

The CONTACTOR™

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Performance of Stahl Columns in Glycol Dehydration

The Stahl column is an interesting way to achieve extreme dryness of glycol solvents for dehydration by using dry stripping gas (rather than heat alone) to remove water from a partially stripped solvent. This issue of The Contactor™ uses ProTreat® to demonstrate how the performance of a Stahl column is affected by the amount of packing in the column, and by the packing size.

There are several configurations in which an additional tower using stripping gas to remove residual water from glycol (triethyleneglycol, TEG, for example) can be used in conjunction with a conventional, reboiled glycol stripper. The common thread, however, is that the partially stripped glycol enters from the reboiler into the top of a packed (Stahl) column where it meets a rising stream of stripping gas. The stripping gas enters into the base of the Stahl column. Typically it is extremely dry (or even “bone dry”) methane or nitrogen.

Unlike a conventional reboiled stripper, the Stahl column reduces residual water content to the level of fractions of parts per million. Stripping under these conditions is not just mass transfer rate controlled—it is controlled by the mass transfer resistance in the liquid or glycol phase. This is for two reasons:

- The water concentration is extremely low. The significance of this is that instead of easily evaporating into the stripping gas because it's already available at the interface in large concentration, water first has to reach the interface by diffusing from the bulk glycol solvent phase which has only a very small water content.
- Even *hot* glycol is fairly viscous. The higher the viscosity, the harder it is for the water to diffuse through its glycol surroundings.

Both factors result in significant liquid-phase resistance to water removal from already very dry glycol. ProTreat's mass transfer rate-based tower

model will be used to show via a case study just what to expect from two different but typical packings, and what effect the amount of packing (i.e., packed height) has on the dryness achieved.

Case Study

The Stahl column is 42-in diameter packed with various depths of Mellapak M125.Y and Mellapak M250.Y structured packing. The partially stripped solvent from the TEG stripper reboiler flows at 130 Std. USgpm (corrected to 60°F) and is 99.05 wt% TEG with 0.85 wt% water content, the balance being trace amounts of C1 to C10 hydrocarbons plus BTEX components.

Two cases are considered (1) “Bone Dry” methane stripping gas and (2) stripping gas consisting of methane with 5 ppmv water content. A stripping gas flow of 1 MMscfd enters the Stahl column at 180°F and the column itself operates at 3.4 psig.

Using Bone Dry stripping gas, packing size and depth were simulated to have the effects shown in Figure 1. Of course, completely anhydrous stripping gas will continue to strip water from

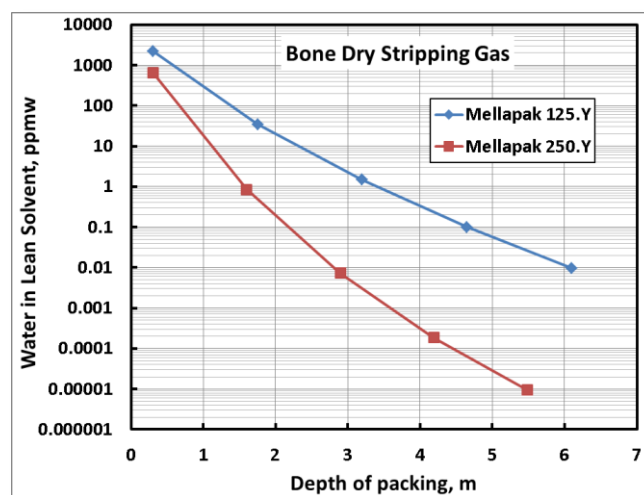


Figure 1 Packed Depth and Type Affects Stripping

the solvent no matter how much the packing depth is increased. In other words, with completely dry stripping gas there is no lower limit to the residual level of water that can be reached. Nevertheless, Figure 1 suggests that residual water decreases exponentially with depth of packing (note the logarithmic scale on the ordinate axis). The logarithmic plot of water concentration in the TEG versus position in a 20-ft (6.1-m) deep bed of M125.Y packing shown in Figure 2 confirms this.

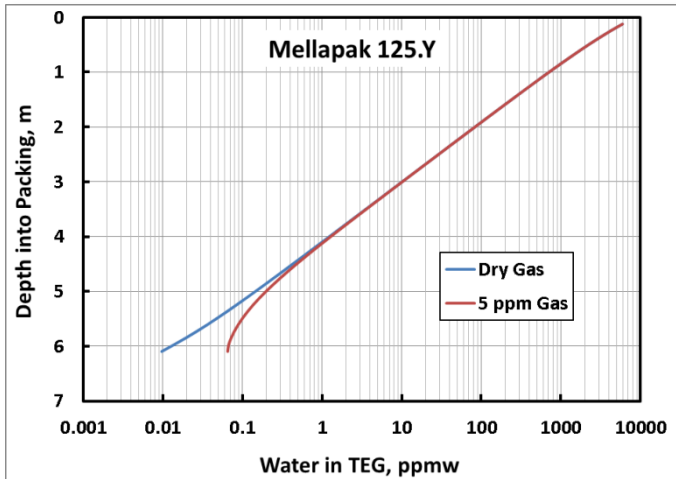


Figure 2 Profile of Water in TEG within Packed Bed

Bone dry is the ultimate in dryness and would be a very unlikely state for the stripping gas in any practical application. A fairly aggressive condition might be 5 ppmv of water content. Figure 3 shows the effect of packed bed depth on TEG dryness. Deeper beds achieve better dryness, but only to the point where the dried solvent is in equilibrium with the inlet stripping gas at process conditions. In the case considered here, the finer packing (Mellapak M250.Y) nearly achieves equilibrium with 3-m of packing. The coarser packing needs

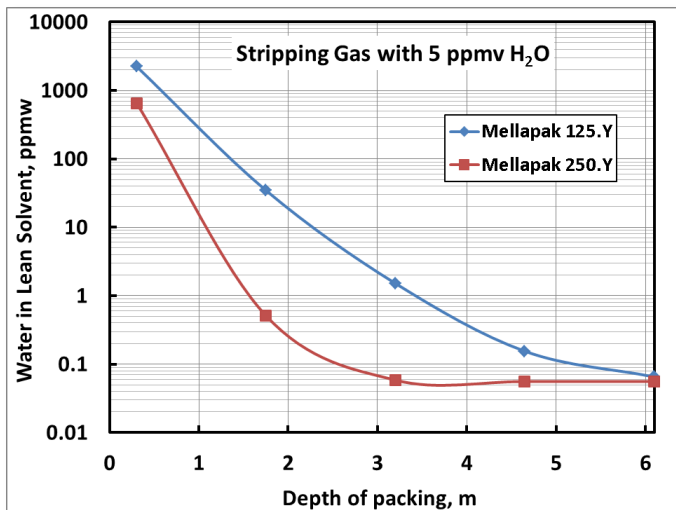


Figure 3 Effect of Bed Depth on TEG Dryness

about 6 meters. This is essentially in line with the relative specific surface area of these two packings. As Figure 2 shows, the solvent dryness profile has almost reached the 0.06 ppmw water level by a depth of 6 meters in the bed of Mellapak M125.Y packing for stripping gas entering with 5ppmv water content.

Although not simulated for this brief study, increasing the stripping gas rate has an effect on final solvent dryness similar to what is seen in Figure 2 for packed bed depth. There is a stripping gas rate above which increasing the gas rate ceases to produce a drier solvent because the solvent is already as dry as the given stripping gas composition can achieve. In other words, once near equilibrium conditions are reached, any further increase in gas rate has no measurable effect.

It is quite evident that treating a Stahl column as ideal stages of contact is a gross oversimplification that will almost inevitably lead to wrong simulation results. Residual water content of the glycol decreases exponentially with distance along the bed, i.e. with packed bed depth. It is important to get the solvent dry enough because this parameter has a large influence on the ability to dry the gas being treated. One would have to have extraordinary good luck to guess correctly the right bed depth, or even a sufficient bed depth, for the Stahl column on the basis of ideal stage and efficiency concepts.

ProTreat® mass transfer rate-based simulation precisely models and predicts the mass transfer performance of an enormous range of commercial packings. Here we have shown how it predicts the effect of packing size and packed bed depth as well as the dryness of the stripping gas on the performance of a Stahl column for TEG stripping to very low residual moisture levels. ProTreat's mass transfer rate approach puts designers and operators in the unique position of being able to model Stahl columns with unprecedented accuracy and reliability.

To learn more about this and other aspects of gas treating, plan to attend one of our training seminars. Visit www.protreat.com/seminars for details.

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