The CONTACTOR™

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Corrosion Troubleshoot

The April, 2015 issue of The Contactor™ discussed the reason for the surprisingly high amine strength found in the fully-lean stream coming from the regenerator in a split flow treating plant. The present issue discusses another cause of unusually high amine strength in a normally-configured, single circuit treating unit. This subject was suggested by John Corley of ExxonMobil's Baytown Refinery.

Case Study: Reboiler Corrosion

This is a refinery DEA unit in which extremely high corrosion rates were being experienced in the reboiler. The solvent was nominally 25 wt% DEA which entered onto the fourth tray of the 23-tray regenerator at 210°F. The upper three trays were wash (reflux) trays intended to recover any DEA from the vapor. The regenerator head pressure was 18 psig.

Symptoms

Corrosion rates in the reboiler were extremely high. However, both the steam consumption and the lean solution acid gas loadings were normal. The clue was that the reboiler vapor-return line temperature was 10–12°F hotter than the reboiler feed temperature (and 10–12°F hotter than the temperature of the lean amine coming from the unit).

Diagnosis

Solvent is removed from the tower using a total draw-off pan below the bottom tray. This allows the tower sump to be used as surge volume for lean amine. Thus, the total liquid flow from the draw off pan is *supposed* to go to the reboiler. But what if the draw off pan was damaged and only a fraction of the flow went to the reboiler, with the rest falling into the tower sump? (From there, of course, the bypassed solvent would simply join the flow from the reboiler and all would be returned back to the absorber.)

We will look at this scenario using ProTreat® simulation to determine whether draw off pan damage is a plausible explanation. Figure 1 is a flowsheet representation of the regenerator with bypassing of solvent to the reboiler. The Divider block labelled "Draw Off Pan" allows a specified fraction of the flow from the draw off pan (effectively, a fraction of the tower bottoms) to bypass the reboiler and to leave the regeneration system without any further processing beyond what has already been done on the regenerator trays.

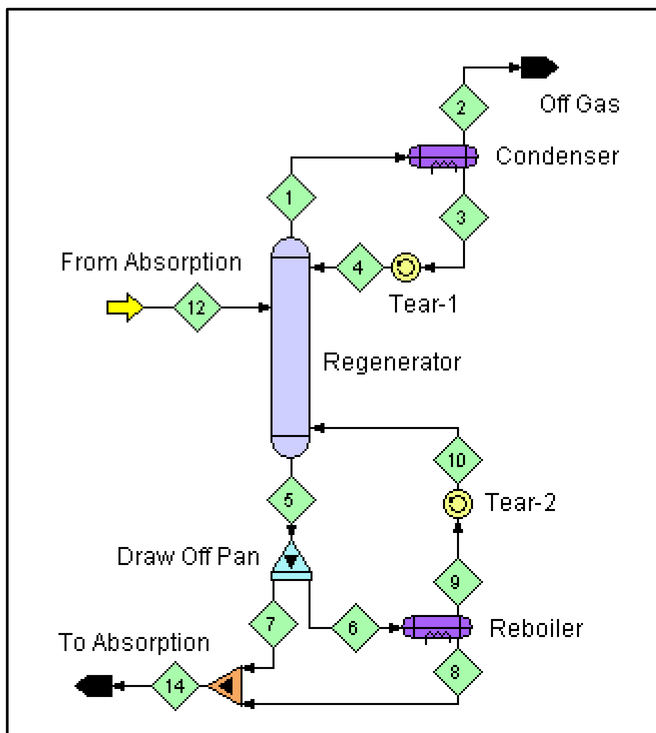

Figure 1 Regenerator with Reboiler Feed Bypassing

Stream 6 is equivalent to the stream from the draw off pan and Stream 9 is the vapor return. If the draw off pan were functioning properly, all of Stream 5 would flow to the reboiler and Stream 7 would have a zero flow rate. A number of simulations were run to determine the effect of various levels of draw off pan damage. The extent of damage was measured by the percentage of the flow entering the draw off pan that leaks from it.

Figure 2 shows how the temperature difference between the reboiler feed liquid and the vapor return line depends on draw off pan leakage. Figure 3 shows the effect on the wt% DEA actually in the reboiler.

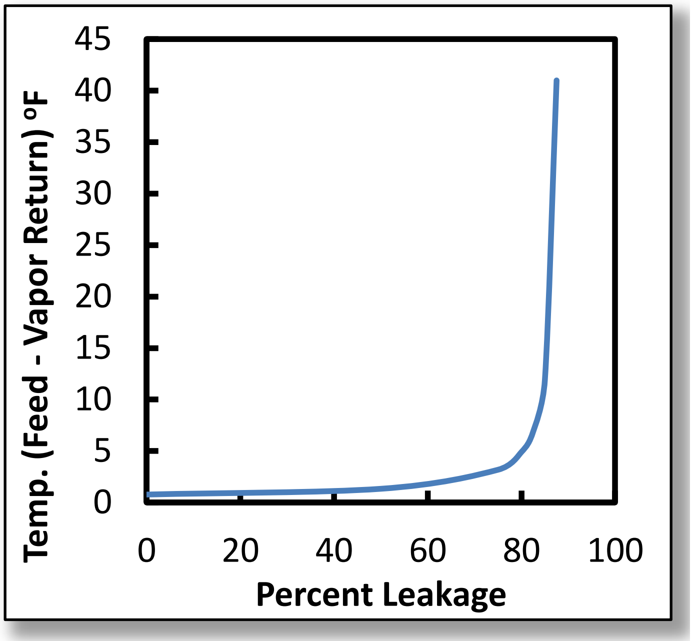

Figure 2 **Effect of Leakage on Feed vs. Vapor Return Temperatures**

Even a 50% leak rate is simulated to cause only a 1.3°F difference between the reboiler feed and vapor return temperatures but 80 and 85% leak rates will result in temperature differences of 5°F and 12°F, respectively. One can surmise therefore, that temperature measurements are probably not accurate enough to permit draw off pan leakage to be detected with any certainty until the pan is on the verge of being almost completely rotted out. Sampling the reboiler contents and measuring the DEA concentration is probably somewhat more reliable. Solvent strength can become very high indeed and a DEA concentration of 60 wt% is quite possible when the overall solvent strength is only 25 wt%. As Table 1 certainly shows, solvent lean loadings are barely responsive even to very high leakage rates.

It is easy to see that a nominal level of heat stable salts equal to 2 wt% can easily double or even triple in the reboiler. The combination of high amine strength, elevated temperatures, and very high heat stable salt levels will likely spell disaster for the reboiler in most amine units.

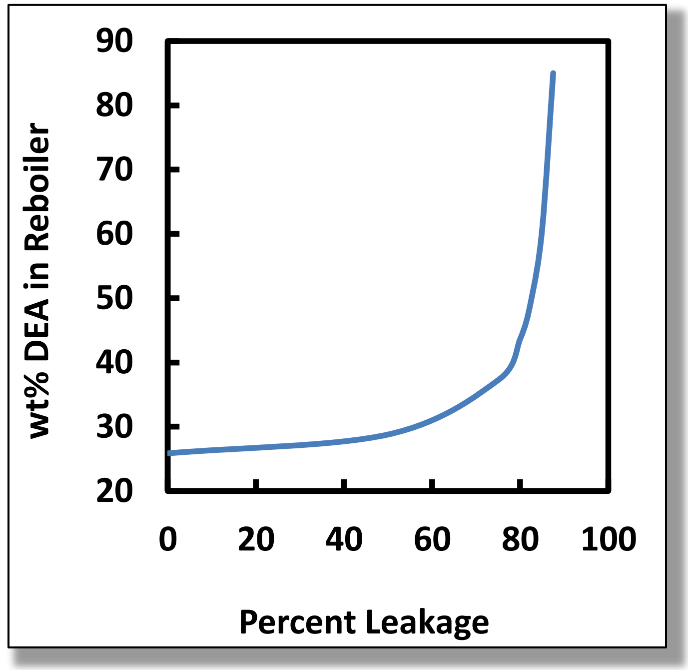

Figure 3 **Effect of Leakage on DEA Concentration in the Reboiler**

Table 1 Lean Solvent Acid Gas Loadings

Leakage (%)	H_2S Loading	CO_2 Loading
0	0.0320	0.00441
50	0.0360	0.00533
75	0.0380	0.00589
80	0.0385	0.00602
85	0.0388	0.00610
87.5	0.0390	0.00618

Simulation can be used very convincingly to diagnose some very unusual amine unit problems, and ProTreat's mass transfer rate basis is increasingly becoming the tool of choice because it accurately predicts conditions and compositions everywhere in the unit.

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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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