# The CONTACTOR™

*Published Bimonthly by Optimized Gas Treating, Inc.*
*Volume 6, Issue 6, November, 2012*

## Projected Performance Curves for a Planned LNG Plant

One of the most effective solvents for $CO_2$ removal in LNG production is piperazine-promoted MDEA. This issue of The Contactor takes a detailed look at expected performance and how trays and packing yield different expectations. The case focuses on an absorber treating methane (84%), ethane (10%), and propane (4%) containing 2% $CO_2$ on a dry basis to a specification of <50ppmv $CO_2$. The proposed column has 60 feet of IMTP-50 random packing, sized for 80% of flood.

Three sets of simulations were run at a series of solvent rates, but with each set having a constant value of $CO_2$ lean loading, as shown in the legend in Figure 1. At each lean loading, the absorber failed to treat adequately if the solvent rate was too low. This is as one should expect, because at too low solvent flows the solvent has inadequate capacity. This makes the column rich-end pinched. But there is a "sweet spot". Why?

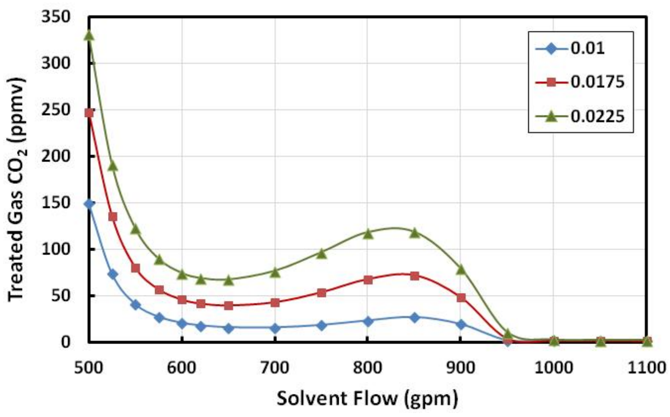


Figure 1 How Absorber Performance Depends on Amine Rate at Various Lean Loads

The temperature profile at 500 USgpm is shown in Figure 2. Increasing solvent flow improves treating, and if the lean loading is low enough there is adequate capacity to achieve <50 ppmv $CO_2$. But as solvent flow is increased further, the temperature profile deforms into the shape in Figure 3 at 800 USgpm and into Figure 4 at 1,000

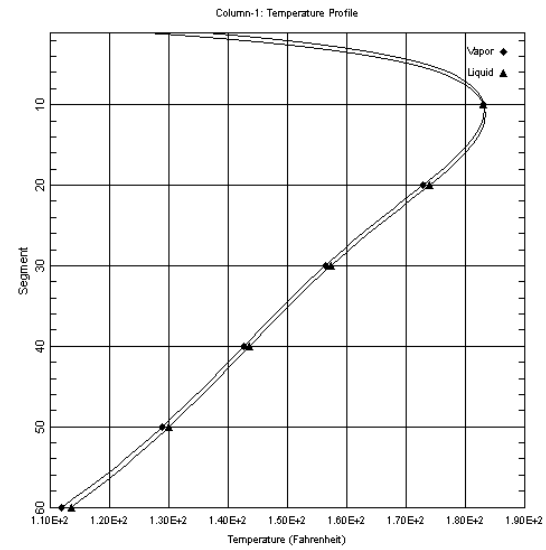


Figure 2 Temperature Profile at 500 USgpm

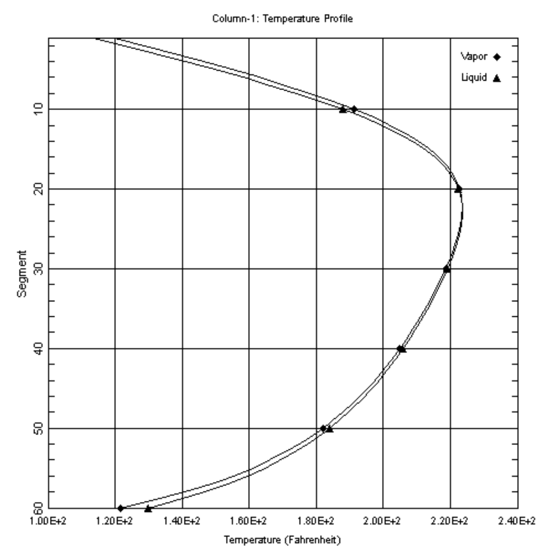


Figure 3 Temperature Profile at 800 USgpm

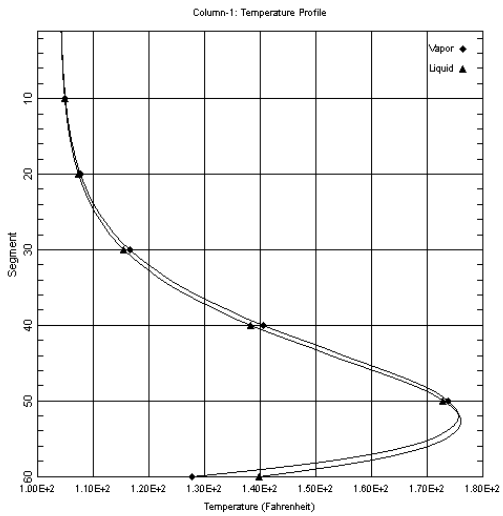


Figure 4 Temperature Profile at 1,000 USgpm

USgpm. The absorber goes from severely rich-end pinched to the more commonly seen lean-end pinch via the bulge pinch of Figure 3. In a *bulge* pinched situation, the temperature in the central part of the column is so high, only the ends are effective in removing $CO_2$, and the center part of the column does nothing. In this particular case, the column will behave as though it has perhaps 30 or 40 feet of packing, not the 60 feet specified. As solvent rate increases, the temperature bulge gets pushed further down the column, and the absorber becomes lean-end pinched where treating is determined primarily by solvent lean loading. In this particular case, the treated gas was 40–45 ppmv $CO_2$ over the flow range from 600 to 700 USgpm but the way to respond to the gas going off-specification may *not* be to increase solvent rate, but rather, it may be to decrease it, or perhaps to increase reboiler steam or hot oil flow. Without a detailed operating diagram such as the one in Figure 1, operations could probably not do much more than guess at the correct response and hope for the best.

The behavior of trayed columns is a little different from packed. With packing, as the solvent flow is increased, the wetted, interfacial area rises as well, and for this reason the absorption rate increases with solvent flow. With trays, gas-liquid interfacial area for mass transfer is only a relatively weak function of liquid rate and the performance curve typically looks like Figure 5. Note the logarithmic scale. There is no maximum because the liquid-rate dependence upon area is insufficient to drive higher absorption rates and torment the central, flat region into becoming a peak. Nevertheless, there are still lean-end, bulge, and rich-end pinch conditions at the low, medium and high solvent rates like those seen in Figures 2 to 4. Under the conditions of the simulation results of Figure 5, none of this really matters; however, if the lean loading were to become too high, one might have to operate at nearly twice the flow of very lean solvent to achieve the <50 ppmv specification.

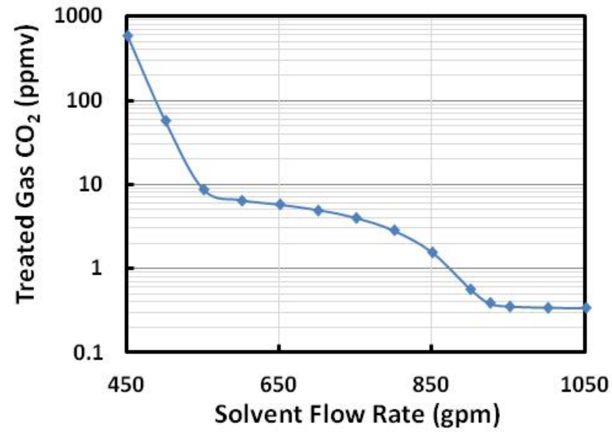


Figure 5 Performance of a Trayed LNG Absorber with 0.015 Lean Loading

The difference between packing and trays and, indeed the effect of packing type and size can be very important in the design of LNG facilities. If your simulator is not genuinely based on mass transfer rates, all of this will be missed, all trays and packings will be treated as ideal stages, the differences will not be apparent, the design will be subject to considerable uncertainty, and in the worst case, the plant may not work at all.

Plant simulation and analysis are holistic because the entire treating plant is examined all at once, or at least the isolated equipment item is examined and analyzed using a simulation tool that is based on considering *all* the factors that affect its performance, without idealizations or unwarranted approximations. The *ProTreat*® simulator is the only available, proven, commercial tool that allows this to be done for gas treating in a computationally robust and completely reliable manner. There is no reason to risk failure using inadequate tools when the right tool is available at quite modest cost.

~.~.~.~.~.~.~.~.~.~.~.~.~.~.~.~~.~.~.~.~.~.~.~

To learn more about this and other aspects of gas treating, plan to attend one of our free seminars. Visit www.ogtrt.com/seminars for details on free one-day seminars in Calgary, Denver, Los Angeles, and Houston being presented in 2012.

***ProTreat® and The Contactor™ are trademarks of Optimized Gas Treating, Inc.***