An Odd Regenerator?

This issue of The Contactor™ focuses on an MDEA regenerator. It draws attention to a peculiarity of processing using fully-lean and semi-lean amine streams (a so-called split flow configuration). In such a processing scheme it’s not unusual to find a much higher amine concentration in the fully-lean stream than in the normally higher flow rate, semi-lean solvent.

**Case Study: CO₂ Removal in a Gas Plant**

The case involves removing the H₂S from nearly 200 MMscfd of predominantly methane containing 5.5% H₂S and 4.8% CO₂ at about 55 barg. The total solvent flow is about 2,000 USgpm of nominally 48 wt% MDEA. Processing is in two parallel trains with each regenerator being fed with about 1,000 USgpm of rich amine with a total acid gas loading of 0.42 mol/mol. Of the total amine flow, 78% is withdrawn from part way down the regenerator and is sent to the corresponding absorber as semi-lean solvent. The remainder continues down the regenerator and exits from the reboiler as fully-lean solvent. The flow diagram in Figure 1 shows the piping arrangement for one of

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**Figure 1**

A Single Regenerator in a Parallel Train Split-Flow Amine System
the regenerators. The total solvent flow to one of the trains enters the top as Stream 64. Semi-lean is drawn from Tray 13 (from the top) of the tower as Stream 23 and is cross-exchanged against a fraction of the rich solvent which has been split from the total flow as Stream 12. The hot stripper bottoms (Stream 20) is cross-exchanged using the balance of the rich solvent flow (Stream 11).

The reboiler duty is sufficient to provide a reflux ratio of 1.07 and a stripping ratio of 1.14. The rich amine enters the regenerator at 48 wt% MDEA while semi-lean (Stream 23) is 46 wt% MDEA. Semi-lean leaves the regenerator with a lean loading of 0.01. Slight dilution of the amine is the result of the condensation of steam which provides the heat needed to drive stripping. The fully-lean solvent is predicted to have a total loading of 0.0013 but with amine strength of 66.6 wt%! The engineer running the simulation was surprised to see such a high MDEA concentration.

Sufficient steam must be provided to the upper section of the regenerator to heat the rich solvent to its bubble point, and to allow the bulk of the acid gases to be removed from the solvent while at the same time providing a value of the reflux ratio near unity. To achieve this, the reboiler must generate roughly 58,000 lb/h of steam. However, the side draw removes 78% of the solvent so 58,000 lb/h of water must be generated from only a relatively small solvent flow. This increases the MDEA concentration in the fully lean stream to nearly 67 wt%.

The lesson is that unless a split-flow plant is very carefully designed, one may find very high amine concentrations in the fully-lean solvent feeding the top of the absorber. If that happens, the solvent viscosity will be very high and absorption rates may be seriously reduced.

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