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Research Paper

The comparison of performance of bidboland gas refinery unit based on the current designing and the new designing

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Abstract

One of the problems of Bidboland Gas Refinery especially in the cold seasons is the low temperature of the sour gas entering to Gas Refinement Unit that .This problem has a direct influence on output reduction of Amin-Amin Exchanger leading to an increase in gas fuel consumption in the Reboiler of Amin Recovery Tower because Amin-Amin exchanger is not able ,in the current condition ,to warm up Rich DEA solution to optimum temperature based on design of the manufacturer company .In order to solve this problem, the Amin-Amin exchanger was redesign by use of Aspen Hysys specialized software and it was used in the process by use of the Aspen Hysys software .Based on the obtained results, in case of using the new exchanger ,the Rich DEA solution temperature will increase from 33°C to 98°C that this increase in temperature causes a 33.2% reduction in gas consumption in the Reboiler. On the other hand ,as a result of improvement in the heat exchanging between Lean and Rich solutions ,temperature of the saturated Amin solution reduces to 57°C which, consequently there is no need to use air cooler to cool running Amin. These equipments are totally omitted from the process, and its operating costs will are returned to Bidboland Gas Refinery .Finally, it was revealed that using the new heat exchanger causes a capital-return to 114864 $ annually as a result of reducing energy consumption in Reboiler and air cooler.

Keywords: *Simulation; DEA Solution; Aspen Software; Bidboland Gas Refinery.*

1. Introduction

The heat exchangers are almost of the most applicable member in chemical processing, and they can be considered in the most of industrial Units [3], [4] They are tools that make heat exchanging between two fluids possible in the different temperature .This operation can be done between liquid-liquid, gas-gas, and gas-liquid. The heat exchangers are used to cool the hot fluid or heating the fluid with lower temperature or both. These applications include power plants, refineries, petrochemical industry, manufacturing industry, process industry ,food and pharmaceutical industry ,metal smelting ,heating, air conditioning ,refrigeration and aerospace applications .Heat exchangers are used in various devices such as steam boilers ,steam generators ,condensers ,operator ,evaporators, cooling towers ,pre-heaters of coil fan ,oil cooler and heater ,radiators ,grills and There are many industries involved in designing heat exchangers and also several courses were provided in colleges and universities with different names to design heat exchanger[2].The calculation of work exchangers are sometimes tedious and time consuming .For instance,designing an exchanger for special operation demands much guesses by which and based on standards, one can find proper exchanger sizes. But, by using computer applications, all of these calculations are done by computer and the designer should only enter the operational conditions and the current fluid properties in the operation .The Aspen B- jac and HTFS softwares are from this type. These softwares include programs that are able to perform such calculation.

2. The operation of gas refinement unit of bidboland refinery

At first, sour gas (table 1 shows input gas structure) with 4169 KP and with the temperature of 30 °C enters two phases exchanger and some of its associated liquids are separated. Then, the output gas enters the Amin contactor from the above of the separator and from the below of the try (numbering is from bottom to top).The rich Amine solution exits from the bottom of the tower contacts the valve pressure is removed first and flashes to 446 KP. Then, the solution enters Amin immediate separator in order to separate some light gases. The output gas flow from this separator is sent directly and continually to the metal and the output liquid flow with the temperature of 45°C is sent to the well-known Amin-Amin exchanger (in this exchanger, which is of pipe-shell type, Amin solution is recovered in exposing with Amin solution and then it should be heated to the temperature of 100 °C; but because the output solution from the bottom of the contactor is cold, this exchanger is not able to pre- heat to 100 °C and in the best condition, the saturated Amin flow can be heated to 74°C). Then, the pre-heated Amin enters Amin recovery tower from above the third tray (numbering is from bottom to the top) and during 20 steps (without consideration of Condenser and Reboiler), the operation of acid gases disposal from the saturated Amin solution takes place (figure 1).The pressure of the recovery tower top is 177.2 KP and the Reboiler pressure is 188.9 KP.The output product from the Condenser of this column (the Condensor is of complete return type) is acid gas (table 2) which is continually sent to metal. The output of this column with try is recovered Amin that is sent to Amin-Amin exchanger with temperature of 120 °C [6].

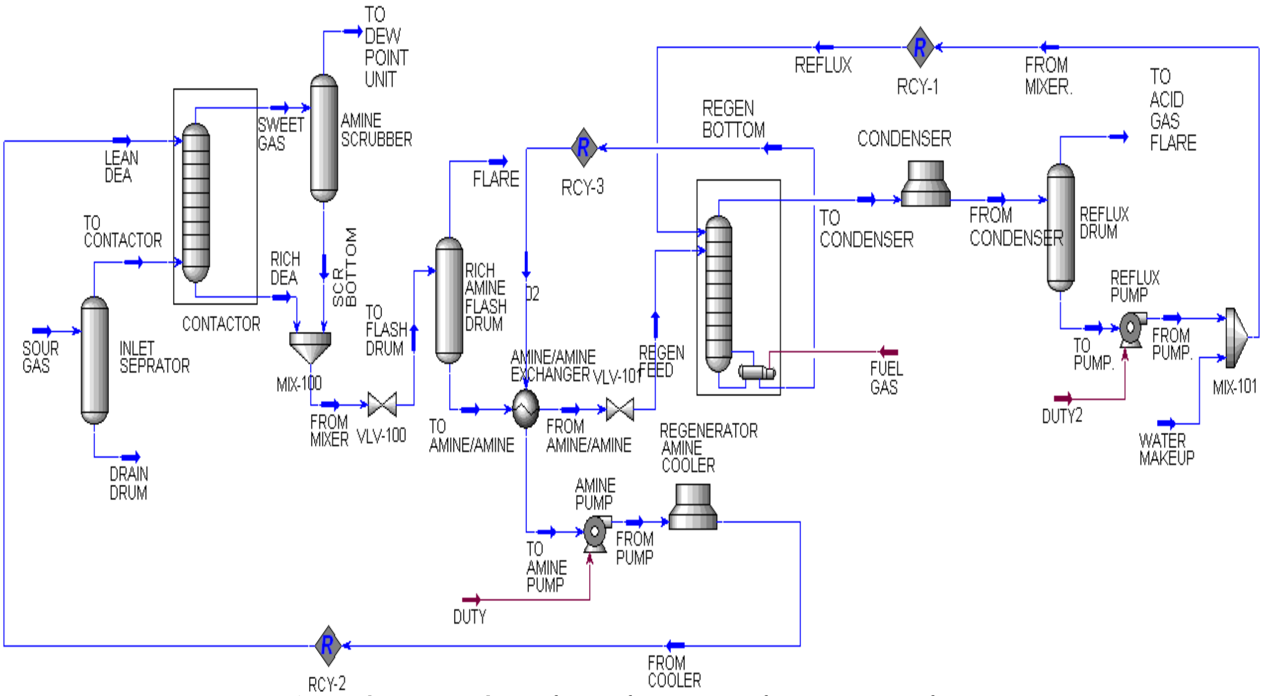

Fig. 1: Schematic Simulation of Gas Refinement Unit of BIDBOLAND Refinery

Table 1: The Sour Gas Structure Entering the Gas Refinement Unit (Bidboland Gas Treating Plant)

Component	Mole Fraction
H2S	0.000309
CO2	0.005677
N2	0.003612
CH4	0.873575
C2H6	0.067402
C3H8	0.027805
i-C4	0.004280
n-C4	0.008420
i-C5	0.002494
n-C5	0.002394
n-C6	0.001058
n-C7	0.000579

Table 2: Acid Gas Structure (Bidboland Gas Treating Plant)

Component	Mole Fraction
CH4	0.00476
H2O	0.099
H2S	0.0471
CO2	0.8485

3. Statement of the problem

The designing of the Gas Refinement Unit of Bidboland Refinery is food based that has an outstanding difference to the current food (table 1) in terms of temperature and acid gases structure (almost dioxide carbon and sulfide hydrogen) and because of these features, other parameters such as Rich DEA are far from the designed amounts. Based on the designing of the manufacturer of Rich DEA solution, the temperature of 33 °C should enter Amin-Amin exchanger [6]. And this solution is recovered in exchanging with Amin's flow. Then, it preheats to the temperature of 100°C and enters disposal tower that as a result of food alternations, its temperature is 33°C now. The Amin-Amin exchanger is able to preheat this flow to 74°C [6].By reduction of flow temperature entering the disposal tower, the amount of gas fuel consumption will increase in the Tower Reboiler that this wastes energy resources and loses capital and will pollute the environment. On the other hand, as a result of outcome reduction of Amin-Amin exchanger because of the temperature of saturated Amin solution being low ,the temperature of Amin solution does not reduce sufficiently after exposing to Rich DEA solution .Thus,this increases the electricity consumption in air cooler (Amin cooler circulating).The flow temperature of the recovered Amin exiting from Reboiler of disposal tower is 120 °C now that enters pump and then air cooler after exchanging heat with Rich DEA solution with temperature of 80 °C (this temperature after a while will damage seriously the pump of solvent rotation).Finally the this study aimed to design the new Amin-Amin exchanger by use of the powerful Aspen HTFS software in order to obviate all the aforementioned problems.

4. Designing amin-amin exchanger by using aspen HTFS software

The HTFS software is full-fledged software in heat and mechanical designing thermal exchangers. HTFS is used to interactive and estimating designing, reduce the fixed costs and accelerate the construction of heat exchangers. This software together with Apsen HYSYS software are used in reducing the operational costs, in minimizing process cut off times and in increasing the efficiency of the process used. This program provides the details of costs estimation including materials costs and manufacturing costs .In this software, exchangers are designed based on the standard codes. Thus, designing calculations and maps can be directly used in constructing the exchanger. Integrating this software with HYSYS software leads to discovering process the bottlenecks, estimating performance process in the different operational conditions and reducing the maintenance costs .By using the HTFS, the engineers are able to simulate the current exchangers performance and to estimate development of the system efficiency .When the operational conditions change, HTFS can be used as to discover operational problems in terms of exchangers performance. This program can be used in new designing with the least fouling and corrosion. Using HYSYS and HTFS gives engineers this chance to analyze the disturbance such as tube fouling and quakes. All in all, the best operation procedure is to study the process in both softwares simultaneously. For example, with use of reviewing the temperature distribution, one can investigate the tension issues during setting up and disablement and choose the proper operational conditions.

In this study, the Amin-Amin heat exchanger is also redesigned based on the current conditions of gas refinement unit, and all of its costs are calculated (figures 2&3 and table 3).first of all, the new conditions of warm and cold flows and their components are defined in the HTFS software. Then after the designing, the obtained results are transferred to ASPEN HYSYS software. In the other words, the possibility of use of the new heat exchanger and its influence on parameters like the amount of reflections to disposal tower, acid gases condense in the sweet gas, and acid gases condense in the flow of the recovered Amin was investigated in the gas refinement Unit. The obtained results from exchanger designing and simulation of the gas refinement unit by using ASPEN HYSYS software revealed that in case of using the new designing, Amin-Amin exchanger is able to increase the Rich DEA flow temperature from 33°C to 98°C, reduce the amount of fuel consumption in the Reboiler of disposal tower for 14% and reduce the electricity consumed in air cooler for 100%.

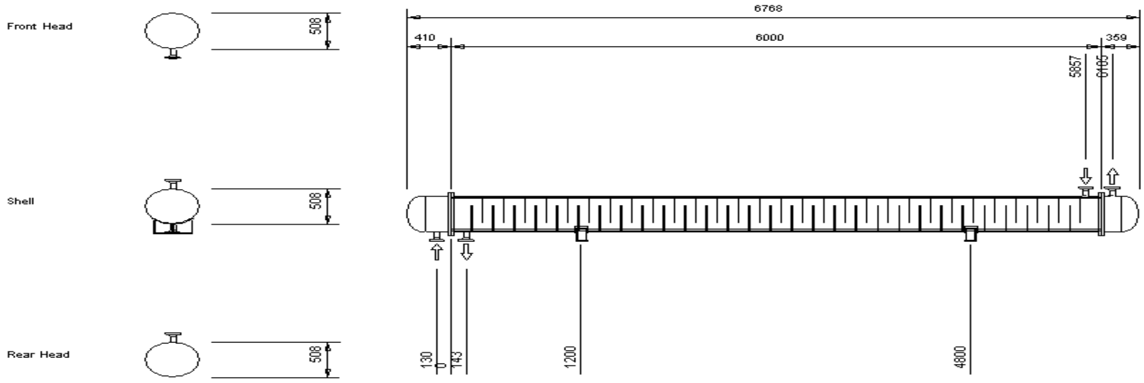

Fig. 2: The Structure of Amin-Amin Exchanger

Table 3: Heat Exchanger Structure

Tubes number	305
Tubes pressure drop (KP)	0.5
Membrane pressure drop (KP)	3.545
Bafel number	58
Bafels space (mm)	98.55
Inner membrane diameter (mm)	508
Tubes length(m)	6
Tubes diameter (mm)	1.65
Tube diameter (mm)	20
Fluid speed in the tube(m/t)	0.03
Fluid speed in membrane(m/t)	0.8
Allowed limitation of corrosion(mm)	1.59

There was a comparison between the current designing and the new designing in order to reveal the superiority of the new designing for Amin-Amin exchanger over the current designing and to improve performance of gas refinement Unit in the new condition over the current process (table 4).

Table 4: The Comparison of Performance of Gas Refinement Unit Based On the Current Designing and the New Designing for Amin-Amin Exchanger:

subject	The current designing	The new designing
Rich flow temperature exiting from Amin-Amin exchanger (centigrade)	74	98
The consuming energy in air cooler of Amin cooler in circulation (KWT)	205.55	0.0
Gas fuel consumption in the Reboiler of the recovery tower (KMT)	4. 67	3.12
Lean flow temperature exiting from Amin-Amin exchanger (centigrade)	80.52	57

5. Economic estimation

In this study, as there was not any basic change in the process and only the Amin-Amin exchanger was redesigned, the investing cost of the project will depend on the purchase price of the new exchanger that all of its costs were designed by computer (table 5).By comparing the heat exchanger costs obtained from reduction in fuel and electricity consumption, one can opine about justifiability of the proposed project. The calculations are as following:

Consuming energy based on the proposed project-current energy-the amount of reduction in energy consumption in Reboiler the amount of reduction in fuel consumption in Reboiler - 4.275-3.6 - .675(GJT)

Capital return - .675 [3] the price of each GJ of energy ×800

Capital return resulting from reduction in fuel consumption =675 ×3$ ×800 = 16200$ (per year)

Capital return resulting from reduction in electricity consumption in air cooler = 3 ×reduced electricity price (KWT) × 800

The cost of electricity consumption in air cooler = 205.55 ×.06$ ×800 = 98664(per year)

Capital return from the proposed project - Capital return resulting from reduction in fuel consumption - Capital return resulting from reduction in electricity consumption

Capital return from applying the new project = 98664 +16200 = 114864& (per year)

Table 5: The Heat Exchanger Costs

subject	price	unit
Worker costs	13334	dollars
Materials costs	5777	dollars
Piping costs	2970	dollars
sales	19640	dollars

6. Conclusion

Economically, doing this project will demand investing cost. The obtainable income from doing this project reveal that the rate of capital return and the project profit for Bidboland Gas Refinery is completely economical. These equipments are totally omitted from the process and its operating costs will are returned to Bidboland Gas Refinery. Finally, it was revealed that using the new heat exchanger causes capital-return to 114864 $ annually as result of reducing energy consumption in Reboiler and air cooler.

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