

FULL LENGTH ARTICLE

Simulation and Optimization of Sour Gas Processing

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ABSTRACT

Selection of an amine for gas sweetening is complex and must be based on several process considerations. These factors are analyzed based on process simulation program for gas sweetening called TSWEET. Providing MEA concentration from 15-20 wt% with the steam ratio from 0.8 to 1.0 lb/gal it was found that the H₂S content in sweet gas stream as well as MEA circulation rate decreases. Processing with MDEA it is possible to reduce circulation rate as a result process cost decreases. TSWEET used to examine the performance of other amines. A mixture of 20-50 wt% MDEA and 0.5 wt% Phosphoric acid yields a sweet gas with less than 4.0 ppm H₂S and 0.7% Carbon dioxide whereas rich loading is below 0.5 which is reasonable. The blending with Phosphoric acid would likely be the most desirable choice for this application. This can be safely operated over a wide range of concentration.

Keywords: TSWEET, Sour Gas, MEA

INTRODUCTION The art of using alkanolamines for removal of hydrogen sulfide and carbon dioxide from natural gases has been used for decades. Since the 1960's and 70's several amines have come into general use, however, limited information has been reported in the literature concerning the amine best suited to a particular service. Many amine units which are operating very inefficiently could be optimized by simply changing amines [1].

The basic flow scheme for an amine sweetening unit is shown in above Fig. No.1 In the design of the process, the primary concern is that the sweetened gas meet the required purity specifications with respect to H₂S and CO₂. The secondary objective is to select the amine which optimizes equipment size and minimizes plant operating costs. Some of the factors to be considered in the selection of the proper amine for design or existing plant evaluation include:

1. Can the amine circulation rate be reduced by selecting an amine which may be used at a higher concentration and/or solution acid gas loading?
2. Could the reboiler/condenser size and duty be minimized by use of an amine which requires a lower circulation rate, and/or which has lower heats of reaction with H₂S and CO₂?
3. If the sales gas specifications allow, could H₂S be selectively absorbed from the sour gas while rejecting CO₂?

Can the H₂S and CO₂ absorption from the sour gas be optimized by use of an amine mixture?

4. Do corrosion problems exist? If so, is there an amine or mixture of amines more resistant to degradation which can be used to minimize corrosion problems and reduce solution losses?
5. Could an alternate flow scheme increase the efficiency of the process (i.e. split flow, absorbers in series or parallel, use of a precontactor for bulk CO₂ removal, or bulk CO₂ removal using a pressure swing plant with no stripper?)

A 50 to 70% of the initial investment for an amine sweetening unit is directly associated with the magnitude of the solvent circulation rate, and another 10 to 20% of the initial investment is dependent on the regeneration energy requirement [2].

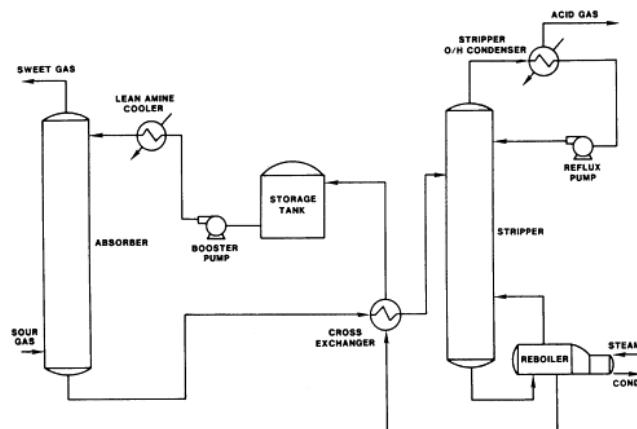


Fig.No.1 Process flow sheet for common sweetening plant

GENERAL CONSIDERATIONS FOR SELECTING AMINES:

The general criteria for amine selection in sweetening plants have very much important issues and updated over the years. Until the 1970's monoethanolamine (MEA) was the amine first considered for any sweetening application. Then switching from MEA to ethanolamine (DEA) yielded favorable results [3-4]. In the era the MDEA, DGA, and mixed amines have steadily gained popularity. As different operating conditions were tested and proven with a particular amine, adopted on an industry-wide basis

POPULAR CHEMICAL SOLVENTS:

Nearly all chemical solvents used for gas sweetening are alkanolamines. An amine is an ammonia molecule (NH_3) with one, two or all three of the hydrogen atoms replaced by some other substituent shown in Fig. No. 2. Amines are classified as primary, secondary or tertiary depending on the number of substituents.

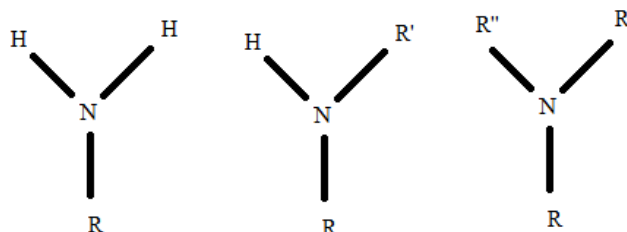


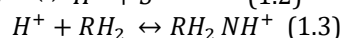
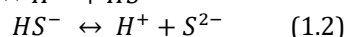
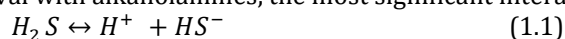
Fig. No.2: Different types of amines: primary (left), secondary (middle) and tertiary (right)

The nitrogen atom on an amine group contains a lone pair of electrons, and this lone pair is free to interact with surrounding molecules. As substituents are added, this lone pair becomes more stable (delocalized), which decreases its affinity for surrounding molecules. Thus, primary amines generally interact most aggressively with their surroundings, while tertiary amines are typically the least aggressive of the three.

When one or more of the amine substituents is an alcohol, the molecule is referred to as an "alkanolamine". Alkanolamines are very effective at selectively removing acid gases from gas streams. In practice they are diluted with water, with the amine content typically ranging anywhere from 10 to 70% by

mass. Adding water reduces the viscosity and corrosivity of the solution to within acceptable limits, and also reduces the hydrocarbon solubility [5]. In addition, it makes regeneration much easier, since the acid gases are better able to vaporize if there is also a relatively large volume of water being vaporized as well.

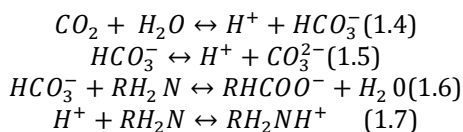
The specific chemical reactions between acid gases and an alkanolamine can be expressed in a variety of different ways. For H_2S removal with alkanolamines, the most significant interactions are the following:



In these reactions, H_2S is first ionized, after which the hydrogen ions interact with the lone pair of electrons on the nitrogen atom. This stabilizes the hydrogen ions in solution and prevents them from recombining back into H_2S molecules. The result is that H_2S molecules are drawn from the gas into solution. Note that Reaction (1.3) refers specifically to primary amines but applies to both secondary and

tertiary amines as well, only with one or both of the H atoms on the amine replaced with an arbitrary R group.

For CO₂ removal with alkanolamines, the most significant interactions are the following:



Note that Reactions (1.3) and (1.7) are identical (i.e. the same reaction contributes to both H₂S and CO₂ removal). Also, Reaction (1.6) is for primary amines but with the proper modification it also applies to secondary amines. It does not, however, apply to tertiary amines. The latter can only absorb CO₂ by attracting hydrogen ions and thereby promoting Reactions (1.4) and (1.5). Because of this, tertiary amines typically absorb much more H₂S than CO₂, a fact which is leveraged whenever CO₂ removal is of lesser concern.

As evidenced by these reactions, it is generally the nitrogen atom of an alkanolamine that drives the acid gas removal. The alcohol groups serve to improve the solubility of the molecule in water, and to reduce its vapor pressure, which helps minimize the amount of amine lost during the solvent regeneration process [6].

Acid gas loading is the ratio of moles of acid gas to moles of amine in a given stream. Rich loading refers to this ratio in the liquid stream leaving the absorber (the "rich" solvent), while lean loading refers to the liquid stream leaving the regenerator (the "lean" solvent). The rich loading provides a relative measure of the acid gas concentration in the solvent, while the lean loading provides a relative measure of how effectively the solvent has been regenerated. Experience has indicated that keeping the rich loading within certain empirically-determined limits is critical to preventing corrosion in equipment constructed of carbon steel.

Each alkanolamine has a recommended concentration range and maximum rich loading associated with it. These recommendations are very general guidelines designed to maintain the solvent safely within corrosion limits. Note, however, that operating outside these conditions is possible, particularly if stainless construction materials are used [7].

MEA

MEA is a primary amine that can effectively remove both H₂S and CO₂ to within most specifications. Of the available amines, it is perhaps the most aggressive, which allows it to remove acid gases down to very low levels even at low pressures. Its structure is shown in **Fig. No. 3**

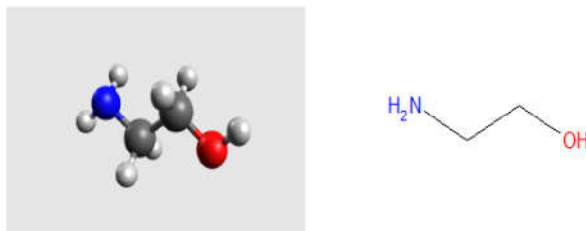


Fig. No.3: Monoethanolamine (MEA)

While long popular for acid gas removal, MEA has a number of drawbacks. It forms degradation products with COS, CS₂, SO₂ and SO₃ and thus requires use of a reclaimer when these compounds are present in the feed [8]. These degradation products are also relatively corrosive, so that the usable concentration of MEA is limited to 15-20 wt%, and the rich loading should not exceed 0.35 with carbon steel equipment.

DEA

DEA is a secondary amine that offers similar performance to that of MEA, but generally with lower operating costs, and without the same tendency to form degradation products with COS and CS₂. It is not as aggressive as MEA, though, so it cannot be used at as low a pressure as MEA. Its structure is shown in fig 4.

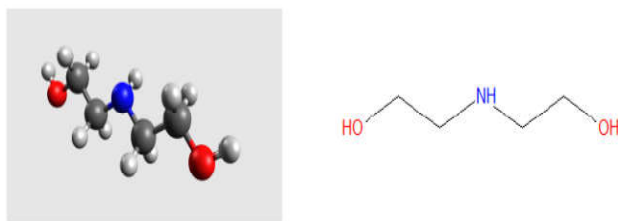


Fig. No.4: Diethanolamine(DEA)

Losses with DEA are minimal because it has a lower vapor pressure, and a water wash is not usually required. DEA is also less corrosive than MEA, which allows it to be used at higher concentrations (e.g. 25-35 wt%) and with lower solvent flow rates. It also does not form non-regenerable degradation products, so it does not require a reclaimer.

MDEA

MDEA is a tertiary amine that offers many advantages over other alkanolamines. Its structure is provided in Fig. No 5

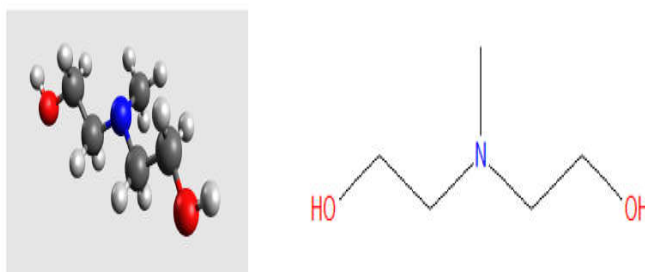


Fig. No.5: Methyl-diethanolamine(MDEA)

Because it is a tertiary amine, MDEA is effective for selectively removing H₂S over CO₂. Thus, it can be particularly useful when the outlet H₂S specification is much more stringent than that for CO₂. The fact that MDEA is a tertiary amine also means it is less corrosive, so that it can be used in concentration up to 50 wt%. Beyond this point, the solution is still not overly corrosive, but its viscosity becomes too great to allow for efficient contact with the feed gas. The maximum recommended rich loading is 0.50, though some have argued it can be much higher. Further, MDEA has a relatively low heat of reaction with CO₂, so that effective regeneration can be achieved at lower reboiler duties.

Mixed Amines

Mixtures of amines are generally mixtures of MDEA and DEA or MEA and are used to enhance CO₂ removal by MDEA, as described by [9]. Such mixtures are referred to as MDEA-based amines with DEA or MEA as the secondary amine. The secondary amine generally comprises less than 20% of the total amine on a molar basis. At lower concentrations of MEA and DEA, the overall amine concentration can be as high as 55 wt.% without the implementation of exotic metal equipment.

Amine mixtures are particularly useful for lower pressure applications since the MDEA becomes less capable of picking up sufficient CO₂ to meet pipeline specifications at lower pressures. At higher pressures, amine mixtures appear to have little or no advantage over MDEA [9]. Mixed amines are also useful for cases where the CO₂ content of the feed gas is increasing over time due to field aging.

SWEETENING A GAS WITH CHEMICAL SOLVENTS:

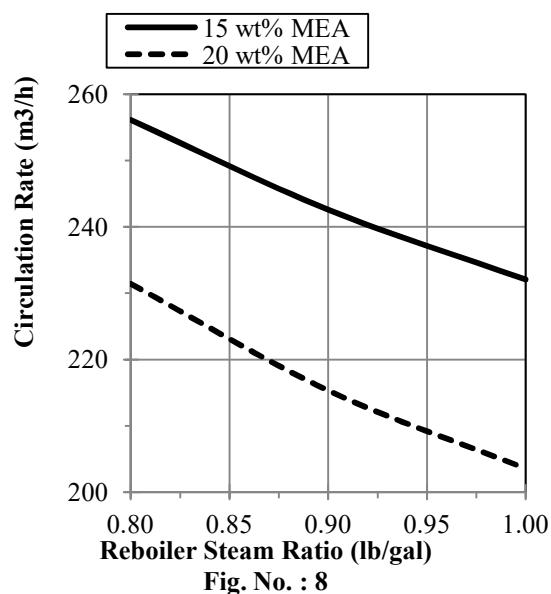
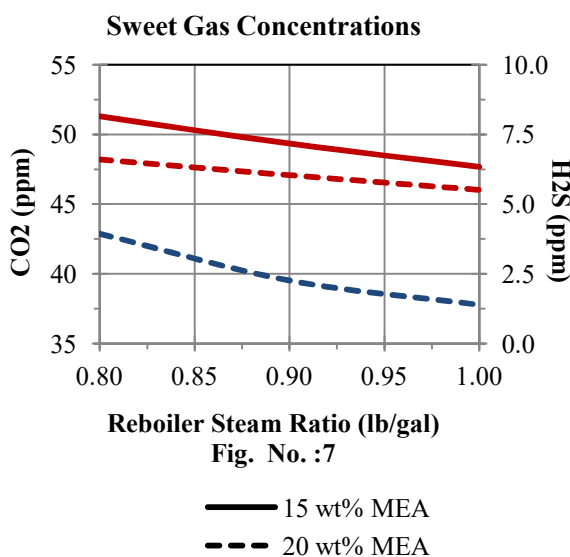
PROCESS SETTINGS: (MEA SIMULATION)

For simulation purpose the inlet condition and inlet composition were shown in Table No. 1 and Table No.2.

1. Selected environment Peng-Robinson.
2. The gas is 100% saturated with water.
3. Provided a complete set of initial guess values (temperature, pressure, flow rate, composition) for the "Recycle Guess" stream leaving the recycle block.
4. The lean solvent is maintained at 15 wt% MEA and 340 m³/hr flow rate. The solvent make-up has taken at 25°C and 1 barg.
5. Assuming pump efficiency of 65% and increases the lean solvent pressure to 0.3 bar above that of the feed gas.

Table No. 3: Result of MEA sweetening Unit

Run #	MEA	Steam Ratio	Sweet Gas (ppm)		Circulation
	wt%	lb/gal	H ₂ S	CO ₂	m ³ /h
1	15	0.80	4.4	51.3	256
2	15	0.90	2.7	49.3	243
3	15	1.00	1.8	47.7	232
4	20	0.80	3.9	48.2	231
5	20	0.90	2.3	47.1	215
6	20	1.00	1.4	46.0	204



The simulation was also extended by providing MEA concentration 20% and steam ratio from 0.8 to 1.0 lb/gal which showed that H₂S content decreases from 3.9 to 1.4 ppm as well as circulation rate decreases from 231 to 204 m³/hr.

The Fig. No.7 and Fig. No. 8 shows that as the steam ratio reduces the acid gas content of the sweet gas and reduces the amount of solvents required to maintain the rich loading at 0.35; whereas increasing the MEA concentration has the same effect.

COMPARING CHEMICAL SOLVENTS:

To compare the performance of MEA, DEA and MDEA for H₂S and CO₂ removal. The sweet gas specification is 4 ppm H₂S, with no requirement on the CO₂ content.

PROCESS SETTINGS:

1. The process handles 28000Nm³/hr of the sour gas specified at below. This gas is 100% saturated with water.
2. Assume the process parameters e.g columns, heat exchangers, pumps etc.
3. The solvent flow rate has set by maintaining the rich loading at a specified maximum allowable value.
4. The reboiler steam rate has a direct function of the solvent flow rate (e.g. 1.0lb of steam per standard gallon of lean solvent [0.12kg/lit]).

Table 4. Inlet Condition ("Wet Sour Feed")	
Temperature	40 ^o c
Pressure	70barg
Flow rate	28000Nm ³ /hr

Table 5. Inlet Composition ("Dry Sour Feed", mol%)

Sr.No.	Composition	Mole%
1.	H ₂ S	5.0
2.	CO ₂	10.0
3.	C ₁	77.6
4.	C ₂	4.0
5.	C ₃	2.0
6.	iC ₄	0.4
7.	nC ₄	0.4
8.	i-C ₅	0.3
9.	n-C ₅	0.3

DISCUSSION

The obtained results are summarized in Table No. 6 using metric unit specification for this feed given Table No. 4 and Table No. 5 three solvents are compared namely MEA, DEA and MDEA respectively. From this Table No.6 it observed that keeping 20wt% MEA and varying steam ratio from 0.07 to 0.1 H₂S content in sweet gas drop from 19.44 to 1.51ppm with decrease in circulation rate from 534.32 to 310.4 m³/hr for maximum rich loading of 0.35.From the Fig. No.10 for 4ppm obtained simulated value was 0.086 and solvent flow rate was 358m³/hr.

Whereas keeping 35wt% DEA and varying steam ratio from 0.090 to 0.120, H₂S content in sweet gas drops from 40.69 to 1.26 ppm with decrease in circulation rate from 179.8 to 142.5m³/hr for maximum rich loading of 0.35.From the Fig. No. 10, for 4ppm obtained simulated value was 0.106 and solvent flow rate was 148.0m³/hr.

Also for 50wt% MDEA and varying steam ratio from 0.110 to 0.140, H₂S content in sweet gas drop from 210.06 to 1.46 ppm with decrease in circulation rate from 95.2 to 85.5m³/hr for maximum rich loading of 0.35.From Fig. No. 10, for 4ppm obtained simulated value was 0.125 and solvent flow rate was 85.7m³/hr.

The result obtained in Fig. No. 11 indicates that as steam ratio increases the circulation rate decreases. For the above obtained simulated result it conclude that, MDEA is a best choice. Since it achieve 4ppm H₂S specification with lowest solvent flow rate and the lowest reboiler duty.

Fig. No. 9: Amine Sweetening Unit

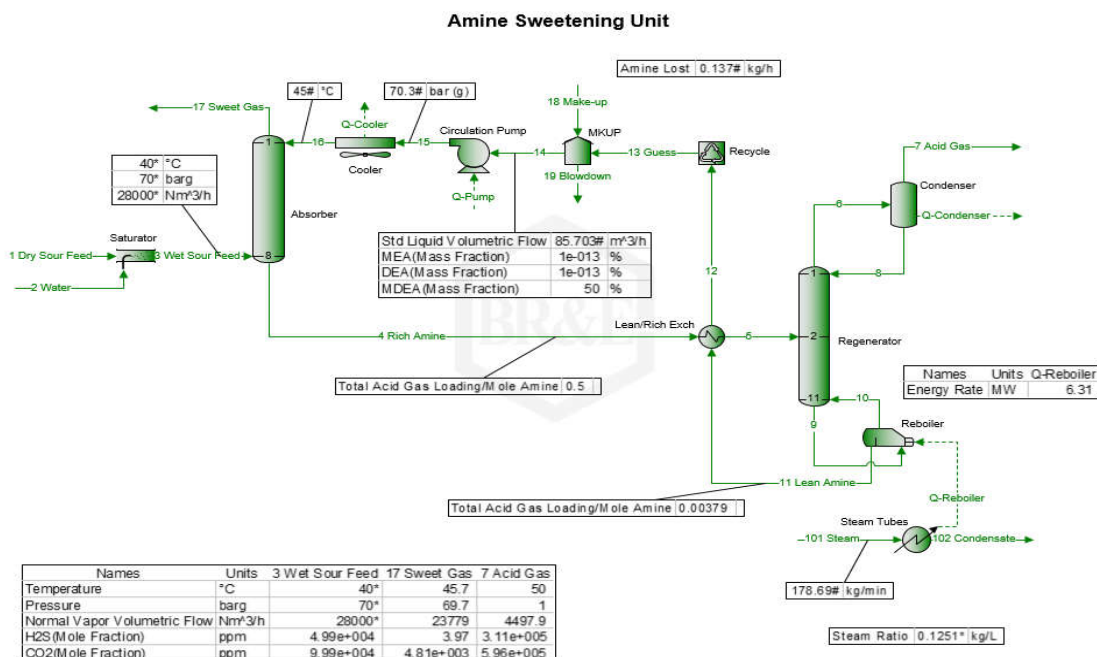


Table No. 6: performance results of MEA, DEA and MDEA

INPUTS					OUTPUTS							
Run #	Feed P barg	Amine wt%			Steam Ratio kg/L	Rich Loading		Solvent Flow m ³ /h	Sweet Gas		Reboiler Duty MW	Amine Lost kg/hr
		ME A	DE A	MD EA		Max	Actual		H2S (ppm)	CO2 (ppm)		
1	70	20	0	0	0.070	0.350	0.3502	534.3	19.44	41.22	22.01	0.236
2	70	20	0	0	0.080	0.350	0.3503	400.7	7.31	31.36	18.87	0.263
3	70	20	0	0	0.090	0.350	0.3500	338.9	2.84	26.50	17.95	0.290
4	70	20	0	0	0.100	0.350	0.3499	310.4	1.51	24.15	18.27	0.276
5	70	0	35	0	0.090	0.400	0.4000	179.8	40.69	112.87	9.52	0.023
6	70	0	35	0	0.100	0.400	0.4001	159.1	13.66	81.91	9.36	0.000
7	70	0	35	0	0.110	0.400	0.4000	144.6	2.14	44.36	9.36	0.007
8	70	0	35	0	0.120	0.400	0.3999	142.5	1.26	36.84	10.07	0.000
9	70	0	0	50	0.110	0.500	0.4998	95.2	210.06	2800.55	6.16	0.110
10	70	0	0	50	0.120	0.500	0.4996	88.1	33.16	4069.76	6.22	0.147
11	70	0	0	50	0.130	0.500	0.5003	85.5	2.53	4885.56	6.54	0.138
12	70	0	0	50	0.140	0.500	0.4995	85.5	1.46	4906.64	7.04	0.138
13	70	20	0	0	0.086	0.350	0.3502	357.6	4.00	28.01	18.08	0.283
14	70	0	35	0	0.106	0.400	0.4000	148.0	3.98	55.62	9.24	0.007
15	70	0	0	50	0.125	0.500	0.5000	85.7	3.97	4814.30	6.31	0.137

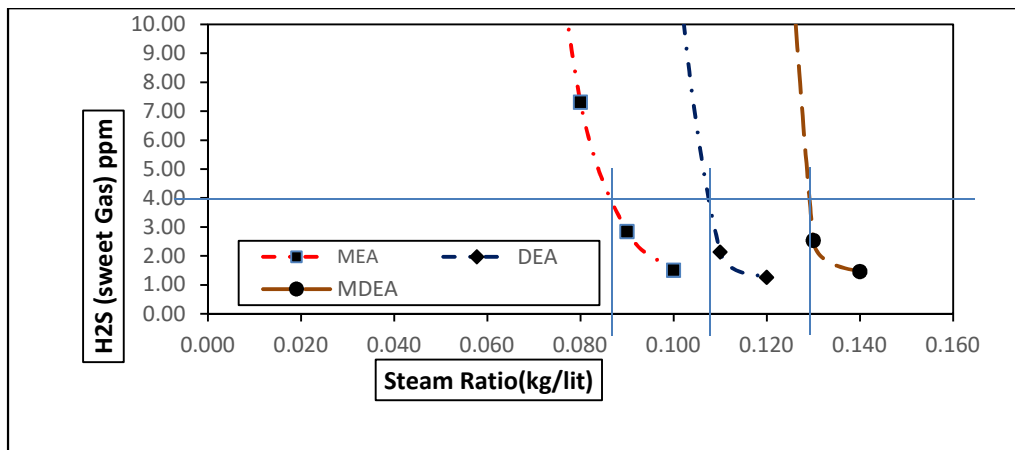


Fig. No.10: H₂S (sweet gas) ppm Versus Steam ratio

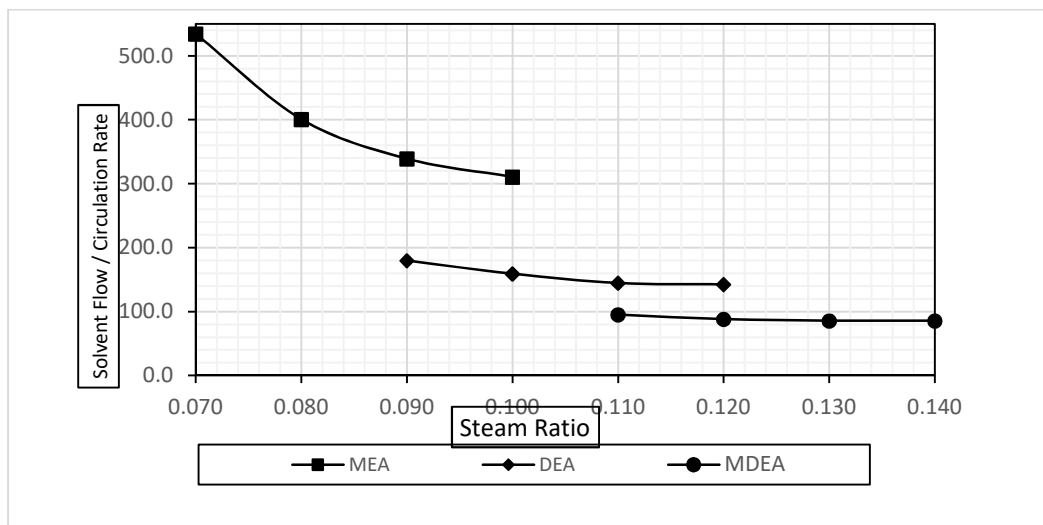


Fig.No.11: Solvent Flow versus Steam Ratio

OPTIMIZATION OF CHEMICAL SOLVENT

One easy way to harness the properties of two different chemical solvents is to mix them together. The most common example is to mix MEA or DEA with an MDEA-based solvent to increase the CO₂ removal while still maintaining the relatively low corrosivity of the MDEA-only solvent.

Chemical solvent performance can also be enhanced by adding specific components in small amounts, usually to an MDEA-based solvent. These components are chosen for their ability to selectively remove one of the acid gases. This approach is particularly useful when optimizing an already-existing process, as these components can be added without having to first shut down and flush the system [10].

PROCESS SETTINGS:

1. The solvent flow rate is 240m³/hr and reboiler duty 480kg/min of 3.5barg steam are already operating at their maximum allowable value.
2. The sweet gas must be contain less than 4ppm H₂S and 1% CO₂.

Parameter	Value
Temperature	40 ⁰ c
Pressure	20barg
Flow rate	28000Nm ³ /hr

Table No. 8: Inlet Composition ("Dry Sour Feed")

Sr.No.	Composition	Mole%
1.	H ₂ S	10.0
2.	CO ₂	20.0
3.	C ₁	60.0
4.	C ₂	5.0
5.	C ₃	2.0
6.	iC ₄	1.0
7.	nC ₄	1.0
8.	i-C ₅	0.5
9.	n-C ₅	0.5

In order to determine the effect on acid gas removal of blending DEA, piperazine and phosphoric acid individually with MDEA. A simulation were generated with conditions shown in Table No. 7 and Table No. 8. with obtained results are summarized in Table No 9 -12

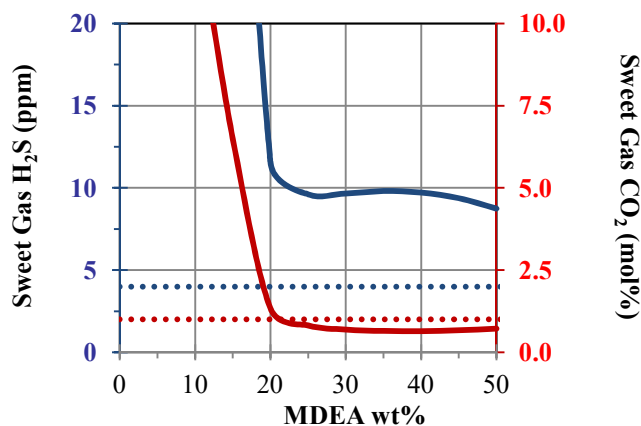


Fig. No. 12: H₂S (sweet gas) ppm Versus MDEA wt%

Fig. No. 12 result shows that using the maximum recommended MDEA concentration of 50 wt% still only yields a sweet gas with about 9 ppm H₂S, which is not within the specification

Fig. No. 13 shows a DEA concentration of about 15 wt% or more (with the balance of the 50 wt% being MDEA) yields a sweet gas that is within the specification: the H₂S content is below 4 ppm and the CO₂ content is around 0.1%. At these concentrations the rich loading is around 0.36 or 0.37, which is reasonable. Note, however, that this solvent removes much more CO₂ than is needed, which may negatively affect the downstream equipment that processes the acid gas stream.

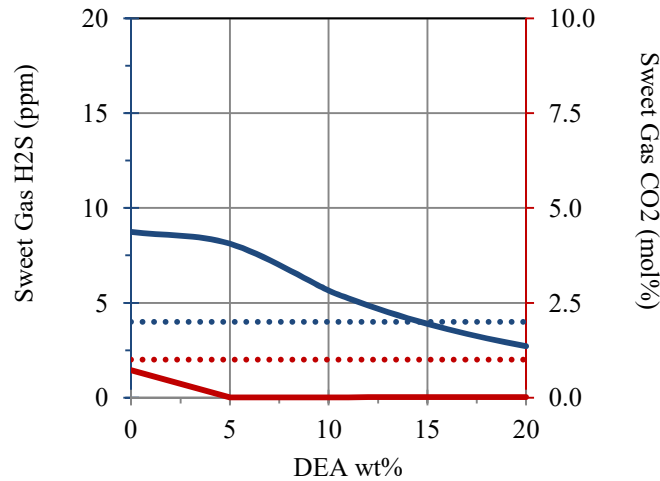


Fig. No.13: H₂S (sweet gas)ppm Versus DEA wt%

Run	Target Outlet Conc.				Sweet Gas		Rich Loading	Lean Loading
	MDEA wt%	DEA wt%	Piperazine wt%	H3PO4 wt%	H2S Ppm	CO2 mol%		
1	50.00	0.00	0.00	0.00	8.74	0.72	0.361	0.003
2	45.00	0.00	0.00	0.00	9.37	0.67	0.403	0.003
3	40.00	0.00	0.00	0.00	9.72	0.65	0.455	0.004
4	35.00	0.00	0.00	0.00	9.80	0.65	0.521	0.004
5	30.00	0.00	0.00	0.00	9.67	0.69	0.609	0.005
6	25.00	0.00	0.00	0.00	9.62	0.82	0.729	0.005
7	20.00	0.00	0.00	0.00	11.56	1.34	0.900	0.005
8	15.00	0.00	0.00	0.00	59.94	6.50	1.039	0.006
9	10.00	0.00	0.00	0.00	10084.46	13.06	1.149	0.007
10	5.00	0.00	0.00	0.00	47066.78	16.25	1.411	0.006

Table No.9 Result for Only MDEA solvent

Table No. 10 Result of MDEA+DEA

Run	Target Outlet Conc.				Sweet Gas		Rich Loading	Lean Loading
	MDEA wt%	DEA wt%	Piperazine wt%	H3PO4 wt%	H2S Ppm	CO2 mol%		
1	50.00	0.00	0.00	0.00	8.74	0.72	0.361	0.003
2	45.00	5.00	0.00	0.00	8.12	0.01	0.363	0.005
3	40.00	10.00	0.00	0.00	5.65	0.01	0.359	0.003
4	39.00	11.00	0.00	0.00	5.24	0.01	0.358	0.003
5	38.00	12.00	0.00	0.00	4.86	0.01	0.358	0.002
6	37.00	13.00	0.00	0.00	4.51	0.01	0.357	0.002
7	36.00	14.00	0.00	0.00	4.19	0.01	0.357	0.002
8	35.00	15.00	0.00	0.00	3.89	0.01	0.356	0.002
9	34.00	16.00	0.00	0.00	3.61	0.01	0.356	0.002
10	33.00	17.00	0.00	0.00	3.36	0.01	0.355	0.001
11	32.00	18.00	0.00	0.00	3.12	0.01	0.355	0.001
12	31.00	19.00	0.00	0.00	2.90	0.01	0.355	0.001
13	30.00	20.00	0.00	0.00	2.71	0.01	0.354	0.001

Table No.11 Result of MDEA+ Piperazine

Run	Target Outlet Conc.				Sweet Gas		Rich Loading	Lean Loading
	MDEA wt%	DEA wt%	Piperazine wt%	H3PO4 wt%	H2S Ppm	CO2 mol%		
1	50.00	0.00	0.00	0.00	8.74	0.72	0.361	0.003
2	49.75	0.00	0.25	0.00	6.28	0.21	0.366	0.003
3	49.50	0.00	0.50	0.00	4.60	0.06	0.367	0.003

4	49.25	0.00	0.75	0.00	4.22	0.03	0.368	0.003
5	49.00	0.00	1.00	0.00	4.12	0.02	0.368	0.003
6	48.75	0.00	1.25	0.00	4.70	0.01	0.368	0.003
7	48.50	0.00	1.50	0.00	6.32	0.01	0.368	0.005
8	48.25	0.00	1.75	0.00	8.01	0.00	0.368	0.006
9	48.00	0.00	2.00	0.00	9.19	0.00	0.369	0.007

Table No. 12 Result of MDEA+ Phosphoric Acid

Run	Target Outlet Conc.				Sweet Gas		Rich Loading	Lean Loading
	MDEA wt%	DEA wt%	Piperazine wt%	H3PO4 wt%	H2S Ppm	CO2 mol%		
1	50.00	0.00	0.00	0.00	8.74	0.72	0.361	0.003
2	50.00	0.00	0.00	0.50	3.18	0.57	0.358	0.000
3	47.00	0.00	0.00	0.50	3.56	0.54	0.382	0.001
4	44.00	0.00	0.00	0.50	3.82	0.53	0.409	0.001
5	41.00	0.00	0.00	0.50	3.95	0.52	0.440	0.001
6	38.00	0.00	0.00	0.50	3.94	0.52	0.475	0.001
7	35.00	0.00	0.00	0.50	3.79	0.53	0.516	0.001
8	32.00	0.00	0.00	0.50	3.49	0.55	0.565	0.001
9	29.00	0.00	0.00	0.50	3.08	0.60	0.623	0.001
10	26.00	0.00	0.00	0.50	2.58	0.68	0.694	0.001
11	23.00	0.00	0.00	0.50	2.08	0.88	0.782	0.001
12	20.00	0.00	0.00	0.50	1.73	1.59	0.884	0.000

Fig. No. 14 shows effect of 49/1 wt% mixture of MDEA and piperazine yields a sweet gas that is very close to the 4 ppm H₂S specification and well below the 1% CO₂ specification (~0.02%). However, even slight variations away from 1% piperazine quickly move the sweet gas outside of the H₂S specification. Given that maintaining an exact solvent concentration is nearly impossible in practice—even though it is straightforward in steady-state simulation—a piperazine/MDEA blend would not be a good choice for this case.

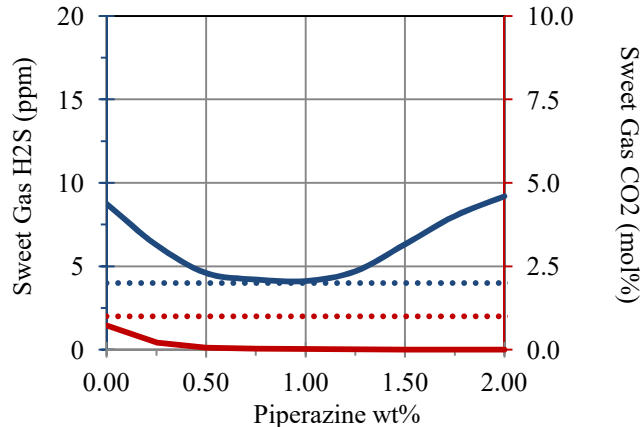
Fig. No. 14: H₂S (sweet gas)ppm Versus Piperazine wt%

Fig. No. 15 shows effect of A mixture of 20-50 wt% MDEA and 0.5 wt% Phosphoric acid yields a sweet gas with less than 4.0 ppm H₂S and 0.7% Carbon dioxide whereas rich loading is below 0.5 which is reasonable. The blending with Phosphoric acid would likely be the most desirable choice for this application. This can be safely operated over wide range of concentration.

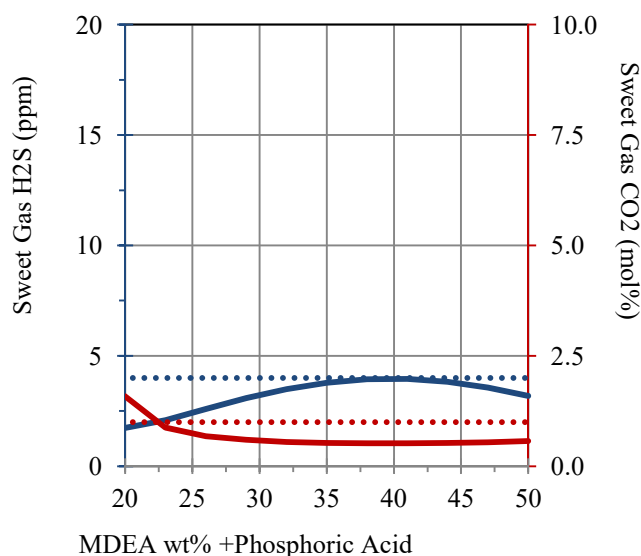


Fig. No.15: H₂S (sweet gas) ppm Versus Piperazine

CONCLUSION

Selection of an amine for gas sweetening is complex and must be based on several process considerations. These factors are analyzed based on process simulation program for gas sweetening called TSWEET.

Providing MEA concentration from 15-20 wt% with the steam ratio from 0.8 to 1.0 lb/gal we found that the H₂S content in sweet gas stream as well as MEA circulation rate decreases.

Processing with MDEA it is possible to reduce circulation rate as a result process cost decreases. TSWEET used to examine the performance of other amines. This analysis demonstrated that the proper selection of the amine can have a major impact on the performance and cost of a gas sweetening unit.

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