WATER TREATMENT TECHNOLOGY FACT SHEET

ELECTRODIALYSIS

Process Description

The basic principles of the electrodialysis (ED) treatment process are similar to ion exchange in that dissolved ions present in water have either a positive or negative charge and are attracted to electrodes with an opposite electric charge. ED differs from a normal ion exchange process by utilizing both cation and anion selective membranes to segregate charged ions extracted from a water solution. In ED, membranes that allow either cations or anions (but not both) to pass are placed between a pair of electrodes. An improvement to ED, referred to as Electrodialysis Reversal (EDR), utilizes the same concept except that in EDR, there is periodic automatic reversal of polarity and cell function to reverse the flow of ions across the membrane. This returns anions across the anionic membranes and helps break up scale formed on the concentrating face of the membranes and minimizes membrane fouling. As with RO, a small pump is required to move the water through the membranes to overcome the resistance of the water as it passes through the narrow passages.

Treatment Company	Electrodialysis	Shale Gas Basin				
		Marcellus	Barnett	Haynesville	Fayetteville	Woodford
	Use of this Technology has been considered but is currently not being utilized as a desalination treatment technology by the Shale Gas industry.					

Technical Capabilities

Depending on the number of stages present within an ED unit, this treatment process can remove approximately 25% to 60% TDS with a resulting stream of approximately 15 to 30% of the raw water input, although higher water recovery rates (90%) are obtainable with low TDS concentrations (<2,000 mg/L).

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

KEY CONSIDERATIONS

- Standard ED is limited to treating TDS concentrations ranging from 4,000 mg/L to 15,000 mg/L.
- ED is also capable of removing and/or reducing aluminum, barium, bromide, cadmium, calcium, chloride, copper, cyanide, potassium, and VOCs.
- ED is more expensive than RO but is more resistant to membrane fouling, which in turn can reduce costs

The ED treatment process is also applicable for removing and/or reducing aluminum, barium, bromide, cadmium, calcium, chloride, 97-98% of copper, 90 to 95% of cyanide, 94 to 97% of potassium, and VOCs.

HEED, or High Efficiency Electrodialysis, is capable of purifying water to contain less than 2 ppm TDS at a flowrate of about 2,400 BPD. The waste generated by this process is less than 2% of the original contaminated water. To achieve these purity levels though, the original TDS levels must not exceed 22,000 ppm. The HEEPM, or High Efficiency Electro-Pressure Membrane, is an improvement of the HEED. It uses HEED technology in addition to pre-filters and RO systems. Vendor information indicates it is capable of handling TDS levels up to 50,000 ppm and with water recovery up to 99% of the feed water.

Technical Limitations

Standard ED is limited to treating TDS concentrations ranging from 4,000 mg/L to 15,000 mg/L, although some newer ED technologies have reported the ability to treat higher TDS concentrations (approximately 35,000 mg/L at a flow rate of 10,000 BPD with 75% recovery). However, as reported by Hayes and Arthur (2004), the economics limit the applicability of standard ED to feed waters with TDS concentrations of 10,000 mg/L or less.

Pre-treatment is necessary for ED to control scale build-up of calcium carbonate ($CaCO_3$) and magnesium hydroxide, as well as iron ions. Typically, these constituents are controlled either chemically by acid addition for pH adjustment and/or by cartridge filter. ED

is not effective at treating bacteria, colloidal material, boron or silica.

Costs

In general terms, electrodialysis is more expensive than RO but is more resistant to membrane fouling, which in turn can reduce costs typically associated with membrane replacement or cleaning. For Coal Bed Natural Gas water, treatment costs have been estimated to be under 15 cents per Bbl for a 0.34 MGD (8,000 bbl/day) treatment process.

ED treatment is more cost-effective and energy-efficient when treating low TDS water (e.g. TDS 4,000-5,000 mg/L).

References

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EET Corporation. 2010. HEEPM Specifications. March 22, 2010.

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