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PERFORMANCE IMPROVEMENT OF REFORMING FURNACE KHARG PETROCHEMICAL COMPLEX USING PROCESS INTEGRATION METHOD

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ABSTRACT

Kharg Petrochemical Complex to produce synthesis gas into methanol steam reforming of methane use. In order to provide heat required in reforming furnace and the furnace temperature to reach 880 ° C, the gas is highly 6MM scfd (million cubic feet per day) is used. Hot exhaust gas stream reforming rapidly to a temperature of 400 ° C and E-2006 converter cooling. The main issue of this study is reforming furnace heat hot exhaust flow in heat exchangers happen. In this thesis integration process with the aim of reducing fuel consumption reforming furnace gas (Fuel Gas) and utilization of waste heat, will be discussed. First reforming unit, taking into account all the details Aspen Hysys simulation software environment and the energy required for it is calculated on the grill, Then, using energy analysis Take advantage of the hot exhaust stream reforming in order to recycle heat loss in the heat exchanger will be discussed. The results of the analysis showed that the exchange of energy between hot stream and the feed inlet to the outlet of the reforming furnace (methane and water vapor at certain molar ratios) in a heat exchanger (Waste Heat Reboiler), can be 185035772 kj / h Energy retrieve and gaseous fuel consumption reduced by up to 2 MM scfd. Another advantage of using this method can reduce air pollution (emissions) aims to reduce gaseous fuel, said.

Keywords: Kharg Petrochemical Complex, Reforming furnace, Furnace gas, Process integration

1. INTRODUCTION

Thermal integration expresses the way of heat recovering, and, in concise, process integration means: General and systematic models for integrated designing of production systems, inseparable processes all over of the site with an emphasis on the effective use of energy and reducing environmental impacts. This is the obvious point of the designing methods but the word of integration means a process for describing physical arrangement such as connecting equipments and process lines in the Unit [1-3]. The following cases are the reasons for the use of processes integration in Units and designing [3-5]:

1. Reducing annual costs by means of determining the parallel relationship between operation costs (raw materials and energy) and investment cost (equipment). The parallel relationship condition in the processes integration can be in reducing energy consumption, improving he raw materials consumption and reducing equipments cost.

Increasing production capacity (Unit capacity) by using process integration for removing bottlenecks

2. Reducing process problems (startup and shutdown) with the most correction which is the most use of process integration.

3. Increasing the process controllability (is from inner tool and is different from process controlling). Simplify the control by choosing the Unit (topology) interconnectors and equipments parameters without considering the system real control.

To ensure system flexibility by considering Unit characteristics (raw materials and or new products, the production capacity compatibility and etc) and unwelcome (such as exchanger fouling and catalysts inactivity) when opposing with operating conditions change, by proper choose of Unit interconnectors and equipments features

4. Unwilling reduction of the Unit wastes, for example, reduction of fossilized fuels, connection to auxiliary resources of energy generation, closed processes and etc

5. Adding some challenges to industrial processes and community in order to have a stable development

The starting point of process integration for energy consumption reduction is 1980. From 1980 onwards, some methods were developed for industrial applications such as the total of annual costs, application in Unit and the Unit flexibility. Nowadays, social estimations such as environment, nutrition are an inseparable part in the process integration. The main reason for achieving

benefits of using process integration is in fact matters which make us closed to systems requirements. Most of the units in the industry have very complicated inner interconnectors such as advanced components; as the result of being so, we will be closed to the Unit basic requirements. The local researches are absolutely effective in optimization. In the thermal integration level, the process integration can determine the optimal level of thermal wastes which are compatible with designing of exchangers networks in terms of the least costs of equipments. In the level of heat and Tolen, the process integration can determine the optimal amount of loading and or the consumption level and or vapor production and also the positions of heat and power systems combination. In proper economic and thermodynamic optimization, the proper process of heat pup can be chosen by using graphical diagrams and systematic methods. In terms of the Unit production increase, the process integration can be used in removing the bottlenecks to increase production capacity [6-9]. As an obvious example, consider an energy system which has mass flow limitation during the process. This event is always seen when the furnace is working at its maximum capacity in the most of the oil refining units. The integration is also

effective in avoidance of investing in the sections of supportive units by using optimum recycling of heat in the process. When the operation is under consideration, controllability and flexibility of the Unit revealed that most the time the major wastes were in the inner interconnectors. The process integration has a more focus on the process structure. The methods compatibility is a vital tool for finding the wastes related to the unit operation. As an example, the Unit flexibility may be achieved from installing additional equipments and components more than the Unit real requirements. In such a condition, the process integration can be used in determining the additional investment place for determining the effective flexible capital. In the environment and stable development, the process integration presents the systematic methods to reduce capital, to comply the government regulations and community expectations. Reducing polluting gasses and wastewater is an example of its benefits (means reducing water consumption). Finally, one can say that the processes integration results causes an increase in information relating to key elements and the dependents in the Units (11-9). The thermal integration is a method to minimize energy consumption based on thermodynamic equations. This objective can

be achieved by optimizing heat recovery systems, methods of supplying the process energy and its operation conditions. This technology is known as thermal integration, energy integration or pinch technology integration [11].

Pinch technology is a heat exchanger network design ensures minimal energy consumption. Exergy analysis uses the first and second laws of thermodynamics to compute Energy flows in the system and to determine non-optimized components. On the other hand, pinch technology is a general method to designing the processes that it has the ability to target the largest possible correction before final designing and simulating. But the disadvantage of this approach becomes apparent when it is used in power generation systems. Therefore, a new method to overcome the weaknesses of these two methods was developed called pinch and Energy combined analysis.

This new method can be used to optimize the systems such as power plants. Some refineries are running a special technique called hydrogen pinch to minimize the amount of investment costs by implementation of an efficient management of resources on hydrogen and its supplying resources and to gain economic profit in a short term by a thrift in these reduced costs. In this approach, the first law of thermodynamics was used to calculate the enthalpy changes in passing flow from a heat exchanger and the second law was used to determine the heat direction. In traditional designing, the process is design at first and then the mass, temperature and flow rate are defined through balancing. Then, the thermal system designing is completed and the remaining cases are determined. Each of these steps can be performed independently. But in a pinch designing, the process integration offers solutions to minimize energy consumption by using pinch technology before designing the network heat recovery. The limitations of the heat and utility recovery systems were considered later on. Pinch designing determines process optimizing chances and heat integration improvement. This method helps optimization of heat transfer equipments during their designing [11].
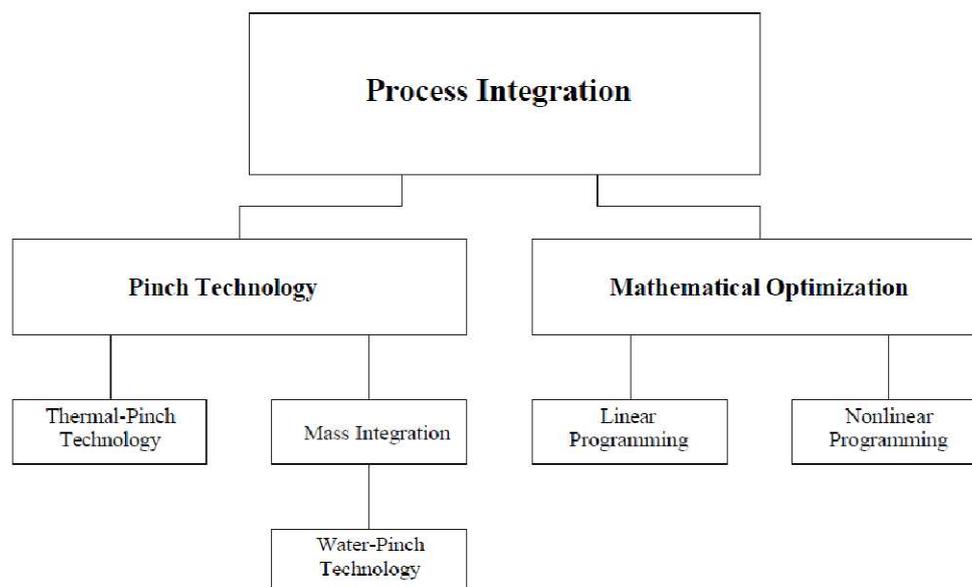
Fig. 1: the relationship between the process integration branches

2. The need for energy efficiency in industry

Applying special methods to determine effective and economic way in a process is called optimization. Optimization is one of the most important decision-making tools in the industry. Optimization chooses the best response or solution from possible responses by applying effective and quantity approaches. But, computer and related software make the required calculations possible with the least costs. Saving energy is always one the most significant considering issues in designing a chemical Unit. Moreover, determining the least amount of heat and cold energy needed by a process is one of the major calculations for determining the amount of energy saving. Therefore,

thermal integration (energy unification) is one of the major factors in economic designs. The brand of pinch technology is known for active researchers and scholars in the field optimization. This technology is used in analyzing and investigating the heat exchanger network in order to reduce energy consumption [12].

Vredeveld and Linnhoff investigated the thermodynamic approach to reduce energy consumption in heat exchanger in the end of 1970s century. And they introduced concepts like combined curve as an important tool in the heat energy recycling [13]. Pinch technology has developed over times, as it is used in the heat exchanger network to optimize energy consumption in the distillation towers, furnaces, evaporators,

turbines, reactors. But this technology faced some problems such as limitation of pressure drop in modifying the current systems, Unit complexity, piping cost, safety problems and etc. The problem of pressure drop was obviated in the beginning of 1990s and in the middle of 1990s, the regional matters that made this technology impossible to operate and uneconomic were resolved [13]. Pinch analyzing tools of integrated curve and the integrated curve are comprehensive (figure 2).

3. Description of the process

in this unit, parenteral (Table 1), which includes natural gas (mostly methane) and water vapor at a temperature of 322 ° C and pressure of 5.25 bar picker 2001 Net heat exchangers (hot box) by the flow of hot gaseous fuels   Are. In this network of heat exchangers in addition to heating the feed reforming furnace, air furnace as fuel reforming, and other streams including water vapor during the cooling operation, its temperature has dropped again to the required temperature and reached feed-in converter transformers to be sent Shvnd. jryan 2001- E In contact with the hot gas and the fuel flow to a temperature of 560 ° C oven heats up and reforming to produce syngas write. In the flow of hot gas (temperature of 990 degrees Celsius is the

current) converters E-2002And E-2003And E-2004Entered in the converter or water vapor flowing currents of water during the two-phase process operations have become converts to superheated steam.

In converters E-2005The compressed air flows into the hot gas heated to a temperature of 320 ° C, and then compressed and heated air stream as fuel reforming furnace is used. Air compression takes place in the compressor 2002, this compressor energy from the turbine (turbine using High pressure steam for powering the compressor funded) funded, Air pressure is from atmospheric pressure to 11 bar. The more air that is compressed and heated with Yshgrm feed into a reformer (H-2001) be. In the steam reformer is used in high temperature and pressure, methane, carbon monoxide and hydrogen to be converted (Figure 3 and 4). The output of the steam reformer as synthesis gas with 880 ° C and 20 bar pressure in the second part of the feed preparation unit write. In this stage, the cooling of the synthesis gas is produced from the steam reformer. For this purpose, heat exchangers and separators to fill the two-phase cooling effect predicted synthesis gas are used. The synthesis gas enters the heat exchanger at 880 ° C.2006 A / B and in touch with current HP BFW Cooled to a temperature of 400 ° C, followed by the

transfer of heat to the HP BFW The HP STEAM 2001 turned into a reservoir located above the heat exchanger network will be sent.In this project both heat exchanger (E-100And E-101) That have been replaced by air cooling using specialized software designed heat exchangers Aspen Bjac The thermal and mechanical design have been optimized (Figures 5 and 6).
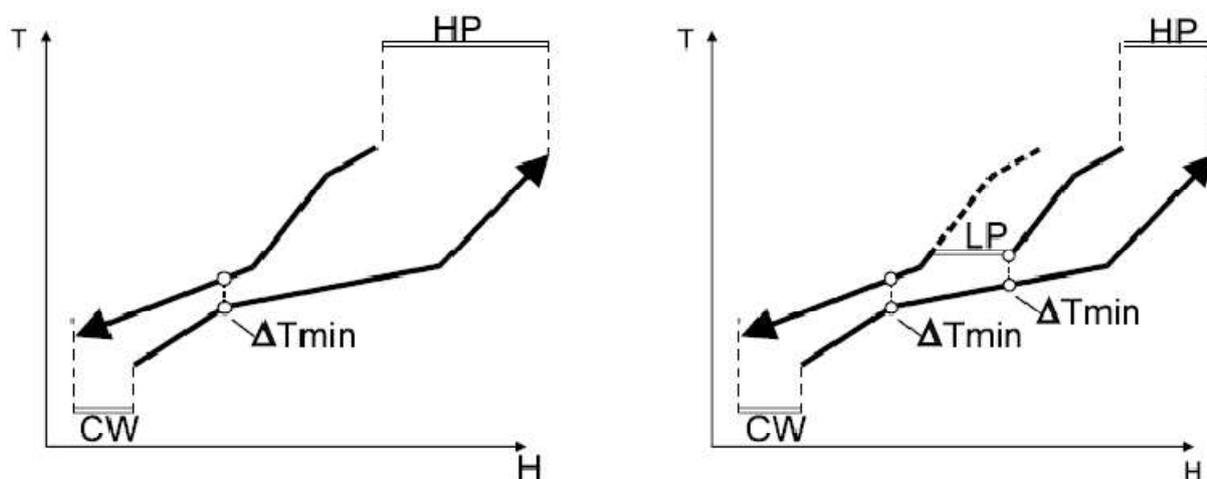

Fig. 2: Temperature-enthalpy curve for analyzing pinch [13]

Table1: compound feed inlet reforming

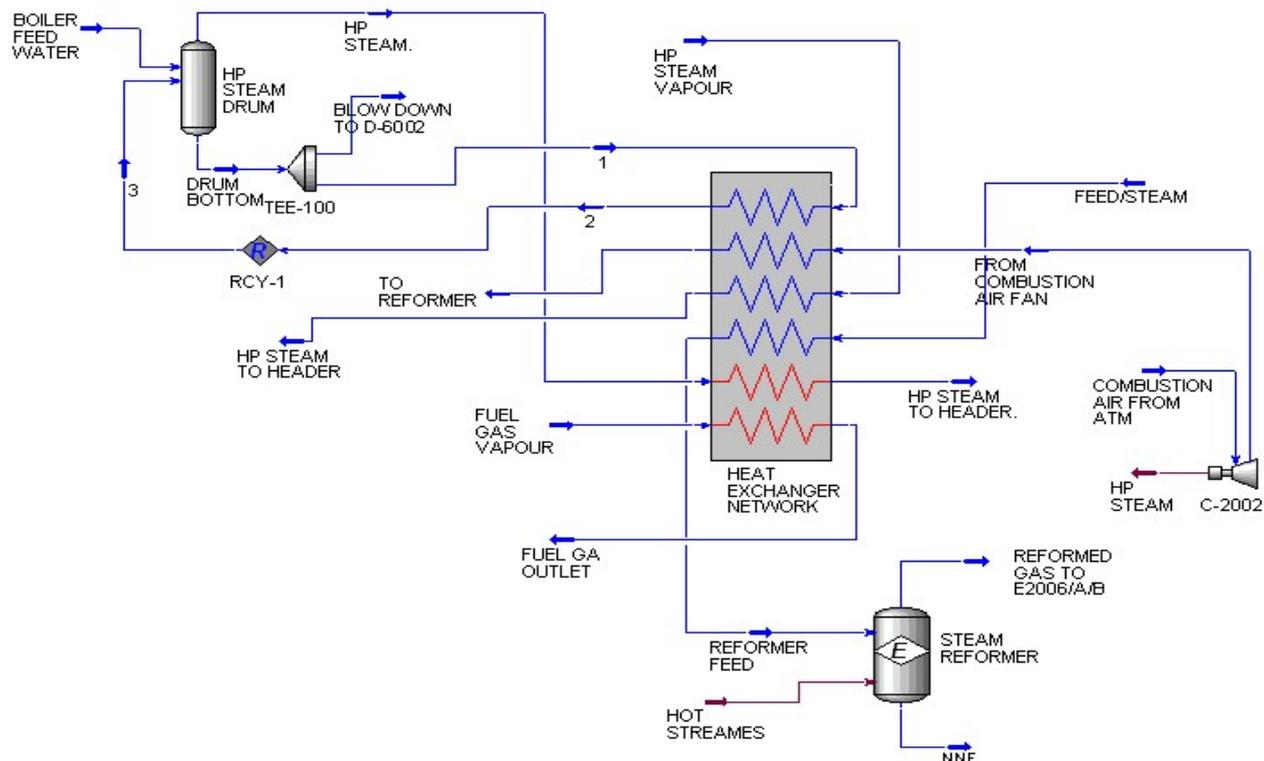| Component	Mole Frac
CO_2	0.000300
CO	0.000100
H_2	0.010301
C1	0.205816
C2	0.034503
C3	0.002700
IC4	0.000100
NC4	0.000100
IC5	0.000100
NC5	0.000100
C6	0.000100
N_2	0.000020
Methanol	0.001300
H_2O	0.7444600

Figure 3: Preparation of feed and reforming Kharg Petrochemical Complex
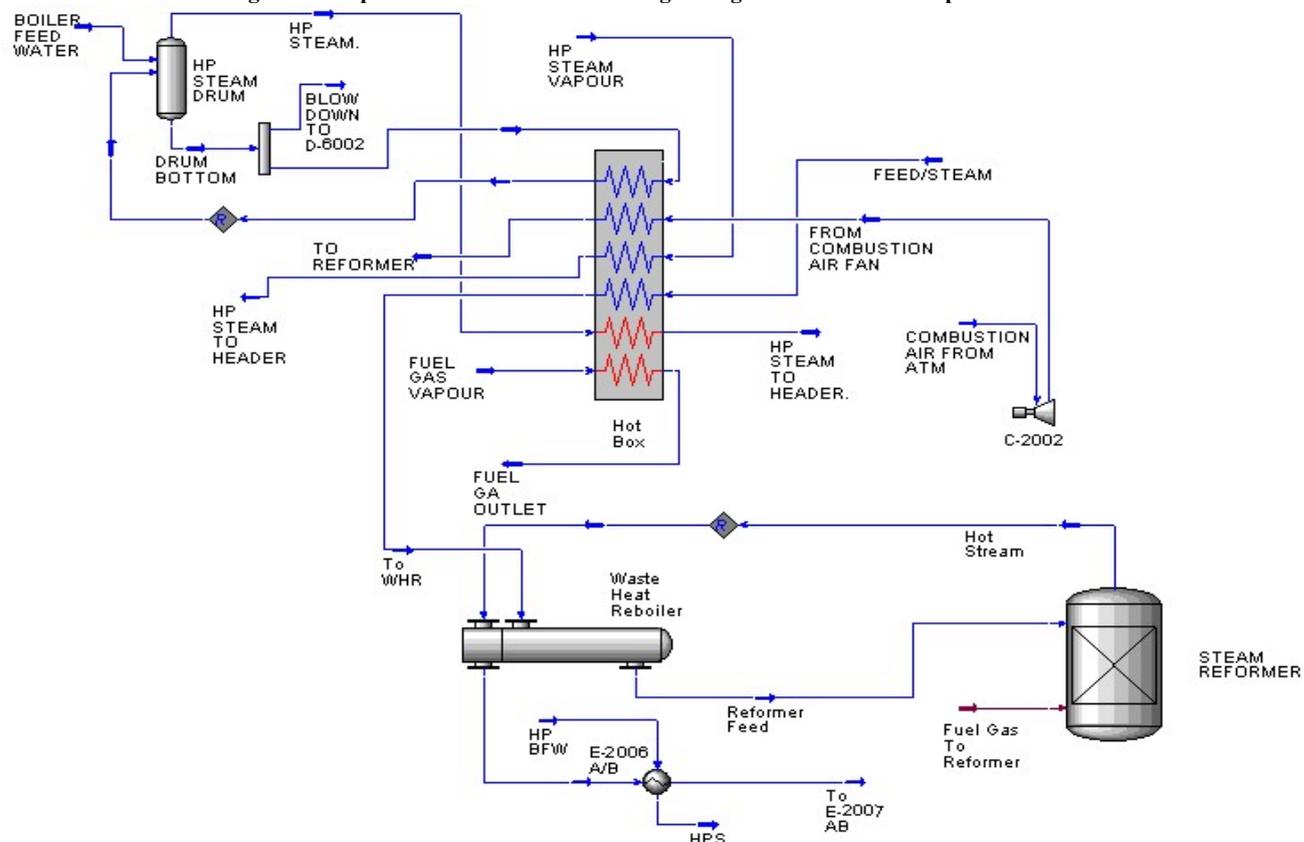

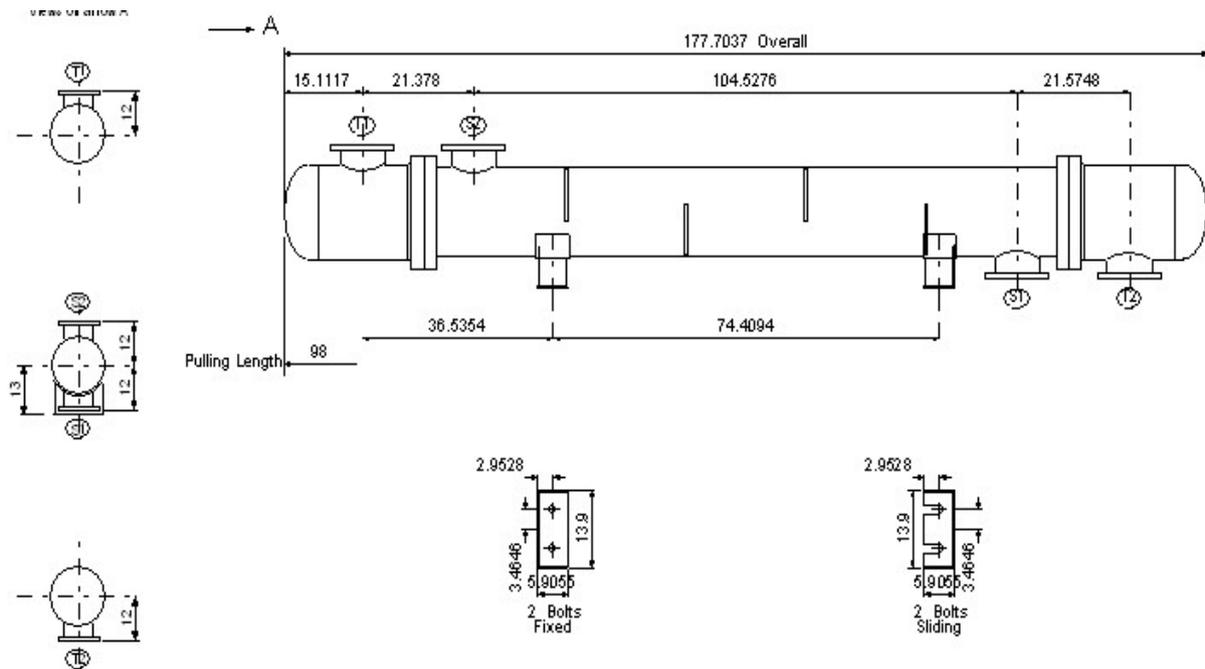**Figure 4: optimization and recycle dissipation reforming heating furnaces**

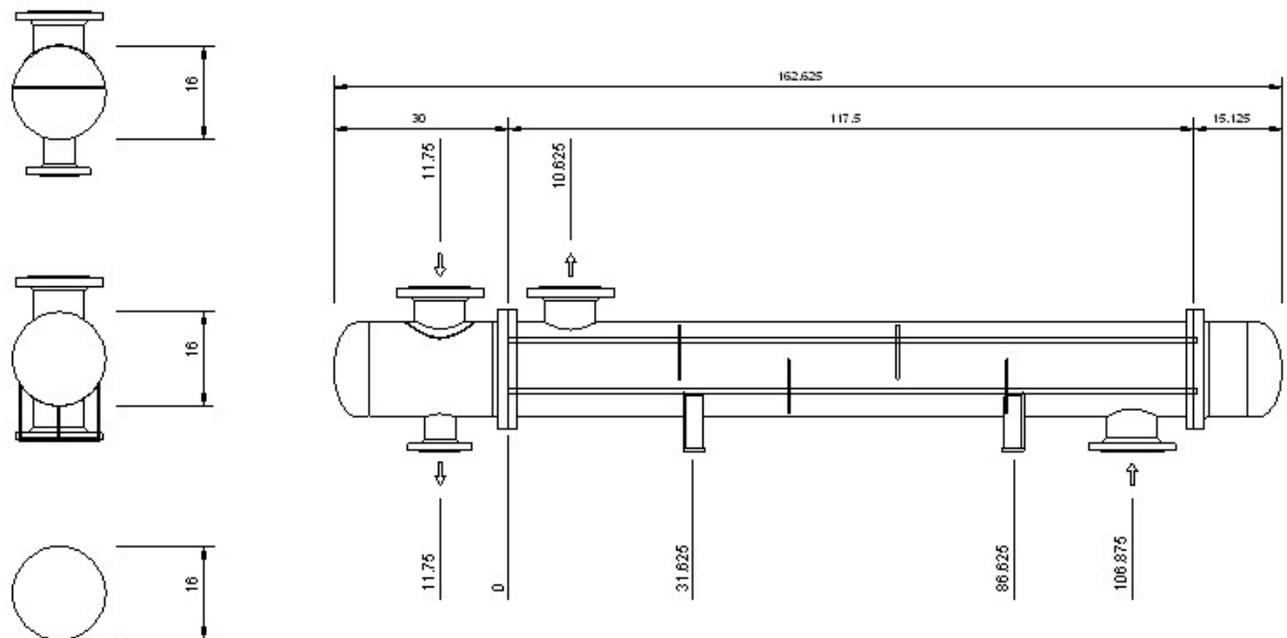**Figure 5: The mechanical design of heat exchanger E-101**

Figure 6: The mechanical design of heat exchanger E-100

4. CONCLUSION

In economic terms, the project will require investment of course obtainable revenues from the project show that the rate of return on capital and profits of the project will be economical Kharg Petrochemical Company perfectly.

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