



The CONTACTOR™

Published Monthly by Optimized Gas Treating, Inc.
Volume 13, Issue 10, October, 2019

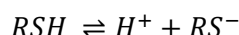
Removing Mercaptans

Removing even small amounts of mercaptans (also known as thiols) using amines can be challenging and the extent of removal hard to understand. We are often asked whether you can remove mercaptans with amines. This issue of The Contactor™ explores the answer to that question.

What Are Mercaptans?

Mercaptans (thiols) are sulfur compounds consisting of a hydrocarbon group (most commonly a methyl, ethyl, propyl, or butyl group) attached to an -SH functional group. Being sulfur containing compounds, they count towards the total sulfur emission from a plant. Mercaptans can push the sulfur content into the region where the fuel exceeds sulfur limits. Thus, it can be critically important to remove them, and they are certainly important in assessing the sulfur content of the fuel being produced.

When they dissociate in water, acids produce hydrogen ions; whereas, bases produce hydroxyl ions. Mercaptans are acids because they dissociate to produce hydrogen ions in water:



Mercaptans are relatively weak acids because they have pK_a^\dagger values of about 10.6 at 25°C. For reference, hydrogen sulfide[‡] has a pK_a of about 7.0 at 25°C, making it a much stronger acid. Being weak acids means that an alkaline solvent such as aqueous MEA or MDEA has the *potential* to remove mercaptans from a gas (or liquid, in a treater for example). The question is why it's so hard to do.

Effect of H₂S on Removal of Mercaptans with MEA

Figure 1 shows the ability of pristine, H₂S-free, 20 wt% MEA to remove mercaptans from fuel gas. The plot was generated using ProTreat® by flashing 20 wt% MEA having various H₂S loadings combined with a fixed flowrate of 5 mol% MeSH in nitrogen at the same 100°F and 0 psig. Figure 1 shows the dependence of the MeSH content of the flashed gas on the H₂S loading of the solvent. The parameter in this plot is the MeSH loading of the flashed solvent so each line corresponds to what is essentially a bubble point calculation.

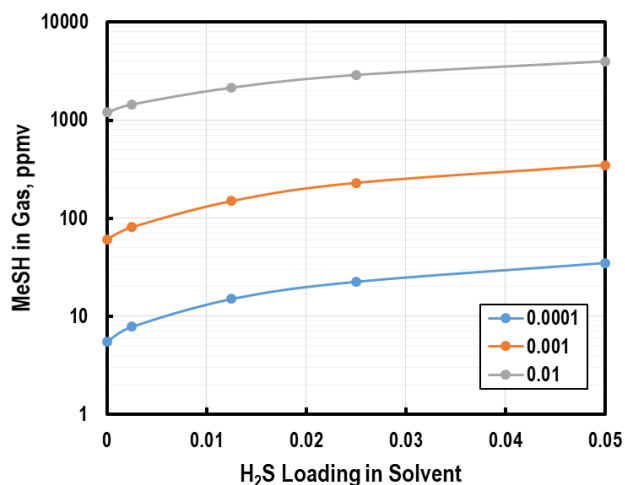


Figure 1 MeSH Removal with 20 wt% MEA Solvent. Removal is Very Poor Using Amines.

It is readily apparent that to achieve a treated gas with only a few ppm MeSH one must keep the H₂S loading as low as possible and use a lot of solvent to maintain an extremely low total mercaptan content. In other words, the capacity of the solvent for mercaptan is exceedingly small and the H₂S content must be kept low as well. Aqueous amines are definitely unsuitable for removing a significant amount of mercaptan. What is needed is either an organic or a hybrid solvent containing enough organic component to solubilize the mercaptan (and COS, CS₂ etc.) species. Hydrocarbons and especially aromatics will be solubilized, too. The inability of aqueous amines to remove mercaptans is valid pretty much regardless of the amine being considered.

To learn more about this and other aspects of gas treating, plan to attend one of our training seminars. Visit www.pro-treat.com/seminars for details.

ProTreat® and The Contactor™ are trademarks of Optimized Gas Treating, Inc. Any other trademarks are the property of their owner.

[†] pK_a is the negative logarithm of the dissociation constant in water.

[‡] Hydrogen sulphide is hydrogen thiol. It is the simplest thiol, with the hydrocarbon group replaced by a hydrogen atom.