DOWEX Ion Exchange Resins

A Low Cost Option to Reduce Sodium Levels in Coal Bed Methane Coproduced Wastewater using DOWEX G-26 Resin

Site Information

Process:
Natural gas production

Location:
Powder River Basin, Wyoming

Purpose:
Reduce sodium adsorption ratio (SAR) of wastewater to enable discharge

Benefits:
- Sodium adsorption ratio (SAR) reduced to <1
- Wastewater can be discharged in an environmentally safe manner
- Low treatment cost

The coal bed methane fields of the Powder River Basin in Wyoming are a rich source of natural gas. However, the water produced along with the natural gas can be very high in sodium, which complicates discharge and subsequent use. The Higgins Loop™ continuous ion exchange system uses DOWEX ion exchange resins to reduce the sodium content of the water and enable environmentally safe discharge.*

Introduction

Water is typically a co-product of natural gas production. When natural gas is produced from certain coal bed methane fields in the Powder River Basin of Wyoming, the water is very high in sodium. The high salt content, expressed as the sodium adsorption ratio (SAR), makes the water detrimental to plants, fish, and the environment. Current federal and state laws prohibit discharge of this water, which limits natural gas production. An effective and cost-efficient way to remove sodium from natural gas co-produced water was needed to allow the water to be safely discharged and potentially used for irrigation. As a result, more natural gas could be produced and sold.

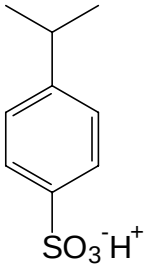
In response to this need, EMIT Water Discharge Technology LLC developed a new process that uses DOWEX* ion exchange resins in combination with the Higgins Loop™ continuous ion exchange system to reduce the SAR of co-produced water. This case history describes field trial results that are typical of expected performance.

Background

DOWEX cation exchange resins are widely used to remove sodium from water. The ion exchange resin of choice is DOWEX G-26 resin, a strong acid cation exchange resin with uniform particle size. This resin features an excellent exchange capacity for sodium so the highest efficiency can be achieved.

DOWEX G-26 resin is a very tough and versatile resin that is well suited to equipment such as the Higgins Loop continuous ion exchange system. DOWEX G-26 resin has been used for years with good success in the Higgins Loop in a wide variety of applications including water treatment and chemical processing. The resin and the equipment have a proven track record together for trouble-free, continuous operation. Figure 1 shows the chemistry of the ion exchange separation. Table 1 lists the properties of DOWEX G-26 resin.

Figure 1. Chemistry of the ion exchange separation.



Removes: Na^+ Ca^{2+} Ba^{2+} Mg^{2+} Fe^{2+} etc.

Table 1. Properties of DOWEX G-26 resin.

Total exchange capacity, eq/L, min.	2.0
Water content, %	45–52
Bead size distribution	
Mean particle size, µm	650 ± 50
Uniformity coefficient	1.1
Whole uncracked beads, %, min.	95
Crush strength, avg, g/bead, min.	>200
Ionic conversion, %, min.	99.7
Trace metals, ppm dry resin, max.	
Na	100
Fe	50
Cu	50
Al	50
Heavy metals (as Pb)	20

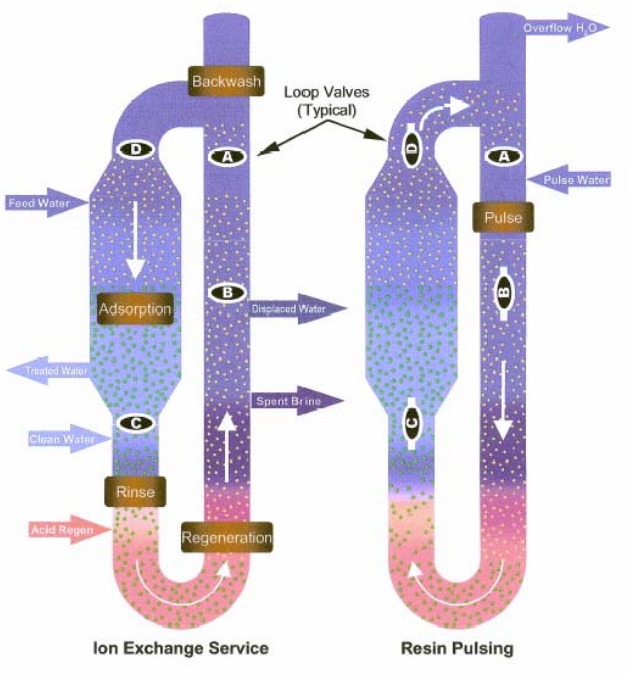
These data represent typical properties only and should not be construed as product specifications.

Process Description

Sodium-containing water is continuously fed into the Higgins Loop system, which produces a steady flow of treated water. Resin advances through the system in the different stages of adsorption, backwash, regeneration, and rinse in preparation for another adsorption cycle. DOWEX G-26 is well suited to this operation because of its exceptional strength. It can withstand the concentrated acid regeneration that allows for minimum production of concentrated brine for optimal use in alternative applications. Figure 2 shows a diagram of the process and an illustration of the demonstration unit.

Process Description, cont.

Figure 2. Water purification using the Higgins Loop process (demonstration unit shown at right).



Process Performance

A field trial was recently conducted on a 200 gpm (45 m^3/h) stream of co-produced water. The results are summarized in Table 2. Overall SAR was reduced to <1, with sodium and barium reduced by at least 97%. The treated water was neutralized with a calcium mineral to adjust the pH and increase calcium concentration.

The combination of the Higgins Loop process and DOWEX G-26 resin offers great flexibility in producing a particular water quality for a wide variety of needs. The treated water can be blended with untreated water to whatever level of SAR is desired for discharge or irrigation. The specific economics of a system will depend on the level and type of ions present in the feed water, the final SAR level required, the location of the system, and access to service components. The best way to express this is with the range of treatment costs of $0.05 to $0.20 per barrel of water produced.

Table 2. Performance of Higgins Loop process.

	Raw Co-Produced Water	**Treated Water**
Cations		
Sodium, mg/L	486	12
Calcium, mg/L	22.2	113
Magnesium, mg/L	13.2	<1
Potassium, mg/L	13.5	<1
Barium, µg/L	720	ND
Anions		
Carbonate, mg/L	<1	<1
Bicarbonate, mg/L	1430	311
Chloride, mg/L	18	42
Sulfate, mg/L	1	1.1
SAR	20.2	0.3
pH	8.1	6.5
Electrical conductivity, µmhos/cm	2340	735

Sample source: Powder River Basin test site; date: August 2003

Conclusions

The Higgins Loop ion exchange system using DOWEX G-26 resin successfully reduced high sodium levels in water co-produced with natural gas from coal bed methane fields.

- Sodium was reduced by 97%.
- Barium was reduced to non-detectable.
- pH was reduced to near-neutral.
- Overall SAR was reduced to <1.

The treated water can be blended with untreated water to whatever level of SAR is desired for discharge or irrigation.

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