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Study and examining the processing parameters on function of MDEA and DEA solvents for measuring removal units of CO₂ and H₂S

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ABSTRACT

One of the main and common processes for deleting acid gases(H_2S, CO_2) is using amino solvents. This research attempts to modeling and evaluation of pressure and temperature parameters for two hydrated solvents (DEA,MDEA) with aspen hysys software. The obtained results of simulation to sure gas in purification unit in gas regions Iran for both of solvents. Obtained results of better function of MDEA process compared with process for selective absorption, reducing consuming energy of purification unit, reducing investment costs in solvent and reclamation unit and decreasing equipment corrosion. According to obtain results, suggests that co-absorption acid gases with amino- processes with combination of two solvents: MDEA and DEA

Keywords: solvents, M.D.E.A, D.E.A, modeling, aspen hysys

INTRODUCTION

Amino- alkanols are organic materials contain nitrogen usual they are applied for sour crude and sour gases purifications. In other words they are combination of alkanols and ammonium. The difference between various amino include different in number of alkanols radicals that instead of ammonium hydrogen's. Natural gas sweetening process by hydrated- amino-alkanols need to repel and absorptions towers in which a series reaction have done. In addition to towers, there is much equipment that have important role in fluids flow between two towers. There is a general back flow of end of process toward it's beginning which doubles self-complexity of calculations.

The processes of amino sweetening have shown in figure (1) amino function is based on their chemical affinity resulting in their alkalinity property. Mono ethanol amino (MEA), de ethanol amino (DEA), three ethanol amino (TEA), de glycol amino(DGA), de isopropanol amino (DIPA) and methyl de ethanol amino (MDEA) are using for gas sweeting. Mono de and three prefixes indicating substitution degree of nitrogen atoms.[1, 2, 3]



Fig 1. Amino- sweetening process

Gas purification system with D.E.A (processing system) have reclamation ability that with using (D.E.A) for separation of (H₂S, CO₂) from sour natural gas. (DEA) solvent in mass fraction (20- 35%). (D.E.A) act non-selectivity with CO₂, H₂S and have co–absorption of them. (M.D.E.A) is an amino of 3 types. Main properties of this solvent comparing with other amino refer to selectivity absorption of H₂S in process of CO₂. One of the solvent properties of (MDEA) is low steam pressure. Also it has stability with heat and has low heat of reaction and less corrosion problems. (MDEA) in concentration weights (40-50%) has used for sour gas sweetening. In this research, process modeling has done with (MDEA-DEA) with Aspenhysys and with same processing conditions for Analyzing and selecting of better process.

2) Evaluation of assimilation result

Modeling of sweetening process with Amine. Package in Aspen Hysys software have done for (D.E.A-M.D.E.A) solvents in order to global standardization of purified Gas and we have used of combination of input materials into Gas purification unit as shown in table (1).[4,5]

Component	Mole Flow Kgmol/Hr
H20	152.96
N2	75.95
CO2	936.3
H2S	562.36
COS	0.25
C1	12909.22
C2	81.8
C3	13.15
I-C4	2.92
N-C4	4.38
I-C5	2.92
NC5	2.92
C6+	14.61
TOTAL Mole Flow	14760.2
Pressure,Psia	1074
Temperature, ^o C	21

Table 1, Sour gas analyze for feed of gas purification unit

According to interests of researchers with assimilation procedure with Amine solvents. We avoid of its repetition. Therefore, we have examined results of assimilation with PFD unit (gas purification unit).

1-2: Evaluation of temperature changes in absorption tower length:

For assessing temperature in absorption tower (with any solvent), we need to heat reaction and solvent heat capacity. When input gas flow into tower has high amounts of acid gases, we need to high flow rate of solvent for cooling output gas of top of tower by input solvent. In this condition, all of heat reaction by solvent exit of tower bottom. As shown in figure (2), there is a maximum point in this curve. We explain that input gas at the beginning takes heat of richer tower and heat, then with as sending in tower gives its temperature to cool solvent of top of power and then cools. This phenomena occurs because of air pre-heat and fuel in stoves for function of combustion gases and there is more temperature in stoves. We have same condition in repel tower. Maximum temperatures within tower are more than of calculated present in basis of heat reaction and heat capacity.

When input gas in to tower has lower acid gases. The gas in which leaves the reaction region into tower has more heat and when input gas has more concentration, exiting solution of tower bottom cools unit input gas temperature and vice versa, all of heat reaction from top of tower exits by purified gas. With this condition purified gas has high temperature. These positions have shown in figure (2) [5, 6, 7].



Figure (2): temperature variation through absorption tower continuing (DEA-MEDA) solvents

With increasing of input A min-temperature into absorption tower, as shown in figures (3, 4), trays of tower have higher temperature. Within creasing of amine temperature input of all of trays of tower increases.

As showing figure (2). In addition to, increasing of tower temperature, maximum temperature of tower also increases. With increasing of tower temperature, absorption of acid gases in tower decrease and reaction regions transfers to top of tower and this is a bad point for my modeling.(H₂S) distribution in tower length have showing figures(5,6)CO₂ distribution in tower length for (DEA)(MDEA) solvents have shown in figures(7,8) with increasing of A min-temperature input to absorption tower, some (H₂S,CO₂) can penetrate into higher trays and reaction region transfers to top of tower and finally, absorption rate of acid gases decreases in tower-MDEA solvent has the selectivity absorption property in comparison with DEA solvent as shown in figures(7,8).



Figure (3): the effect of input amino- temperature through absorption tower on temperature distribution in absorption tower length for (DEA) solvent



Figure (4): the effect of input amino- temperature into absorption tower on temperature distribution through absorption tower with (MEDA) solvent



Figure (5): the effect of input amino- temperature into absorption tower on (H₂S) distribution in gas phase through absorption length for (DEA) solvent



Figure (6): effect of input amino- temperature into absorption tower on (H_2S) distribution in gas phase through absorption length with (MEDA) solvent



Figure (7): effect of input amino-temperature into absorption tower on (co2) distribution in gas phase through absorption for(DEA) solvent



Figure (8): effect of input amino-temperature into absorption tower on(co2) distribution in gas phase through tower length with MEDA(solvent).

2-2-Examination of pressure changes in absorption tower length:

Pressure through tower length changes linear and has descending procedure. Dropping of tower pressure including two sections: drop of dry tray pressure and dropping liquid pressure. Trays distances are same with identical hydraulic designs in tower length and flow stability for all of trays are in the same way and therefore dropping of linear pressure occurs through tower. These changes have shown in figure(9). As we have shown, these variations are the same in both of solvents.



Figure (9): variation of pressure through absorption tower containing (DEA-MEDA).

3-2-evaluation of changes of changes of acid gases concentration in absorption tower length: variation of H_{2s} concentration through tower have shown in figure (10) and variation of CO_2 concentration through ration through tower for both solvent have shown in figure(11). There is no difference for H_2S absorption in two solvents. But in bottom trays of tower for CO_2 absorption– its absorptivity in (MDEA) solvent isles than (DEA)solvent. But this difference in high trays decreases but finally, (MDEA) solvent as shown in figure, absorbs less $CO_2[5,6,7]$



Figure (10): variation of H2S concentration in gas phase of absorption tower containing(DEA-MEDA).



Figure(11): variation of CO2 concentration in gas phase of absorption tower of DEA-MEDA.

3-results:

In this research, we have examined function and reaction of (M.E.D.A-D.E.A) solvents in absorption tower and other equipment's of process include: aspen hysys software.

Some conclusion as follow:

1-3: increasing of pressure leads to:

*partly increasing in absorption of acid gases.

*partly variation in operation costs....

Arrangement and type of equipment have no change. Only towers must have operation pressure capacity

2-3: increasing of amino-temperature into absorption tower lead to:

*reduction of (CO₂- H₂S) absorption. Output purified gas has high amounts of acid gases.

*reduction in operational costs in this process occur because of decreasing in heat loading of repel tower boiler and therefore dilution of amino cooler. Generally, function of MDEA solvent in selective absorption of acid gases has shown better function. Using of amino-solvents for deleting acid gases (CO- deletion of CO₂-H₂S), selective property of MDEA solvent with combination of two solvents(MDEA- DEA).

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