NEW MEDIA

Gregory Hallahan and Caleb Smathers, ProSep, USA, and Jeff Myers, Williams, USA, examine the effective removal of BTEX from rich water to reduce the concentration of BTEX in reclaimed methanol using a new media system.

When reclaiming methanol from water, the disparate boiling temperatures of the two compounds are used to create separation via distillation. The number of stages within the distillation column dictates the level of purity achieved, which is often set by the specifications for the products for resale and reuse. The ability to separate two components is further complicated by the existence of many other components, some of them in trace amounts, causing multi-component interactions, affecting vapour pressures, and creating azeotropes that affect the ability of a distillation column to reach the purity levels required.

This is the case for the Williams' Discovery Larose gas processing plant, which is transporting and producing natural gas from offshore Gulf of Mexico. Some wells require methanol to be injected downhole to prevent hydrate formation. Natural gas from these

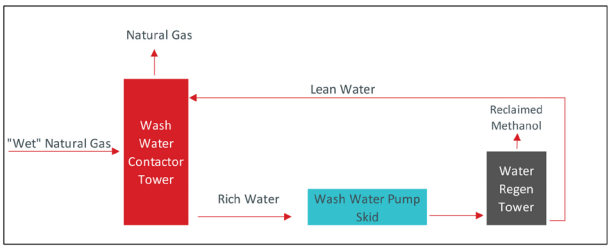

Figure 1. Gas processing in the Larose facility, in regard to wash water.

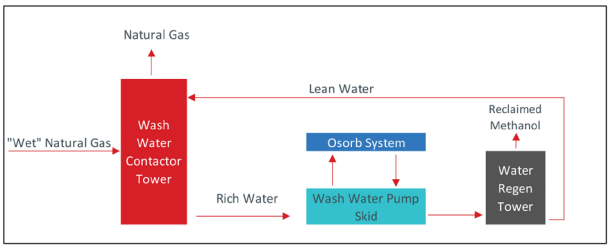

Figure 2. The proposed location of an Osorb media system in a gas processing sequence. During the demonstration, the system processed a slip stream of the rich water flow.

Table 1. Target BTEX concentrations in reclaimed methanol

Species	Concentration without the Osorb system* (wt%)	Target concentration (wt%)
Benzene	0.050	<0.024
Toluene	0.027	<0.011
Ethyl benzene	0.0044	<0.0007
Xylene	0.0187	<0.001

*Estimated from previous sample analysis

Figure 3. The Osorb media system for 300 – 500 bpd of water.

wells are saturated with methanol and cannot be processed due to the damaging effects that would be caused to gas dehydration molecular sieves inside the processing facility. Extracting the methanol out of the gas stream with a water contacting tower as the gas arrives onshore at the plant is necessary to prevent these effects. The resulting rich water, which is 5% methanol and 95% water, also contains trace amounts of gas condensate components. These components, particularly benzene, toluene, ethyl benzene and xylene (BTEX), track with the reclaimed methanol, thus contaminating the sales product and resulting in a lower market price. Removing these trace BTEX components increases the value of the methanol, increasing revenue while also avoiding the logistics of selling an inferior product.

Williams and ProSep deployed the proprietary Osorb® media to reduce or remove BTEX components from the reclaimed methanol stream at Williams' gas processing plant. This is a proprietary, silica-based media that is hydrophobic and does not absorb water. It is effective at separating free, dispersed, emulsified and soluble hydrocarbons, as well as some oilfield chemicals from water streams. It is capable of repeated regeneration cycles and is reusable, without significant loss in performance. Additionally, the organics and chemicals captured by the media can be collected during regeneration and fed back into the requisite process stream. This regeneration and reuse of the media generates no waste stream, thus alleviating the need for waste disposal and transport, as well as the storage of replacement media.

The mechanism by which the hydrocarbons and oilfield chemicals are removed from the contaminated water is unique. It is both an adsorbent and absorbent, with no permanent chemical bonds formed between the media and the contaminants. It is this lack of permanent bonding that allows the media to be fully regenerated and reused while also recovering the captured components. While absorbing free, dispersed and emulsified hydrocarbons and non-polar organics, the matrix structure of the media reorganises and expands to provide increased capacity and bed life.

The report below outlines the results of tests performed, the requirements needed to scale up the technology to treat the full rich water stream, and the cooperative work ProSep performed with Williams to provide a final, engineered, easily regenerated full process system for the removal of BTEX from the rich water stream to enhance the quality of the reclaimed methanol product.

System setup

The wet natural gas enters Williams Discovery Larose plant (Figure 1) containing methanol, BTEX

and hydrocarbons. It is first processed in the wash water tower. In the tower, the wash water removes the methanol injected for hydrate inhibition, but also dissolves some BTEX and hydrocarbons in the process. The exiting natural gas is directed to further processing and the wash water (now called 'rich water' because it contains methanol, BTEX and hydrocarbons) is processed to reuse the wash water and recover the methanol. The problem at the Larose facility is

Figure 4. Samples collected from the inlet and outlet of the Osorb media system.

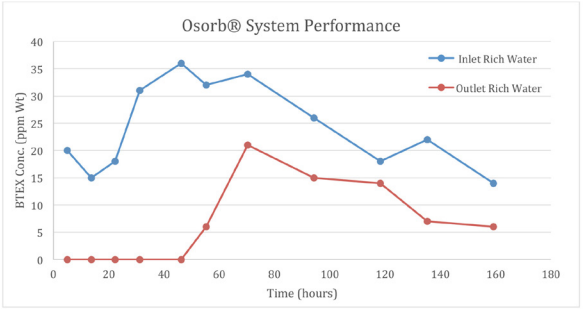

Figure 5. BTEX levels in rich water at the inlet and outlet of the Osorb media system.

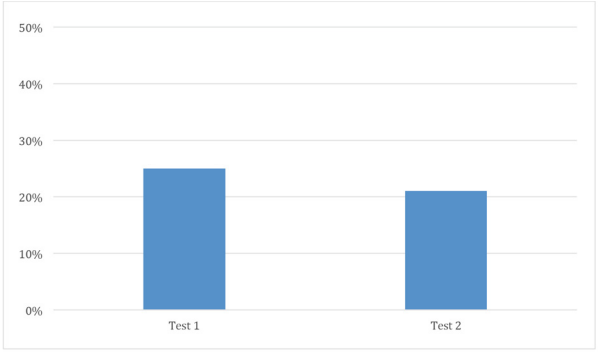

Figure 6. The average reduction of BTEX in reclaimed methanol during tests 1 and 2.

contamination of the reclaimed methanol with BTEX at the methanol reclamation tower.

Based on laboratory testing, ProSep suggested the set up shown in Figure 2 for the Osorb media system at the plant. This process would remove the BTEX from the rich water, but allow the methanol/water solution to be sent onward to the methanol reclamation tower. The reclamation tower recovers the methanol and provides lean water for reuse. Removal of the BTEX components with the media system prior to the reclamation tower provided a cleaner methanol product compared to the existing setup.

The regeneration of the media was completed using a small steam generator supplied by ProSep. Following the regeneration of the media, the system was put back into service to test the regenerated capture capacity of the media.

Following the laboratory study, a pilot test was completed to verify that an Osorb system could reduce the BTEX in the reclaimed methanol to the required specifications as outlined in Table 1. By meeting this target specification, the reclaimed methanol value substantially increases.

Testing

The system contained two 18 in. vessels, each with 35 kg of Osorb media, valves, instruments, and intra-connecting piping on a 4 x 8 x 6 ft skidded package. The piping was configured for water treatment in series. The system was connected to the washwater pump skid where a slip stream could be directed to the media for treatment and then returned to the wash water skid (Figure 3).

Tests 1 and 2

The first test was carried out treating 15 – 20% of the total rich water flow. Reclaimed methanol and rich water inlet and outlet samples were collected and sent to a third-party independent laboratory for analysis. The inlet and outlet samples visually demonstrated the ability of the media to remove free and dispersed oils, while the third-party laboratory samples confirmed its ability to simultaneously capture soluble components, such as BTEX. Figure 4 shows a few inlet and outlet samples collected and sent for testing.

The BTEX concentration at the inlet and outlet of the media system is shown in Figure 5. As laboratory tests indicated, the system removed 99.9% of the BTEX from the rich water with inlet BTEX concentrations ranging from 14 – 36 mg/l. The system maintained high efficiency BTEX removal for 48 hrs.

As predicted, the reduction of BTEX in the rich water resulted in a reduction of BTEX in the reclaimed methanol. The system provided 99.9% BTEX removal for 20% of the rich water flow, while concurrent samples of the reclaimed methanol demonstrated a 20 – 30% reduction of BTEX in

both tests. The media regeneration between both tests was completed by purging the vessel with 275°F steam (Figure 6).

Results

The goals of the demonstration were to reduce the concentration of BTEX in the reclaimed methanol and demonstrate media regeneration and reuse. The system achieved a substantial reduction of BTEX in the methanol during both tests. Additionally, the media was regenerated between tests and regained its performance capabilities after the regeneration. This proved that a full-scale system could be designed based on the pilot testing, thus providing a system to increase revenue for reclaimed methanol byproduct.

The Osorb system treated a slip stream of rich water before the methanol reclamation tower. While treating only a small portion of the water, at a maximum of 20%, the reclaimed methanol displayed a significant reduction in BTEX components. During test 1, an average reduction of 25% was observed from the baseline of 1118 mg/l BTEX in the reclaimed methanol. During test 2, an average reduction of 21% was observed with a baseline of 1984 mg/l BTEX in reclaimed methanol. Treatment of the full stream, as the commercial system is set to do, will provide the full removal of BTEX from the reclaimed methanol, providing a superior product than is currently obtained.

ProSep, along with Williams and the media's supplier, also tested a pressure swing adsorption (PSA) system that quickly regenerates the media within 1 – 2 hrs. The process is simple, fast, and provides a close to brand new media quality with the restored 100% capture efficiency rates for BTEX and condensate components. The PSA system also delivers a clean contaminant stream that can be comingled with other natural gas products present at Williams' Discovery Larose gas processing plant. These advantages of the PSA system provided a final system design for implementation at Williams.

Conclusion

The implementation of a full-scale Osorb media system will allow the system to meet or exceed the required specification for BTEX in reclaimed methanol. The expected average methanol flow rate is 1.3 gpm, for a total of nearly 2000 gal./d of reclaimed methanol. Once implemented, the system will not only provide reliability for processing the rich water from the contacting tower, but also yield an estimated internal rate of return (IRR) of up to 40%.

Note

ProSep would like to thank Williams Discovery Larose plant for allowing it to conduct this demonstration and propose an economical solution. The company would also like to provide a special thanks to the Larose plant operations team and Jeff Myers for all their assistance.