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SIMULATION OF MAROON PETROCHEMICAL DEPRPANAIZER UNIT, ITS DESIGN AND ECONOMIC ASPECTS

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ABSTRACT

Petrochemical industries producing a wide variety of polymeric materials play a significant role in the modern and modern human life. Polymer materials today meet an important part of human needs, and the application of these materials in various industries such as coloring industries, resin industries, clothing industry, classification industries, aerospace industries, automotive industry and hundreds of other industries represent this important role. Modern human beings seek to achieve nanotechnology as well as smart polymers. Iran, our dear country, enjoying huge oil and gas resources, can be considered as an important pole of the production of polymer mate rials in the world. In this project, we try to find some issues such as simulation of the propylene production unit, the impact of the main process parameters on the product, as well as economic calculations, such as the construction, installation and commissioning of the unit, which is the most important part of the project.

Introduction

Maroon Petrochemical Company as the implementer of the 7th Olefin Project, was registered under the number 148012 at the Tehran Office of Industrial Enrollment and Registrationat the pre-operational phase indate 1999/Feb/13. The start date of the project was in 2000 and it was predicted to beexploited in 2005. Currently, the company is a subsidiary of the National Petrochemical Industries Company. The main center of the company is located in Tehran and its factories are in Ahwaz (9.5 hectares) and Mahshahr (petrochemical special economic zone - 93 hectares).

In accordance with article 3 of its articles of association, it is active inthe construction, commissioning and operation of industrial plants for the production, marketing, sale, export of petrochemical products, the storage, import, export and conversion of all petrochemicals and related derivatives and all Industrial, industrial, commercial, technical and engineering activities directly or indirectly related to the operation.

The Company

Galas: The purpose of the company's establishment is to create a petrochemical complex for the production of basic and fundamental petrochemicals using extraction C2+ gas in the natural gas in Khuzestan region and its conversion to various polymer and chemical products. The choiceof the latest and best technologies with world-class capacities, being to the environmentally friendly by choosing advanced technologies, recovering them from natural gas for the first time in the country, creating the most equipped safety systems, training and technology transfer, maximum use of domesticman force in designing, engineering and manufacturing equipment, the use of internal contractors in installation and commissioning are of the highlights of the company.

Final products: In maximum capacity of the complex, over 1,300,000 tons per year are produced from different materials, polymers and some sub-products, which, in addition to exports, provide a large part of the downstream industries.

Geographical Situation: one of characteristics of the seventh olefin plan is to provide integrated feed supply using their compounds and heavier hydrocarbons in natural gas in the Khuzestan region for the first time in the country; hence the design is carried out geographically in two regions.

A) kirit Camp District, Ahwaz: At this site, Ethan Retrieval and other related facilities have been constructed in an area of 15 hectares for the extraction of ethane and heavier compositions in light gases of NGL 1500, 800, 700, 600, 400. The product of the Ethan Recovery Plant (C2+) is sent as a feed to Mahshahr Olefin unit using pipeline.

B) Mahshahr Petrochemical Special Economic Zone: Maroon Petrochemical Complex including Unit of Olefin, Polymeric and Chemical units and public facilities has been established in a 93-hectare land on the site No. 2 of the Petrochemical Special Economic Zone.

Technical knowledge and implementation stages: Among other features of Maroon Petrochemicals project is the use of technical knowledge, technology and advanced processes and global scale capacities. Design, engineering, purchasing machinery and equipment was assigned to international accredited companies with the participation of domestic consultants. The selection of all processes and technologies has been done in a way that is in line with the environmental standards of the climate of the country and is optimal in terms of primary costs and secondary services cost of production and repairs as well as the possibility of future development. The complex contracted with 7 internationally accredited companies to obtain technical, design, engineering and procurement of machinery certificates. The design and engineering of this complex has been started since 2000. In this regard, companies such as Linde, Uhde, Tecnimont from Germany and Italy and Pides, Sazeh, Nargan, Eied companies from Iran carried out engineering and logistics activities and construction and installation is done by domestic companies.

The licensees are from Basell, Shell, and Stamicarbon companies. Forcoordination and uniformity in the design and supervision of the installation and commissioning of the complex, Saze company has been chosen as the contractor for the entire manager and the designer of off-site facilities, and has been responsible for the tasks involved.

Process Description

General description of the process

The C3 fluid particle enters from the top of the 10-T-4001 depropanizer to the 10-T-C3 (4301A / B C3 - SpliHer)Separator. The separator consists of two parallel towers, which are

re-boiled with 10-E-4311 A and 10-E-4311 B Reboilers. Each of these two Reboilers is intended for a tower. For the purpose of creating a heat balance in column a rinse water is warmed up to about 87 ° C. Steam in Heater E-4313 10 while flowing from the Reboiler, is returned to the 10-E-2311 cooler. The water flow velocity is controlled by the Reboiler, in which the flow of water of inlet and outlet temperature is measured. In addition, the inlet water temperature of the water to Reboiler can be adjusted by the Lp steam, which flows to the 10-E-4313 wash water heater. The end product of the separator C3 10-T-4301 B, of which approximately 92.5 wt% is propane, is removed under surface flow control and is mixed with recycled C4, in is vaporized10-E-2112 vaporizer and will be converted into a Super Heater in 10-E-2112 Super Heater.
Super-heated C3 H8 and recovered C4 before they enter the furnace will be mixed with a C3 positive particle. At the top of the separator tower 10-E-4312A / B, the C3 particles in the 10-E-4312 are placed against cold water in condenser and are collected in Reflux Drum 10-D-4312A / B). A part of the condensed propylene from 10-D-4331 is returned by the Reflux pump (10-P-4371A / B to the C3-spitter tower). The product of the residual propylene product is pumpedby 10-P-4371 A / B separator and pump of product of 10-P-4372 A / B propylene during a normal operation directly to the electric range. In some cases, the propylene product may be sent to the propylene tank, in which case the propylene product is cooled in the propylene cooler (10-E- 4314) before being stored approximately to15° C below the HP Coolant andthe flow of propylene is released with a surface control from 10-D-4331.

Detailed Description

The C3 fluid component is pumped through a reflux pump from the top of the 10-T-4001 depropanizer tower to the nd52 tray of the two C3 B, A 10-T-4301 separators that operate parallel to each other. The following explanation refers to the 10-T-4301A separator function In addition, the training of the 10-T-4301B separator function will be added in brackets.
The feed speed is set by the surface flow cascade. The 10LIC43011 (10-D-4031) controller at the designated point 10FIC40421 (422) that adjusts the C3 particle flowdirects it to 10-T-4301 A (B). 10-HC-40311 distribution controller has been addedto distribute C3 separators. 10-T-4301 A (B) separator separates a high-propylene particle and a low propylene particle, which contains approximately 3% mol of propylene and about 1.5% of acetylene C3.
C3 10-T-4301 A (B) separator is heated by the Reboiler of C3 splitter 10-E-4311A (B). Water removed from the 10-P-2371 A-C wash pump is heated in a 10-E-4313 heater against Lp steam to a temperature of about 87 degrees centigrade. The Lp stream to the 10-E-4313 wash water heater is controlled by a temperature cascade, 10TIC43102 / 10FIC43104 current and is controlled by thermal control of 10-E-4313water. The QIC4301 thermal controller (111) controls the flow of water to the 10-E-431A (B) reboiler.The heat load is calculated according to the flow of 10F143101 (111) and the temperature difference between the inlet water to 10T143102 and the outlet of10T143103 (113) is calculated. The input required for heat load is based on the amount of C3H6 measured by the separator 10A143206 (306) in the lower gas phase of the lower fluid.
The natural amount of propylene in 10A143206 (306) should be 3% mol / mol.
The particle of propylene collected in the 10-T-4301A (B) C3 separator is introduced into the recycling constituent 10-E-211, where the particle is evaporated along with the C4 resulting from the separation of C4 / C5. The propane flow from the 10-T-4301 is controlled by the 10FIC43208 (308). In the event of an increase in the level in the shelldeal, 10-E-2111, 10LIC21203 blocks the propane control gage 10FV43203 (308) through the minimum 10Fy43203 (308), regardless of the signals, of the 10FICU3208 (308) controller.

The gas above the 10-T-4301A (B) C3 separator is condensed completely in the E-4312A / B separating condenser against cold water. The 10-P-143204 (304) pressure related to 10-T-4301 is determined by the pressure condenser at 10-E-4312 A / B. Condensed gases that accumulate in the condenser or in the gas phase of the Reflux Drum 10-D-4331 increase the pressure in the C3 separator, which this increase in the pressure is displayed and alerted by 10P143204 (304)
These condensed gases can be released to Flare from top of the condenser or fromReflux Drum 10-D-4331. If the pressure of the condenser continues to decrease, two of the 3 pressure switches (10PSHH43402 A-C) will stop the Reboiler warming up by closing the water inlet valve 10 Q763101 / 111 to prevent the failure of the safety valves.
In addition, the upper gases are suitable for controlling the pressure of A / B 9101-TK-10 propylene tanks (line 43406). When the reservoir pressure is lowered to 8barg, 10PIC91207 requires gaseous propylene. Condensed propylene is collected from 10-E-6312 A / B in RefluxDrum (10-D-4331) related to C3 tower split. The propylene fluidized by the RefluxDrum (10-D-4331) for the C3 splitter is sent to top of C3 (10-T-4301 A and B) as the Reflux and some as propylene products to the propylene pump A / B 10-P-4372. Using this pump propylene product is directed through a product coolant propylene 10 -E-4316 to the propylene tank
B / A 9101-TK-10. Reflux flow velocity is controlled by FIC 43209 (309) current flow controller with minimum flow alarm. Regarding the minimum flow rate of 10-P-4371 A / B pumps and high energy dissipation, this controller allows the natural gas lines to remain closed. In the case of the Reflux flow to the C3 spliters, which is below the minimum flow of 10-P-4371 A / B, block valve of downstream associated with the Restriction orifice in the minimum flow path should be open. During standby, "1 block pass valve around the Restriction orifice should be open. Both reflux flows should be reduced to below the minimum reflux flow rate, low flow switches of10FSLL43209 and 10FSLL43309 to turn on Spare A / B 10-P-4371 pump,must activate the output 2 from switch 2. This is to ensure that the flow of propylene flows in the specified path and to prevent high pressure in the C3 separator, which causes trip of both columns through 10PSHH 43204 AB. If the C3 A / B 10-P-4371 separator Reflux pump is turned on and the spare pump is not onduring 15 seconds, the Propilen 10-P-4372 A / B product pump will also be automatically cause a trip;each of the C3 A 10-P-4371 and B 10-P-4371 Separator Reflux Pumps and 10-P-4372 A / B propylene pumps are equipped into a liquid drum seal and a minimum flow line (which is normally closed for 10 -P-4371 A / B). Also due to the automatic startup of the sparepump, there is an additional bypass 1 "around the block valve in the 10-P-4371 A / B current line, which should be open. In Reflux Drum, (10-D-4331) related to the C3 separator is controlled by 10LIC 43401,which in active at the split range on the propylene product valve to the 10FV91515A battery range via the minimum selection of 10 Fy91315 A,as well as LV43401 B to the C3H6 10- TK 9101 A / B tanks.
If 10-D-4331 level is increasing, then 10LIC43401 must first open the minimum selection through 10FV91315, so that 10FIC 91315 controls the propylene product and limits the flow. In case of further increase in the level of 10-D-4331, 10LIC 43401 to transfer propylene from the Reflux Drum of C3 separator topropylene tanks will close. In the event of a decrease in the level, the splitrang 10LIC 43401 controller will close the LV 43601.B and then 10FV91315.A, through the 10Fy91315.A minimum Selection, regardless of the 10FIC 91315signal. The C3H6 product stream to the battery limit will exit through C3H6 10-TK-910 A / Bspheres.
The obtained C3H6 is measured respectively by 10F1 / FQ43510 at battery limit and C3H6 reservoirs. The resulting propylene obtained cools down 10-E-4316 of fluidized propyleneagainst propylene HP (+ 10c) before it is directed to propylene tanks. The amount

of C3H6 obtained is controlled by 10LIC 43501. Propane, methyl acetylene propadiene in the exhaust gases from the 10-T-4301 A (B) C3 separator are measured by the AI 43207 (307) A / B analyzer. Estimated values are:
Propane 0018 mol%
Methylacetylene + Propylene <1 mol. Ppm
The pressure drop in tray 1 to 206 and tray 53 to 206 of C3 separatoris measured by PDI43205 (305). There are similar valves for measuring pressure in different parts of the tower that should be opened and closed.

(Process Data at Normal Operation)

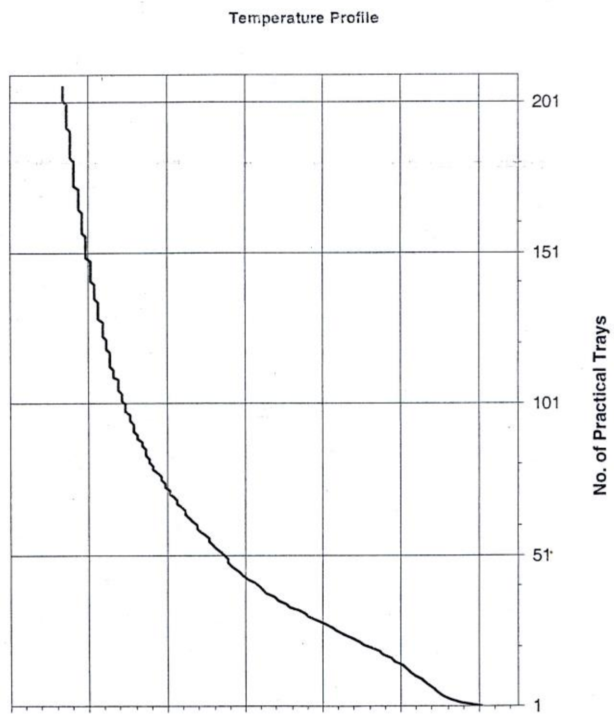
C3 Spilitter 10-T-4301 A(B)

Item / Location	Flow (Kg/hr)	Pressure (bar g)	Temperature
C3 feed 10FIC40421(422)	22016		46,5
Bottom product 10FIC43208(308)/ 10TI43202(302)	9348		57
Operating pressure 10PI43204(304)		18,0	
Reflux 10FIC43209(309)	272087		
Overhead temperature 10TI43203(303)			46,3
Pressure drop total 10PDI43205(305)	770 mbar		
C3H6 content bottom (gas) 10AI43206(306)	3,5 mol %		

Reboiler 10-E-4311A(B)

Item / Location	Flow (Kg/hr)	Pressure (bar g)	Temperature
Wash water flow 10TIC43102 10FI43101(111)	900009		87
Wash water outlet temperature 10TI43103(113)			65

Temperature profile C3 splitter



Project design and process economics
Concept of process design
The main task of a chemical engineer is the design, construction and commissioning of chemical plants. To do it, the engineer must always seek to obtain more information. Such information can be gathered from a variety of sources, including new magazines, the review of the operation of existing process factories, the data obtained from the laboratory and the semi-industrial unit. The collection and review of all the information obtained is so important that chemical engineers, as members, advisors or research team guides, usually participate in the development of any new process or upgrade and review the existing process. In this case, a chemical engineer can always advise the research team on how to provide a significant amount of valuable design data. The following decisions should be taken on a variety of subjects on a regular basis, while designing each process. What are the best ways to collect adequate and usable data? What information is sufficient and what information is reliable? Can there be better communication between the data so that better outsourcing can be achieved? And so on.
A chemical engineer must always strive to achieve completely new designs. An attempt to understand the process controller, whether physical or chemical, is useful for proposing new or advanced methods; for example, consider the process of aromatic nitration and the isobutane alkylation with olefins to produce high-octane gasoline. Both reactions have two incompatible liquid phases and the mass transfer stages are controlled by the reaction speed. Nitrate ethers are usually produced with high yields (up to 99%), although the isobutane alkalinity involves a lot of side effects and very complex chemistry that is hardly understood. Different types of reactors are used for each reaction. New and simpler responses have been made based on a better understanding of existing chemical and physical processes. Each design project always begins with an initial idea or map. This early idea should be expressed as precisely as possible to define the project's perspective. General characteristics and laboratory data and chemistry engineering should always be presented with the basic idea.

Types of design
Design methods
The methods of each design project can be classified according to the accuracy and details required:
1. Preliminary design or design with quick estimate
2. Detailed Estimate Design
3. Firm design or detailed design
Preliminary design is typically used as the basis for determining whether more work is needed on the process to be performed. Design is based on approximate process procedures and provides inaccurate estimates of cost. Particular information is provided in a small amount so that a minimum amount of time is spent on calculations. If the preliminary design findings show that more work is needed on the process, detailed design estimates can be developed. In this type of design, the costs and potential of process profitability are fully explored and calculated. Of course, in this design, at least, the exact features of devices and maps are presented. If a detailed design of the project indicates that the project is economically successful, the final step before the design of the plant is to prepare a reliable design, in which the full features for all components and costsis provided. This design includes enough information to quickly prepare the factory's final designs.
Feasibility Study 7 1
Before performing any kind of minor tasks, the technical and economic parameters of the process should be investigated. Different reactions and physical processes should be considered in conjunction with the market situation for that specific product. A preliminary

review of these types of signs indicates the potential success of the project, indicating that the additional information needed to complete the evaluation. Below is a list of issues that should be considered in the feasibility study:

1. Raw materials (availability, quantity, quality, cost)
2. Thermodynamics and kinetics of existing chemical reactions (equilibrium, efficiency, speed, optimal conditions)
3. Facilities and devices available
4. Facilities and devices to be purchased
5. Estimated production costs and total investment
6. Profits (probable and optimal per pound of product annually, return on investment)
7. Building materials
8. Safety Considerations
9. Market (current and future supply and demand, current consumption, future consumption, current purchase price, main product range and sub-products, attribute characteristics, number and position of potential customers)
10. Competition (production statistics, comparison of various production processes, product characteristics of competitors)
11. Product Characteristics (Physical and Chemical Properties, Specific Properties, Impurities, Effects of Storage)
12. Sales and after-sales services (sales and distribution methods, advertisements required, technical services required)
13. Transport restrictions and transportation tanks
14. Factory location
15. Patent situation and legal constraints

When detailed data on the process and the main features of the products are available, a complete review of the market can be made, taking into account all the sales factors. These surveys can be made up to the number 9 listed above.

Process development

In many cases, an initial feasibility study indicates that further research, laboratory information, or data from a semi-industrial unit is needed and a plan that provides this information should be provided. The development of a semi-industrial scale process is usually required in order to obtain accurate design data. Valuable information on material and energy balances can be obtained and the process conditions for providing data on temperature and pressure variations, returns, raw material properties, product characteristics, continuous or discontinuous operations, material, operating characteristics, and other design variables can be asssessed.

Designing

If sufficient information is available, the initial design can be developed along with the feasibility study. A chemistry engineer in the preliminary design must first determine the production process applicable to the production of the desired product. Usually, there are different processes and methods for producing each product. Except for obviously inappropriate processes, the rest should be fully considered. The first step in the design is to determine the basis for design. In addition to the fact that the product properties and the availability of raw materials are known, design can be done by factors such as annual operating factor (part of the year the plant is in operation), cold water temperature, pressures for steam, fuel consumption, amount of secondary products and so on.

The next step involves preparing a simple flow diagram that represents the processes that are available and making decisions about each unit operation possible. The initial balance of the material at this stage can remove some of the various situations very quickly. Flow rates and stream conditions for residual and critical states can be evaluated by material balances, energy balance, and raw material and product awareness, efficiency, reaction speed, production time cycle. Temperature, pressure and composition of each process are determined. Enthalpy of currents, vapor, liquid and solid percentages, the role of heat and .... are added to the process if necessary.

The principles of the unit process are used to design certain pieces of devices. Devices are generally summarized in tables and attached to the final design report. Those tables usually include:

1. Columns (distillation) In addition to the number of trays and operating conditions, it is necessary to determine the diameter of the column, its diameter and the shape of the plates.
2. Containers, in addition to the dimensions that usually are determined with the time, filler materials and barriersshould be specified.
3. Reactors, type of catalysts and sizes, the diameter and its thickness, the heat exchange facility, the cycle and the catalyst regeneration method, the material, and the ...... should be specified.
4. Heat exchangers and furnaces; usually producers provide information such as the logarithmic average temperature difference, the percentage of evaporated material, the required pressure drop, and the material.
5. Pumps and compressors; the type, power required, differential pressure, gravity, viscosity and operating pressure.
6. The precision instrument and its other requirements must be specified.
7. Special machines such as mechanical separators, mixers, dryers, etc.

This list is not complete. But is presented as an overview of the type of summary required. As outlined in the summary, the choice of material depends entirely on the design and selection of the appropriate device.

Once the devices are known, the necessary side and human resources can be determined and listed in the table. The investment estimate completes the product initial design calculations. Economic evaluations play an important role in the design process. This is not only necessary for each particular process, the choice of raw material, the selective state, but also necessary for the determination of the characteristics of the device. No plan of machine parts or process steps is complete without economic evaluation. Assessing costs in the initial design can help the engineer eliminate many of the various things. The final stage and most important step in designing each process is to write a report that incorporates the results of the design. Unfortunately, this part of the design is ignored by chemical engineers. Sometimes some high-engineering ideas and calculations are removed, because there is weak link between engineering and management.

Construction and operations

When it is decided to build a factory, there is always interest in its rapid launch. Delays may take place in the manufacture of major parts of the device and they may be delivered much later than the specified time. When developing the final maps, these factors have to be considered. One can use the method of reviewing and evaluating the project technique or the critical path method for controlling construction operations. The chemistry engineer should always work alongside other people along with the final stages of construction and purchasing items. In this way, design steps can be organized in such a way as to prioritize the steps that postpone the construction. Building a factory may start a long time before the design is completed. The proper arrangement of design steps is essential to avoid delays in construction.

Design of the device and its specifications

The aim of the factory design is to provide a complete factory that can operate on an industrial and efficient basis. To achieve this, the chemistry engineer must be able to integrate

many separate units or components of the devices together to create a coherent plant operationally. If the plant is to succeed, every part of the device must operate. Therefore, the design of the devices is the main component of the design of the factory. An engineer who designs each process must accept the responsibility of obtaining the specifications of each device or components and get familiar with the manufacturing methods of different types of devices. The importance of selecting suitable materials in this work should be considered. Design data must be upgraded, including dimensions, operational status, number and openings, heads, flanges, codes, permissible changes, and other information.
Many details of the design of the machines are provided by their manufacturers, but the chemical engineer should provide the main design information.

Design calculations

Production per year
Propylene production (product)mw *
Operating time per year

The amount of production per year is 10^4 Lb × (200/000 ton) 44053, we consider the operating time to be 300 days:

$$mw = 42.1 \, {}^{Lb}\!/_{Lbmol}$$

Propylene production rate: $= \dfrac{44053 \times 10^4 \; {}^{Lb}\!/_{year}}{300 \, \dfrac{day}{year} * 42.1 \, {}^{Lb}\!/_{Lbmol}} = 3.5 \times 10^4 \, \dfrac{Lbmol}{day}$

The stream that enters the propane tower is a mixture of the following materials:
Ethane, propadiene, propane, propene
12-butadiene, 1-butane, 1-butane, n-butane
On average (in normal conditions), 13ton / hr enters the tower.
Design data:
- Trace Distance is 24 in
- Duct height is 3in (12.5% tray distance)
- The assumption of the ideal gas is not true in the foam system.
- The total area of the holes is 10% of active level
- The gutter surface is approximately 5% of the total cross-sectional area.
- The molecular weight of liquid and gas is assumed to be the same at all points given above.
- The diameter of the tower is constant throughout it.

conclusion

The finished product price is 1881 Rls / kg, and given the fact that the company price for propylene in 2001, was 300 Rls/Kgthis is a cost-effective economic unit. Because the finished product price for is for the same year, this unit is profitable with these operating conditions. According to the calculations of the previous section, it can be seen that the return on capital is about 17 years, which with this amount (after 17 years itwill have the payback), then this unit has a relatively good investment value. But given the fact that in order to obtain the price of the product, due to the lack of prices of some of the raw materials, we had to guess them, there may be errors in obtaining the final price of the product and thereafter there are problems in obtaining the payback and it is possible to decrease this amount, when the payback of unit decreases the value of the investment is higher. As a result, according to the calculations, this unit is currently profitable. The only drawback is that the payback of unit is about 17 years. This represents the economic value (investment value) as relativelygood (not good), but according to the above description, it can be considered as a good investment.

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