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Anatomy of sour gas sweetening simulation software HYSYS with various amines

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Abstract
In recent decades, due to its importance for the simulation of sweetening units are taken into consideration . Natural gas often contains impurities such as carbon dioxide and hydrogen sulfide items within the gas, acid gas or sour gas is highly toxic and that they in turn can lead to corrosion of pipes and devices Hence, it must be purified before use of natural gas, ie the impurities such as carbon dioxide and hydrogen sulfide and other acid gas components can be separated and so sweet The removal of acid gases in the oil, gas & petrochemical is a very important These gases are usually by some physical or chemical solvent absorption towers, can be absorbed Alkanolan aqueous amines such as DGA and MDEA, DEA, MEA solvents commonly used in the process are important items within the natural gas sweetening In this paper, H2S and CO2 solubility in the solvent mole-time DEA, MDEA and also combinations of temperature and pressure is measured absorption tower refinery. And the absorption tower refinery using HYSYS software accurately simulated and the results for selected vehicle with real data are compared with each other and the .
Keywords:Simulation, sweetening unit, sour gas, amine, software Hysys

Introduction

In addition to removing water, oil, and gas liquid (NGL) is one of the most important parts of gas processing to separate the carbon dioxide and sulfur Natural gas from some wells contains large amounts of carbon dioxide and sulfur is. Sulfur in natural gas, hydrogen sulfide (H2S) and is usually the amount of the substance in one cubic meter of natural gas from the 7/5 mg is more natural gas, sour gas, called Separation process, hydrogen sulfide gas is called sour gas sweetening. The reasons for removing acid gases can be toxic, corrosion, frost problems and control the heating value of natural gas would The basic process for sweetening sour natural gas is quite similar to the processes of glycol dehydration and NGL absorption is help. Except that in this case the amine solution is used to separate the hydrogen sulfide Hary tower of sour gas into an amine solution driven. The solution to the sulfur and absorb it like a water glycol absorbs. Three solutions include Mono Ethanol Amine amine (MEA) and Di Ethanol Amine (DEA) and methyl di-ethanol amine (MDEA) is used for this purpose These solutions are liquid sulfur components in natural gas that passes between them attract. Component of natural gas, sour gas releases its sulfur sweet gas to be converted. Like the process for NGL extraction processes and help glycol dehydration, the amine solution used can be regenerated (separating the sulfur uptake) and that it can be used again. Although most sour gas sweetening involves the amine absorption process, it is possible to separate the hydrogen sulfide and carbon dioxide from solid desiccants like iron sponges to be used. In addition to H2S and CO2 may be sulfuric acid, carbonyl sulfide (COS), carbon disulfide (CS2) and total mercaptan (RSH) are present in the gas that they can be removed by amine. Separation processes in chemical, acid gases using amine process by chemical reaction takes place.

Acid to help direct absorption or a combination of adsorption and chemical reaction are separated. Amines can be categorized based on the chemical. Truly an agent (MEA and DGA) two-factor DEA) and DIPA) and three-factor TEA) and MDEA) are included. New solvents and amines MDEA inhibitor (FLEXSORB) are The suitability of chemical properties, each of amines to certain conditions, as appropriate. Drtrahy process, the first important point for the desired purity of the valley, sweet gas and H2S and CO2 content in it. The second point, which causes an amino select the optimal size of the equipment and operating costs to a minimum. By choosing an appropriate amine can be recycled and the amount of energy required for crop rotation dramatically reduced. Select amine or amine compound in the best conditions can drastically reduce the overall cost of the desalination unit.

Truly, a general agent in solution for 10 to 20 weight percent of the water used. Acid gas load due to corrosion problems typically 3/0 to 35/0 mole mole amine acid gas for carbon steel is limited. Though Aztjhyzat be used with stainless steel to 7/0 to 9 / 0 mol mol arrives and there is no corrosion problems Although MEA is corrosive effects of the products of corrosion is highly undesirable. MEA with oxidant agents such as SO2, CS2, COS,

SO3 reacts with oxygen thus obtained should be removed to prevent corrosion of the system. Amine the effect of MEA break down, but restoration has been largely ineffective amine can be recycled. Since single-agent amine MEA has a high PH is the sweet gas H2S content less than 4/1 Green is SCF100 MEA solution, the partial pressure of H2S will produce very little. Green with H2S gas to produce less of a need to fully absorb CO2, the MEA is used Since the heat of reaction of CO2 in MEA or Btu / Ib ¬ 825, if the feed contains high concentrations of CO2, the cause will go up once the reboiler. MEA reacts with H2S Btu/1b 550 is heat. The overall heat of reaction for amines and other conditions as a function of time is usually acidic gas with a total time of about 5/0 mol mol, varies only between Btu/1b 60-50. Higher loads, the heat of the reaction significant changes that should be calculated as a function of time.

On the other hand, two-factor amine DEA commonly is used with 25 to 35 percent by weight. The total time for di ethanol amine acid gas to 3/0 to 35/0 mol mol for carbon steel equipment is limited. When the equipment with stainless steel or inhibitors are used in the process SNPA DEA can be used with high safety. Hazardous Decomposition Products DEA, MEA provides less corrosion. DEA exposed to oxygen, to form corrosive acids. COS and CS2 can do irreversible reaction with DEA. In most units, the DEA is a two-factor alkanolan Amine, H2O and CO2 has little affinity for sweet gas can not be certain requirements for certain gas flows with low pressure created In general, if the gas pressure is low, the steam required for the process to increase surgical exposure or split stream to be used for this purpose. In some cases, these predictions are not sufficient, in which case other solvents must be used. Amen DGA also a factor generally between 50 and 70 wt% solution in water used. As for the DGA MEA due to corrosion problems, Azbarhay solution above about 35/0 mol mol prevented. The sweetening of gas streams containing high acid gas partial pressure, low temperature absorption tower can rise to F200 DGA tend to react with more CO2 than H2S, therefore, except in cases where large amounts of CO2 than H2S is present, it can easily H2S concentrations less than 4/1 Green cause. DGA has advantages over other amines, including high concentrations of DGA makes it less rotation is needed, the DGA has a low freezing point. In addition DGA easily COS, SO2, CS2 and SO3 reaction is not irreversible One of the main problems DGA, the heat of reaction with Btu/1b Co2850) and (Btu/1b 674) H2S Is . But for truly three-factor MDEA, certain operating conditions similar single-factor and two-factor Amen there. This is due to the flexibility and diversity of MDEA and thus has a wide range of applications. Furthermore, the range of successful applications will be reviewed. With 20 to 50 wt% MDEA traditionally used Low weight, high selectivity at low pressures will lead to a solution. Relatively large to reduce corrosion problems, acid gas can be time for carbon steel at a rate of 8/0 is the mole to mole. Methyl Di Ethanol Amine exposed to oxygen, corrosive acids that are created out of the system if they do not, they will cause the iron sulfide. Methyl Di Ethanol Amine amine than a factor of two distinctive advantages include lower vapor pressure, lower reaction temperatures Btu/1b) 600 for Btu/1b 522 for CO2 and H2S), high resistance to decay, corrosion problems property is less than the selectivity of H2S in the presence of CO2, the Now the most important advantages compared to other amines MDEA properties selectivity toward H2S in the presence of CO2.

Selective absorption of H2S can be absorbed by an appropriate tower design with a time of 5/1 to 3 seconds will increase the temperature of the liquid in the tray and place towers . Both of these conditions can increase the absorption of H2S , but will not increase the CO2 absorption . Generally amine compound comprises a mixture of MDEA and MEA or DEA , is one of the amines . The addition of either of these two amines to MIDA for CO2 absorption takes place . Such combinations include MDEA and DEA or MEA as base as a secondary amine . Overall, the secondary amine is less than 20 % mole of amine . At lower concentrations of MEA and DEA metal equipment normally used if the total amine concentration can be increased to 55 % by weight . Amine compound is particularly suitable for low pressure systems . MDEA because lower pressures are less likely to combine with CO2 . At pressures higher than MDEA amine compounds alone are not many advantages . In cases where the feed gas Co2 time of rising life expectancy increases , the use of amine compound would be useful.

To achieve the optimum design for each specific system, several operational parameters should be included in the study. The large amount of fresh gas conditions, operating parameters will affect. Due to the composition of the inlet gas (temperature and pressure) and sweet gas conditions, the main operating parameters are as follows. (1 to 4:(

-Retention time of the liquid in the tray: Since the reaction rate of CO2 with MDEA is the tower diameter and height of the weir should be designed so that there is enough time to react. For a typical range of 2 to 4 inches is the height of the weir, which is responsible for the retention time between 2 to 5 seconds.

-Poor amine temperature , usually the only parameter for temperature control tower, amine temperature is poor . Because the reaction of CO2 with MDEA the kinetics is controlled , more heat will increase the reaction rate of

the tower . However, when the amine temperature to 135 to 140 degrees Fahrenheit poor , reducing the solubility of CO2 in amine solution will be an important factor and net CO2 uptake begins.

-Amine circulation rate when the amine circulation rate is increased to a certain tower , will also increase CO2 uptake . This will keep the right amount of MDEA in a tower diameter will be fixed. Although the retention time of the liquid in the tray will decrease with increasing flow rate.

-The amount of vapor -free : With the increasing amount of vapor -free will create a truly poorer which will absorb more CO2 and H2S from the sour gas

Arak refinery gas sweetening units to simulate feasibility of alternative solvents, MEA and DGA PRO II software has already been done by other researchers. (5). These investigators have proposed that in order to compare the capabilities of existing commercial software, process simulation software such as Hysys well done. Therefore, in this study, and in that spirit, Arak refinery gas sweetening units to simulate feasibility of replacing the MEA solvent instead of DGA was performed by the software.

Hysys and software solution

Due to the growing need for industry to do calculations fast, accurate and low cost , the use of computers and the benefits it is inevitable . Effective uses of computers in the oil, gas and petrochemical simulation software , including software Hysys is certain . The software is programmed in such a way that the simulation speed , accuracy and simplicity of integrating the simulation . The new design of the software is able to quickly create models for evaluating multiple options . After selecting a superior design , Mitt van models that they create very realistic , based on their additional equipment and process details are also considered . Simulation Software Hysys in two stages . First, the principles and the basic data used for software simulation are defined. Finally, the simulation can be used to describe how to design and implement plans intended to pay. The software includes a thermodynamic model that is designed to simulate the amine sweetening units . In this application , the properties of amines are incorporated in such a way that it can be done safely simulate the amine units . Information about the equilibrium solubility of acid - Gas kinetic parameters for aqueous solutions in contact with H2S alkanolan amines are incorporated in the software and the ability to simulate real- tray tower provides Software Hysys, computational efficiency, CO2 and H2S separately based on the tray dimensions and conditions of absorbing and processing is done inside the tower .

Should simulate

The following are the steps :

- Establishment of an individual
- Select a model property
- Select an ingredient
- Create and specify the feed stream
- Install and define the operational units of the tower
- Installation compliment Tower

In this study , the initial substances (compounds) as well as the desired amines are selected thermodynamic model simulations did so accordingly . In this way, solving a conjecture and an error occurs . To begin the calculations , the temperature of the top and bottom of the tower is selected via software to solve the system of simultaneous equations to estimate and error method must converge to the values given . In this research, and to simply solve the linear pressure profile is considered . (6 to 9).

Simulation Results and Discussion

The results of this study and the software Hysys instead DGA MEA solution has been to replace the tables (1) to (6) is shown . The results of this simulation suggest using software Hysys with 12 trays balance , in most cases gives better results . For example , the amount of acid gas removal software Hysys of the initial amount of 49/8 mole percent to ppm2 The woman PRO II software to ppm 26/3 reduced this difference , significant changes in the efficiency of the tower and provides a cost . The results of simulation software Hysys, however, dissolved in the exhaust gas shows . The importance of the issues, and expected loss to represent the MEA solution . The MEA solution is expensive (if the purchase price of the amine solution with coefficients to be compared , one menu Ethanol Amine , Di Ethanol Amine 5/1 and more Ethanol Amine will be 2 . Well as the price per kg of MEA amine with regard to complications andhr 106 = Q implies that the amount of acid gas removal software Hysys of the initial amount of 49/8 mole percent to ppm10 the woman PRO II software to ppm 14/69 is reduced. The PRO II simulation software to simulate this type of software is representing inaccuracies .

Table 1 : Comparison of actual results with the simulation results in different solvents

Using Hysys software for absorption tower pressure in terms of Q (m3/hr)

The actual composition of the inlet gas composition , gas inlet
(% Molar) simulation results
(Mole %) with DGA
(Q = 300) simulation results (mole %) with MEA (Q = 1000) simulation results (mole %) with DEA
(Q = 300) simulation results (mole %) of DIPA
(Q = 220) simulation results (mole %) of MIDEA
(Q = 220)
H2 11/61 84/62 83/62 86/62 85/62 86/62
H2S
(ppm) 86/2 2 1 2 4 3
C1 25/9 49/9 5/9 5/9 51/9 5/9
C2 57/13 95/13 95/13 95/13 95/13 95/13
C3 73/11 06/12 06/12 06/12 06/12 07/12
n-C4 55/0 56/0 57/0 56/0 56/0 56/0
i-C4 84/0 86/0 87/0 86/0 86/0 86/0
n-C5 02/0 04/0 03/0 02/0 02/0 02/0
i-C5 05/0 05/0 05/0 05/0 05/0 05/0
C +6 02/0 05/0 02/0 02/0 02/0 02/0
H2O 0 11/0 12/0 12/0 115/0 12/0
Halal 0 0 ppm12 0 0 0

Table 2: Comparison of simulation results for H2S using Hysys software
(Present study) and PRO II (other investigators (5)) for the absorption tower pressure and solvents, MEA and DEA
Solvent type, gas flow rate, gas composition
The actual composition of the inlet gas
Input (% mole) simulation results
The MEA (Hysys) simulation results
The MEA (PRO II)
MEA 1000 H2S (ppm) 86/2 1 87/0
DEA 86/2 H2S (ppm) 86/2 2 88/4

Table 3: Comparison of simulation results for H2S using Hysys software
(Present study) and PRO II (other investigators (5)) for the absorption tower pressure and
DIPA solvents and m3/hr220 = Q
The actual composition of the inlet gas composition
Gavz input
(% Molar) simulation results
(Hysys) DIPA simulation results
(PRO II) DIPA simulation results
With MDEA
(Hysys) simulation results
With MDEA
(PRO II)
H2S (ppm) 86/2 4 88/15 3 74/11

Table 4: Comparison of actual results with the simulation results in different solvents
Using Hysys software for low pressure by absorption tower (m3/hr)
The actual composition of the inlet gas composition , gas inlet
(% Molar) simulation results
(Mole %) with DGA
(Q = 1060) simulation results (mole %) with MEA (Q = 1060) simulation results (mole %) with DEA
(Q = 1060) simulation results (mole %) of DIPA
(Q = 1060) simulation results (mole %) of MIDEA
(Q = 850)
H2 89/38 96/41 98/41 96/41 96/41 42
H2S

(ppm) 49/8 8 2 8 10 9
C1 43/14 73/15 74/15 73/15 73/15 72/15
C2 37/14 67/15 67/15 66/15 66/15 66/15
C3 55/12 70/13 69/13 69/13 68/13 69/13
n-C4 49/3 81/3 81/3 81/3 81/3 80/3
i-C4 68/7 40/8 38/8 40/8 39/8 38/8
n-C5 12/0 22/0 22/0 22/0 22/0 22/0
i-C5 26/0 28/0 28/0 28/0 28/0 28/0
C +6 03/0 03/0 03/0 03/0 03/0 035/0
H2O 0 20/0 19/0 19/0 20/0 20/0
Halal 0 0 ppm4 0 0 0

Table 5 : Comparison of simulation results for H2S using Hysys software
(Present study) and PRO II (other investigators (5)) for the absorption tower pressure and
DIPA solvents and m3/hr220 = Q
The actual composition of the inlet gas composition
Gavz input
(% Molar) simulation results
(Hysys) MEA , with the simulation results.
(PRO II) MEA simulation results
The DEA
(Hysys) simulation results
The DEA
(PRO II)
H2S (ppm) 49/8 2 26/3 8 36/11

Table 6 : Comparison of simulation results for H2S using Hysys software
(Present study) and PRO II (other investigators (5)) for low- pressure absorption tower
DIPA solvents and m3/hr1060 = Q
The actual composition of the inlet gas composition
Gavz input
(% Molar) simulation results (ppm)
With DIPA (Hysys) simulation results (ppm)
With DIPA (PRO II)
H2S 49/8 10 14/69

Conclusions

Performed simulations with HYSYS software will show the capabilities of this software . In this simulation calculations and return the tray to the one we have considered equilibrium . The results of simulation software Hysys absorption tower with 12 trays equilibrium can be summarized as follows :

- Comparison of simulation results for H2S using Hysys and PRO II software for high-pressure and solvent absorption tower m3/hr DEA 300 = Q in Table 2 show that the amount of acid gas removal software Hysys of initial value 86/2 mole percent to ppm2 reduced by the PRO II software ppm 88/4 decreases. Introducing the PRO II software simulation inaccuracy in this type of software for the simulation and lawful.
- Comparison of simulation results for H2S using Hysys and PRO II software for high-pressure and solvent absorption tower m3/hr DEA 220 = Q in Table 3 indicate the amount of acid gas removal software Hysys initial amount of 86/2 ppm4 mole percent of the PRO II software to ppm 88/15 reduced to PRO II software indicating the percentage of error in these conditions.
- The amount of acid gas removal Hysys software for MEA solution of the initial value of 49/8 mole percent to ppm2 and the PRO II software ppm 26/3 decreases (Table 5) that the differences are dramatic changes in terms of efficiency Tower provides cost . In the process of fixed costs and initial investment is particularly important . Significant difference in terms of efficiency and cost makes the tower .
- Given that the simulation is close to the operating conditions of the working principles . There 's Hysys software simulation results show that the solution in the exhaust gas , while important, does not show the PRO II software . The importance of the issues and the anticipated loss of MEA solution . The importance of the forecast

represents the loss of MEA solution because of the MEA solution is expensive to retrieve and insert it again desalination cycle is of utmost importance .

- The simulation results indicating that the gas sweetening plant simulation software Hysys PRO II relative to the overall tower efficiency and reduce costs in most cases followed , and therefore the case and type of the simulation , the Hysys software is recommended .

- Comparison of simulation results for H2S using Hysys and PRO II software for low- pressure solvent absorption tower m3/hr DIPA 1060 = Q in Table 6, indicating that the acid gas removal rates of software Hysys initial value 49/8 percent Molly ppm10 of the PRO II software to ppm 14/69 is reduced. PRO II software indicates that the percentage of error in these conditions.

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