The CONTACTOR™

Published Quarterly by Optimized Gas Treating, Inc.
Volume 3, Issue 1, 2009

Acid Gas Enrichment — Process Strategies

Low quality (low H_2S) Claus Sulphur plant feeds present unique challenges to both designers and operating companies. Acid gas enrichment (AGE) is one group of methods that can be used to upgrade such feeds, or instead to produce a small-volume, concentrated stream suitable for reïnjection. Design is difficult because it's hard to predict *reliably* how a specific column will perform—each case is one-of-a-kind, and with fewer than 25 AGE plants in operation world wide, experience is limited.

Plant operations can be problematic because the usual stream to be enriched may consist of little more than a mixture of wet acid gases so, in principle, the entire stream can be absorbed. The acid gas from a regenerator is a typical example, and the fact that anything from none to all can be absorbed makes for a possibly sensitive response to control.

Process goals are: (1) Achieve the highest possible CO_2 slip to maximize enrichment potential, (2) Keep the H_2S leak in the treated gas leaving the absorber as low as possible to achieve the greatest H_2S recovery and flare the minimum sulfur. In other words maximize selectivity and minimize H_2S leak. The perfect process removes all the H_2S and none of the CO_2 because then the regenerator offgas is pure (wet) H_2S. The high selectivity achievable with MDEA makes it the obvious solvent choice[‡].

Both trayed and packed contactors have been used for AGE, usually in a treating plant separate from the main amine units, but sometimes on the same amine circuit and served by the same regenerator as a tail gas treater (Figure 1). Both operations require the same close attention to solvent purity and prevention of contamination.

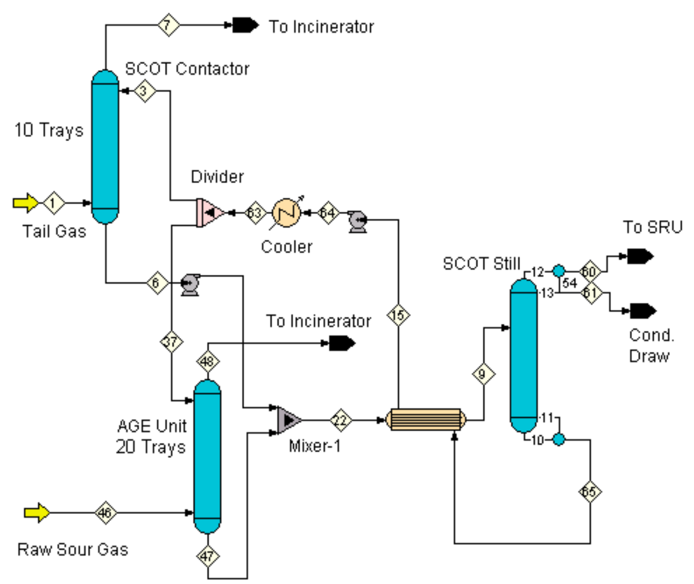

Figure 1 SCOT and AGE Units with Common Still

ProTreat™ simulation of this particular plant gave results in close agreement with operating data. The SCOT contactor was by far the biggest contributor to plant sulfur emissions. It was thought that perhaps a salt additive such as phosphoric acid might reduce the H_2S leak because it is an excellent stripping promoter and allows the regenerator to reach 10 – 100 times lower solvent lean loadings. However, this contactor was *not* lean-end pinched (i.e., was *not limited by lean solution acid gas loading*) and simulation showed that phosphoric acid would provide no benefit—in fact, it would cause sulfur emissions to increase. Simulation of the base case with generic MDEA indicated that a sulfur plant feed of 83% H_2S could be achieved from a raw acid gas of 48% H_2S and a tail gas of 1.3% H_2S.

The rich solvent from a SCOT contactor is almost always very lightly loaded and it seems a waste to send it immediately to the stripper for

‡ There are other more selective amines, such as the family of FLEXSORB® solvents (registered trademark of ExxonMobil Corp.), but they are proprietary, and of publicly undisclosed composition.

regeneration. Therefore, a process called DUAL-SOLVE was developed by URS Washington Group. In the example, amine from the SCOT contactor (Stream 6 in Figure 2) goes to tray 14 from the top of the AGE absorber. Other variables are unchanged.

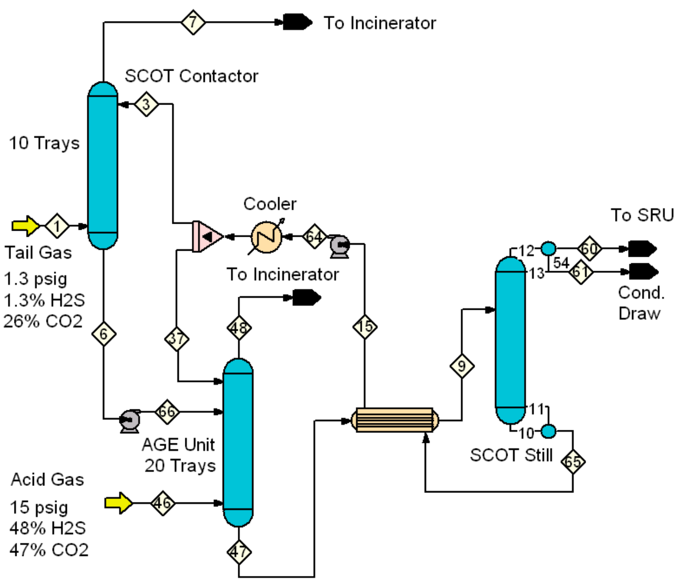

Figure 2 DUAL-SOLVE Process Flow Diagram

ProTreat showed that this simple rerouting would result in a 20% lower solvent circulation rate, a 10% reduction in reboiler duty, and 40% less lean/rich exchanger area. Sulfur emission and SRU feed quality remained the same. But there are other schemes that can provide even more benefit.

One such innovation is HIGHSULF™ due to Khanmamedov, disclosed initially in US 5,556,606 and discussed in numerous subsequent publications and patents—see Khanmamedov and Weiland, Sulphur 318, Sep–Oct., 2008 for a bibliography. The basic scheme is a very interesting one, involving the recycle of a portion of the acid stream produced by the regenerator, back to the AGE absorber for reprocessing. The principle is simple: if the absorber is fed with a higher H_2S content stream, it will yield a rich solvent containing more H2S and the regenerator will produce an enriched SRU feed.

Using now an (8% H_2S + 92% CO_2) Raw Acid Gas stream to the AGE absorber (instead of the 48% H_2S stream as in the previous cases), the effect of the amount recycled was determined. Without recycle, the SCOT Still in the original plant (Figure 2) produced a 40% H_2S feed to the SRU. ProTreat simulation of the effect of % Recycle (percentage of the SCOT still acid gas stream) on SRU feed quality is shown in Figure 3. All simulation results in the figure were obtained under identical process conditions. At 70% recycle the SRU feed quality can be raised from 40% to 70% H_2S and there seems to be no end in sight. However, the leak from the AGE contactor will also be going up. As seen in Figure 4, ultimately H_2S breaks through the contactor and the H_2S leak skyrockets. There is a practical limit even to acid gas recycle. But, the results are spectacular and HIGHSULF warrants serious consideration.[§]

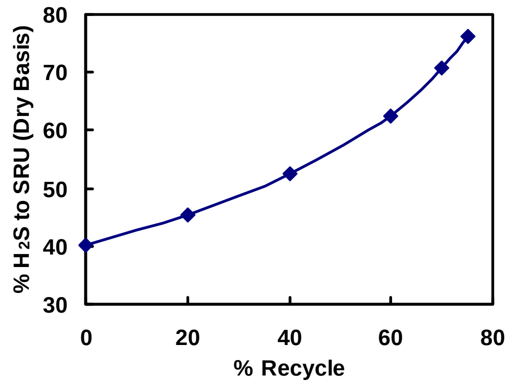

Figure 3 Effect of Acid Gas Recycle on SRU Feed

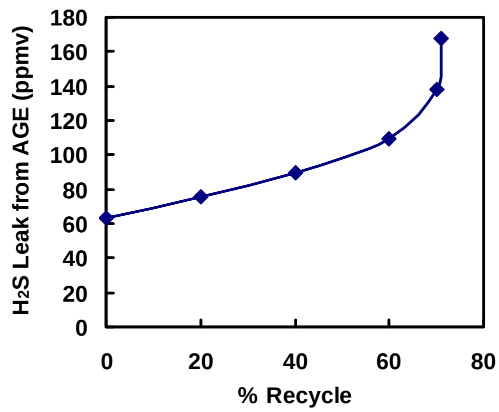

Figure 4 Effect of Recycle on AGE Unit H_2S Leak

ProTreat simulated these schemes easily and results agreed well with available performance data.

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

™ HIGHSULF is a trademark of TKK Company

§ HIGHSULF technology is covered by US and other patents and may not be applied except under license or other arrangement with TKK Company (www.tkkcompany.com/).