Selecting the best amine/solvent for gas treating is not a trivial task. There are a number of amines available to remove contaminants such as CO₂, H₂S and organic sulfur compounds from sour gas streams. The most commonly used amines are methanolamine (MEA), diethanolamine (DEA), and methyldiethanolamine (MDEA). Other amines include diglycolamine® (DGA), diisopropanolamine (DIPA), and triethanolamine (TEA). Mixtures of amines can also be used to customize or optimize the acid gas recovery. Temperature, pressure, sour gas composition, and purity requirements for the treated gas must all be considered when choosing the most appropriate amine for a given application.

**Primary Amines**

The primary amine MEA removes both CO₂ and H₂S from sour gas and is effective at low pressure. Depending on the conditions, MEA can remove H₂S to less than 4 ppmv while removing CO₂ to less than 100 ppmv. MEA systems generally require a reclaimer to remove degraded products from circulation. Typical solution strength ranges from 10 to 20 weight % with a maximum rich loading of 0.35 mole acid gas/mole MEA. DGA® is another primary amine that removes CO₂, H₂S, COS, and mercaptans. Typical solution strengths are 50-60 weight %, which result in lower circulation rates and less energy required for stripping as compared with MEA. DGA also requires reclaiming to remove the degradation products.

**Secondary Amines**

The secondary amine DEA removes both CO₂ and H₂S but generally requires higher pressure than MEA to meet overhead specifications. Because DEA is a weaker amine than MEA, it requires less energy for stripping. Typical solution strength ranges from 25 to 35 weight % with a maximum rich loading of 0.35 mole/mole. DIPA is a secondary amine that exhibits some selectivity for H₂S although it is not as pronounced as for tertiary amines. DIPA also removes COS. Solutions are low in corrosion and require relatively low energy for regeneration. The most common applications for DIPA are in the ADIP® and SULFINOL® processes.

**Tertiary Amines**

A tertiary amine such as MDEA is often used to selectively remove H₂S, especially for cases with a high CO₂ to H₂S ratio in the sour gas. One benefit of selective absorption of H₂S is a Claus feed rich in H₂S. MDEA can remove H₂S to 4 ppm while maintaining 2% or less CO₂ in the treated gas using relatively less energy for regeneration than that for DEA. Higher weight percent amine and less CO₂ absorbed results in lower circulation rates as well. Typical solution strengths are 40-50 weight % with a maximum rich loading of 0.55 mole/mole. Because MDEA is not prone to degradation, corrosion is low and a reclaimer is unnecessary. Operating pressure can range from atmospheric, typical of tail gas treating units, to over 1,000 psia.

**Mixed Solvents**

In certain situations, the solvent can be “customized” to optimize the sweetening process. For example, adding a primary or secondary amine to MDEA can increase the rate of CO₂ absorption without compromising the advantages of MDEA. Another less obvious application is adding MDEA to an existing DEA unit to increase the effective weight % amine to absorb more acid gas without increasing circulation rate or reboiler duty. Many plants utilize a mixture of amine with physical solvents. SULFINOL is a licensed product from Shell Oil Products that combines an amine with a physical solvent. Advantages of this solvent are increased mercaptan pickup, lower regeneration energy, and selectivity to H₂S.

**Choosing the Best Alternative**

Given the wide variety of gas treating options, a process simulator that can accurately predict sweetening results is a necessity when attempting to determine the best option. ProMax® has been proven to accurately predict results for numerous process schemes. Additionally, ProMax can utilize a scenario tool to perform feasibility studies. The scenario tool may be used to systematically vary selected parameters in an effort to determine the optimum operating conditions and the appropriate solvent. These studies can determine rich loading, reboiler duty, acid gas content of the sweet gas, amine losses, required circulation rate, type of amine or physical solvent, weight percent of amine, and other parameters. ProMax can model virtually any flow process or configuration including multiple columns, liquid hydrocarbon treating, and split flow processes. In addition, ProMax can accurately model caustic treating applications as well as physical solvent sweetening with solvents such as Coastal AGR®, methanol, and NMP. For more information about ProMax and its ability to determine the appropriate solvent for a given set of conditions, contact Bryan Research & Engineering.

For more information about this study, see the full article at www.bre.com/support/technicalarticles

ProMax® process simulation software by Bryan Research & Engineering, Inc.

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