

**ULTRALEAN™ AMINE
ZERO RESIDUAL ACID GAS LOADING**

By

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TYPICAL SYSTEM

As shown in Figure 1, the UltraLean™ Process is an “add-on” to any conventional amine Absorber/Stripper Arrangement. A slipstream of 5% to 10% of the normal lean amine flow is diverted to the MPR Process Unit where the remaining Residual Lean Loading (H_2S , CO_2) is removed. This essentially pure amine stream is now used for enhanced acid gas removal from natural gas.

The example presented is for two amine Absorbers in a common system with one amine stripper. For illustration, one of the Absorbers is defined as the Fuel Gas Sweetening Absorber. With the tightening SO_2 emissions regulations, it will become necessary to reduce the H_2S content in gas used for combustion. UltraLean™ Amine can solve this problem without affecting the design and operation of the existing system. By taking a small slipstream of the lean amine that was previously flowing to the existing Fuel Gas Absorber, and then removing essentially all of the residual acid gas that was not removed during the normal stripping operation, an amine is produced with enhanced Absorption capability. The result is that the vapor/liquid equilibrium on the top tray of the new ULA Absorber will be markedly shifted in favor of increased acid gas absorption. Typical improvements would be reductions in the H_2S content in the Sweet Fuel Gas from 300 ppmv to 30 ppmv, 150 ppmv to 4 ppmv, and 30 ppmv to 0.5 ppmv. Essentially any desired improvement can be obtained.

ADDITIONAL BENEFITS

The MPR Processing System does more than just remove the Residual Lean Loading from the amine. It also removes:

- Heat Stable Salts
- Suspended Solids
- Hydrocarbons

A beneficial consequence of the production of UltraLean™ Amine is that all impurities are removed. In fact, impurities are removed from the entire amine system. Even though only a slipstream of the amine system is being processed, over a short period of time the entire amine system will be treated. The HSS incursion rate, the HSS concentration, and the HSS removal rate will come into balance such that the entire amine system solution will be maintained in nearly new condition.

Removal of the Heat Stable Salts (HSS) (and other impurities) does not result in loss of amine. The regeneration method utilized in this Patented Process [1] releases bound amine from the HSS, recovers the amine, and returns the amine to the system. Amine losses previously associated with the necessity to purge salts from the system (and then to be replaced with costly new amine make-up) will be eliminated. With all mols of amine now “un-bound”, the total system capacity for acid gas removal is expanded.

Removal of the Suspended Solids (SS) from the total amine system will reduce foaming. Solids promote foaming directly and also act as a miscible agent to prevent the easy separation of hydrocarbons from amine solutions. Hydrocarbons also promote foaming. The removal of SS by the MPR Unit will greatly extend the life of the existing plant filters.

Removal of Hydrocarbon from the amine system, as indicated above, will reduce foaming and eliminate the need for antifoam agents.

Although corrosion is primarily caused by the contained acid gases, the removal of impurities will aid in corrosion reduction by the following mechanism. The thin layer of Iron Sulfide passivation formed by the reaction of H₂S with carbon steel, which normally protects piping, and equipment, can be removed by the washing action of salts and solids in solution (particularly if high liquid flow velocities are also occurring). Therefore, the removal of Heat Stable Salts and Suspended Solids will help to preserve the passivation layer.

APPLICATIONS

The Process can be used in conjunction with most of the commercially available Gas Treating Solvents including:

MEA	DGA
DEA	Sulfinol
MDEA	Flexsorb
DIPA	

The example presented in Figure 1 was for Fuel Gas Sweetening. Other potential applications would be for SRU Tail Gas Treating Units, Ammonia Plants, FCC Absorbers, Increased Protection of Catalysts for which H₂S is a poison, Reduction in Over-Stripping, LPG Treating, and SO₂ Removal. SO₂ Removal may not be an obvious application. Previously, conventional amines have not been used to directly remove SO₂ from gases because the Heat Stable Salt that is formed between amine and SO₂ was not regenerable resulting in a continuous loss of amine. The ULA System will recover the amine from the bound HSS such that the amine is not lost. Please refer to Figure 2 for an example of a potential SO₂ Removal/Recovery System for small SRU facilities in the size range of 2.0 to 20.0 LT/D. Another application is the substitution of a less expensive Treating Solvent while obtaining the same or better acid gas removal. The absorption enhancement provided by the removal of the Lean Loading can increase the performance of Amine Gas Treating Solvents that previously could not meet desired specifications.

REGENERATION

The processing unit is designed to operate continuously “on-line”. However, there is a periodic requirement to reactivate the absorption media. There are two parallel Absorption Towers, one of which will be in the Absorption Mode while the alternate Tower is in Regeneration. Regeneration is a sequence of several steps including water rinsing and caustic treating. Approximately 50% of the rinse water is returned to the amine system in place of the normally required amine system water make-up. The remaining rinse water along with the caustic used for reactivation leaves the unit as a slightly basic, dilute brine solution containing various sodium salts. This stream can normally be routed to the wastewater treatment facility for final disposal.

ACKNOWLEDGMENTS

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2. J.C. (Jack) Dingman, Vice President, Optimized Gas Treating, Inc., for use of the “ProTreat” Amine Simulation Software in the detailed performance evaluations of numerous amine systems.

REFERENCES CITED

1. MPR Services, Inc. is the owner and/or exclusive licensee of the following patents: US 5,788,864; US 5,208,164; US 5,368,818; US 5,190,662; US 5,162,084; US 5,006,258; US 5,045,291; US 4,970,344; US 6,071,484. UltraLeanTM is a Trademark of MPR Services, Inc.

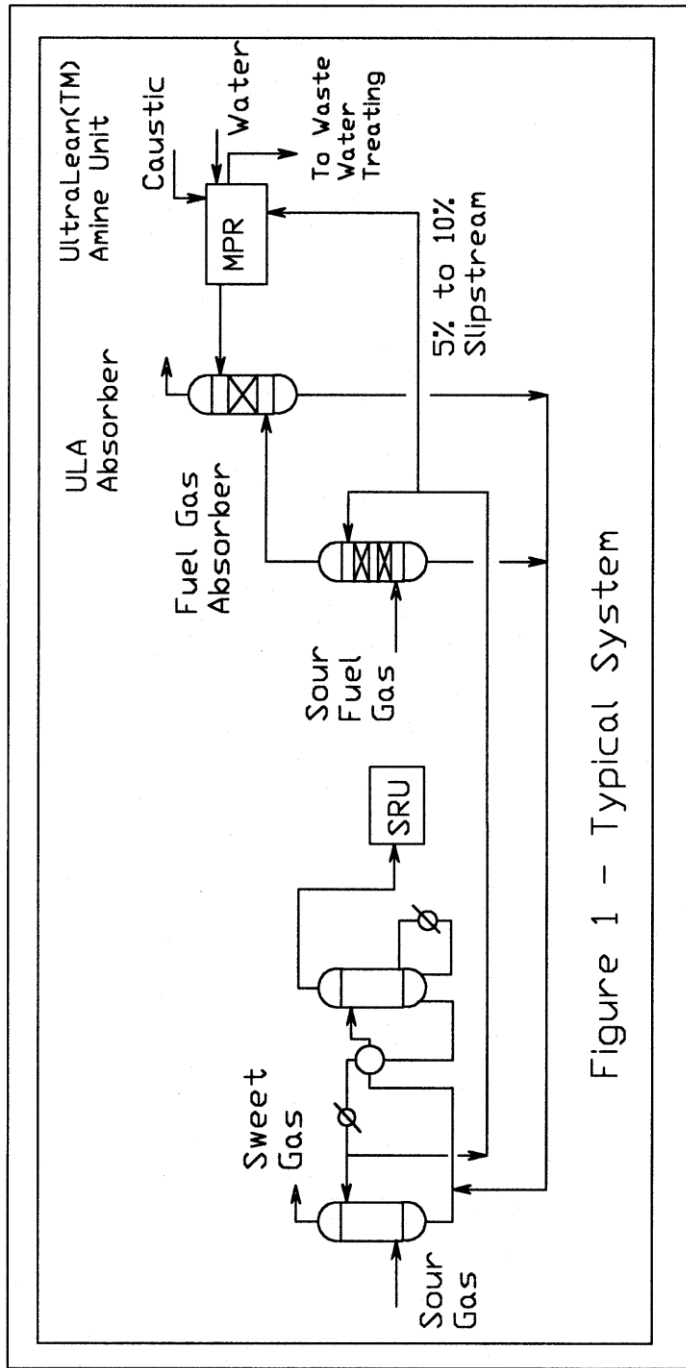


Figure 1 - Typical System

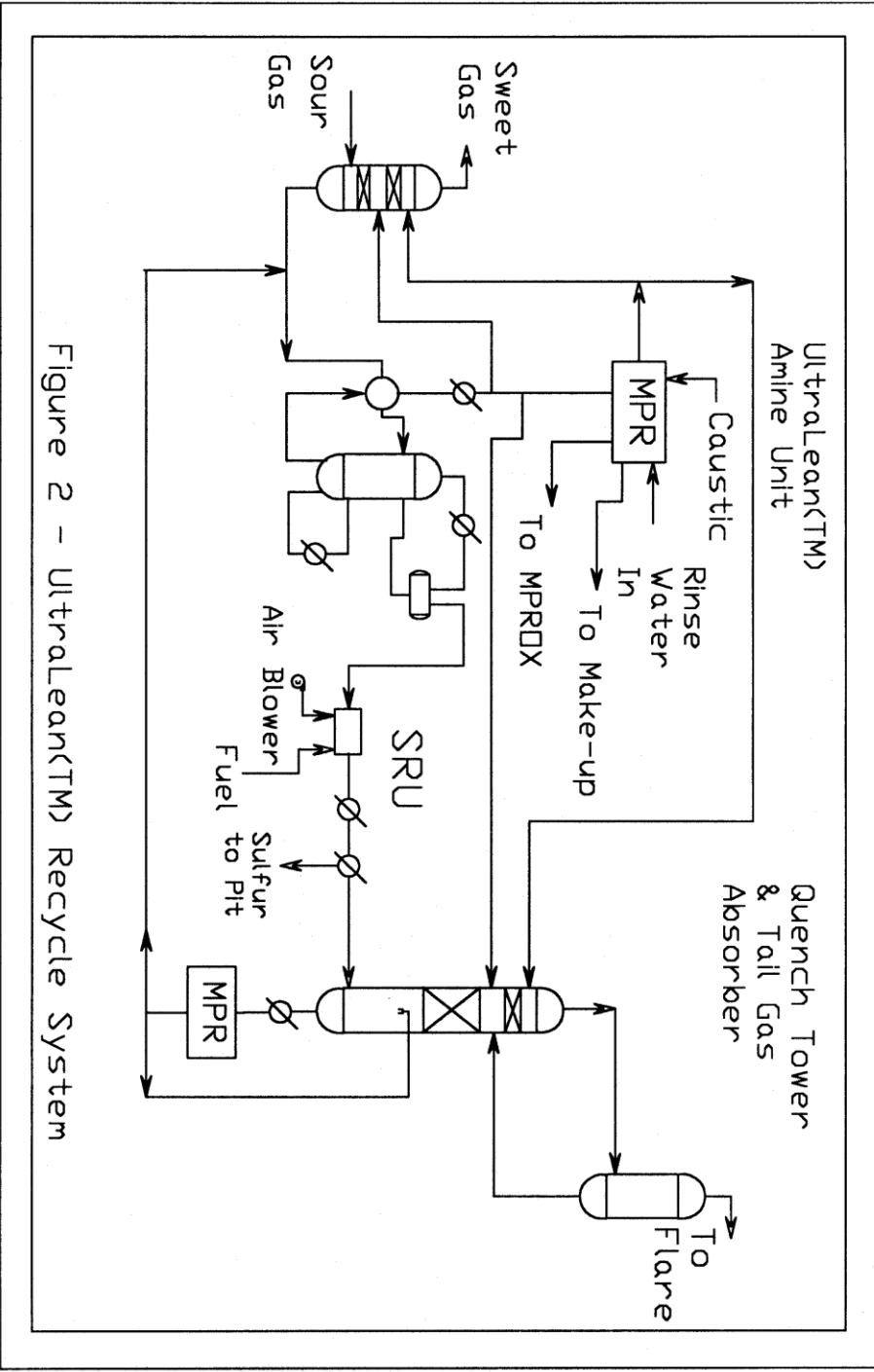


Figure 2 - Ultralean™ Recycle System