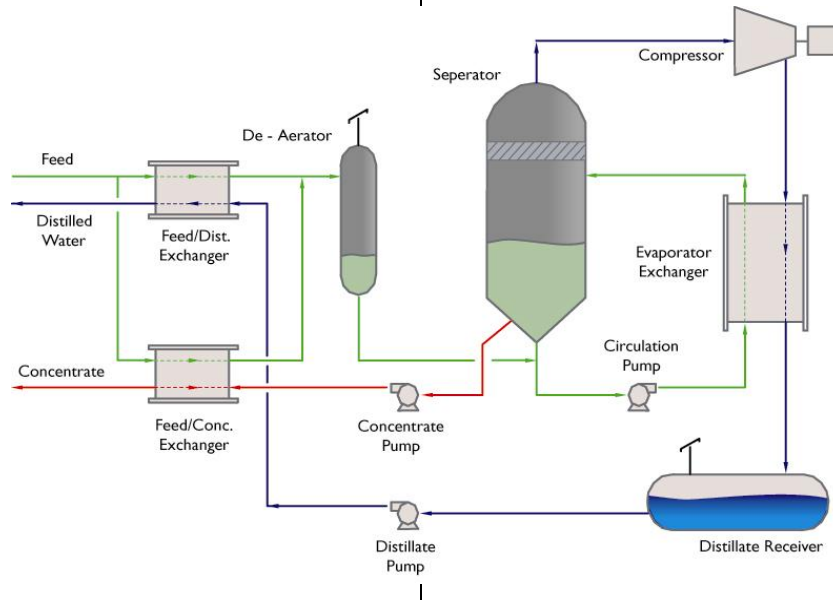
Costs

To include, transportation, power consumption, labor and treatment, cost estimates range from \$3.00 to \$5.00 per Bbl (disposal costs not built-in to the overall cost). To only process or treat the water, costs estimates equate to less than \$3.00 per barrel, as compared to an estimated \$2 to \$2.50 per barrel for typical water disposal into an injection well in the Barnett, or approximately 50 to 75 percent more.

References

National Energy Technology Laboratory (NETL). Produced Water Management Information System

(PWMIS). Produced Water Management Descriptions- Thermal Distillation.



Aqua-Pure NOMAD MVR Process Diagram
Courtesy of Fountain Quail

AquaPure. NOMAD 2000 Mobile Oilfield Evaporator Fact Sheet.

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