Welcome

To

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CDR Sample for production Engineer

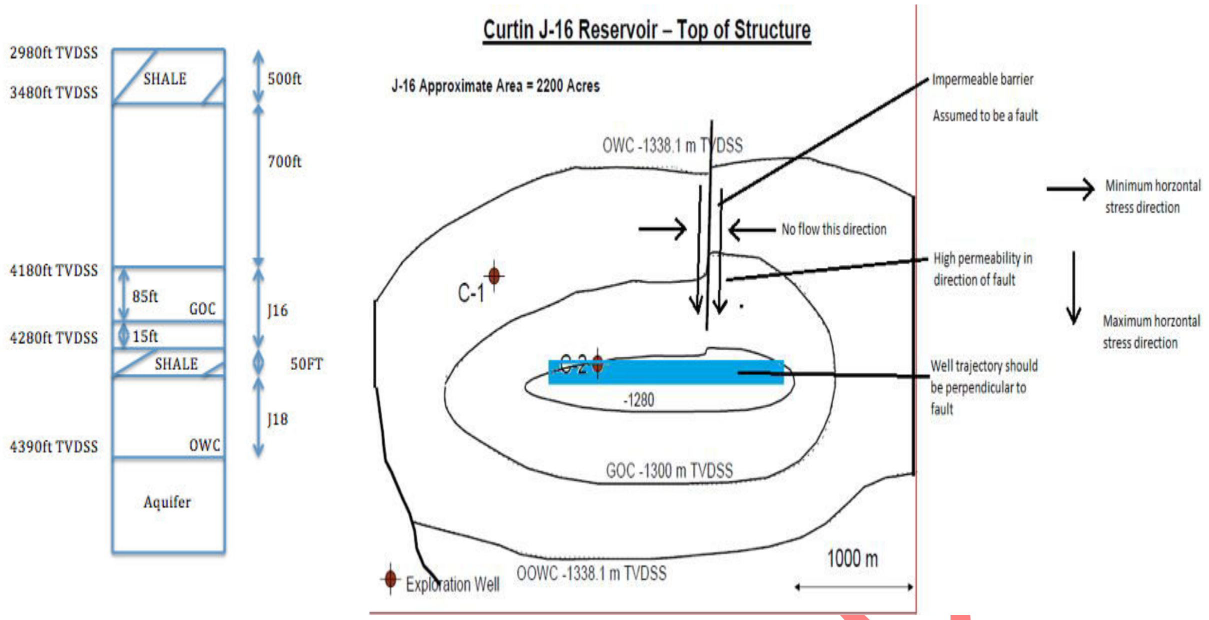
Episode 1

Introduction

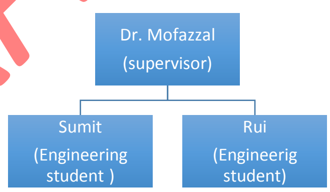
CE 1.1 Curtin University is a very reputed Educational institute. It is located at Bently, Western Australia, Australia. I completed Bachelor of engineering in petroleum field in this university. Between July 2014 till November 2014, I was enrolled in unit called Petroleum Production Technology. As part of assessment I required to develop proposal for The Curtin offshore Field , in which I needed to design production wells. For this purpose I was provided access to PIPESIM 2013 software, which is very reputed among petroleum production engineers.

Background

CE 1.2 The overall aims of this project was to develop The curtin Offshore Field by using skills learned in the unit. Curtin offshore field consist two main reservoir J16 and J18 with top true vertical depth subsea(TVSS) 4180ft and 4330ft respectively. Lithology of this reservoirs was consolidated and well sorted sand stone so this reservoirs had higher porosity and permeability. These reservoirs had minimum clay content which increase towards top of the reservoirs.



CE 1.3 There were list of designated tasks with regards to the Development of The Curtin Offshore Field those I needed to complete. Firstly, the most appropriate well-type had to be determined for both reservoirs. Secondly it needed to select appropriate well suspension option, casing program and completion option for production. Thirdly it needed to find most productive Perforation intervals and locations. Lastly it needed to do Nodal analysis to determine the optimum tubing size, water cut, gas-oil ratio and wellhead pressure.



CE 1.4 This project was group project. We had group of three engineering students, me , Rui and Nikiata. I was team leader for this project. However, Nikita discontinued this unit after two week so this project was done by me and Rui Only. As shown in Figure 1.3, Dr Moffazal was our supervisor and Instructor. Me and Rui divided this project in two part: one designing and second report writing.

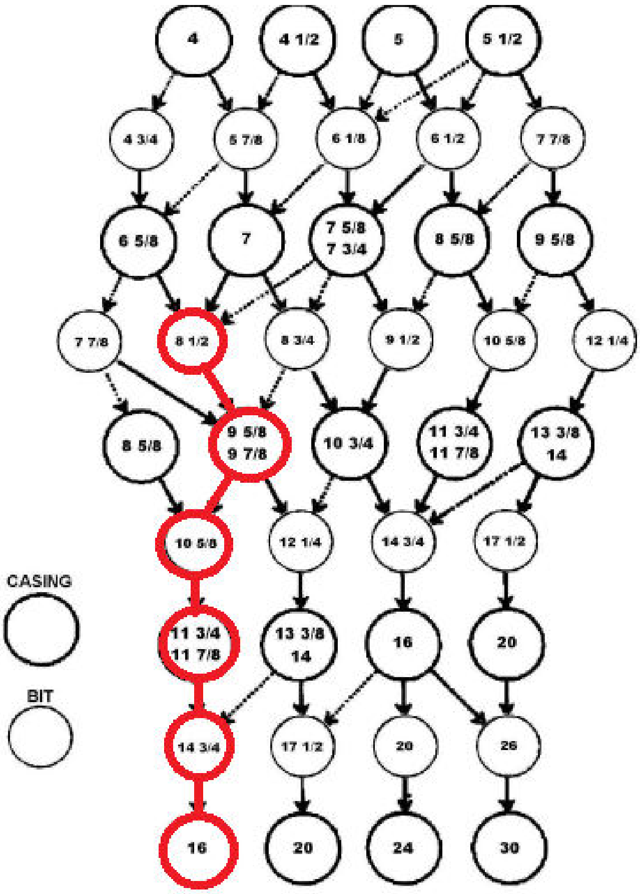
CE 1.5 My task was to make simulation model, do calculation to choose correct casings and tubing size while Rui needed to write report based on my findings.Apart from this , I needed to Report the progress of the project to Dr. Moffazal every week and record into University log book and in my record book with time and date to prove evidence of the work. I also needed to communicate my findings with Rui every week. At the end of semester, me and Rui needed to give presentation front of department staff and other students. During this presentation, we also needed to provide two pages of extended summary report to give to all the students in the lecture hall.

Personal Engineering Activities

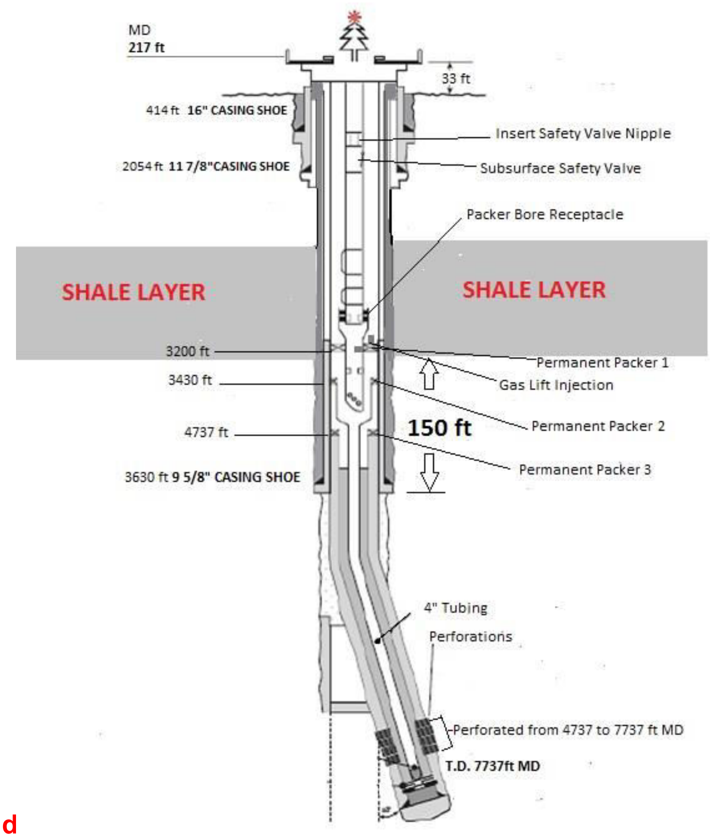
CE 1.6 I needed to make simulative well with appropriate casing size so I can do nodal analysis using PIPESIM software. I also needed to do sensitivityanalysis and optimization of production. But I did not have enough data for creation of simulation model so I had to made few assumption based on my knowledge. According to the requirements, It is advised to drill Cased hole with cementing and perforation. To choose correct casing size and well type I needed to understand the lithology of reservoir. Firstly I Analysed reservoir J16. The formation of J-16 was rectangular in shape with relatively long and thin pay zones. These conditions were ideal for horizontal drilling, as they result in larger reservoir contact area, reduced drawdown and increased production rate.

CE 1.7 In order to avoid wellbore stability issues I decided to design well in such manner that so build-up begin from the bottom of the shale interval and reach 90 degrees ounce the bottom of J-16 is reached, resulting in the horizontal section intersecting the oil interval. In order to reach this target I set a constant build-up rate of 11.25 degrees per 100ft with a radius of curvature of 800ft.

CE 1.8 After analysis of J 16 I analysed J 18 reservoir. the lithology of J-18 contains consolidated sandstone that was well sorted with good porosity and permeability. It contained minimal clay content in the reservoir that increased towards the top of the reservoir. There was 50 ft of thick continuous shale between reservoir J-16 and J-18 from 4280 ft TDSS to 4330 ft TDSS. Due to these lithological factors, I determined that a horizontal well was the most suitable well-type for this reservoir. Due to the sandstone in the reservoir having good permeability and porosity, it was likely that coning will occur with a high production rate. Horizontal wells had the advantage of reducing the drawdown and therefore reducing the coning.



CE 1.9 After considering lithology of both reservoir. I came to conclusion that I needed to use the hole diameter size above 8.5. There was only size available was 9 7/8 inches. For this reason, I chose a hole diameter of 9 "7/8 for well. Using Figure 3 I worked down from the casing selection chart in order to select the appropriate casing sizes and corresponding bit sizes. The minimum casing diameter was selected to achieve an open hole of 8.5" to save on tubing costs. I set the conductor casing at depth of 414ft TVDSS . The Surface casing is usually set at a depth of 100 to 1000m so I chose to set at depth of 2054ft TVDSS with 11 7/8" diameter. For Production casing I selected setting depth of 3480ft TVDSS with 9 5/8 inch diameter. I diceded to use Uncemented liner for rest of the depth.



CE 1.10 My completion design focused on simplicity as per the project objectives. It employed the use of a 7 5/8" expanded liner into 9 5/8" production casing to save on costs and maximize the completion tubing ID. The installed completion tubing for my 'first stage' well was designed with a simple 5" 24.1ppf (4"ID) upper and lower completion with PBR (polished bore receptacle). I decided to put

The PBR as low as possible in the well, but not so deep as to have adverse effects (stresses) from too high a well inclination. I plan to place the PBR at the point of 30deg inclination.The use of a PBR was to allow for work over of the upper completion which could provide options for later gas lift. The use of PBR also allow for expansion (lengthening) / contraction (shortening) of the tubing string during temperature changes. A schematic of the completion string, including some basic jewellery/components can be seen in Figure 14.

CE 1.9 my next challenging task was to build model well in PIPESIM. I never used PIPESIM before so I faced lots of difficulty. During this time I read lots of article on PIPESIM and I also took help from my instructor. I also watched few tutorial online to learn PIPESIM. Once I know about it Developed well simulator In PIPESIM as shown.

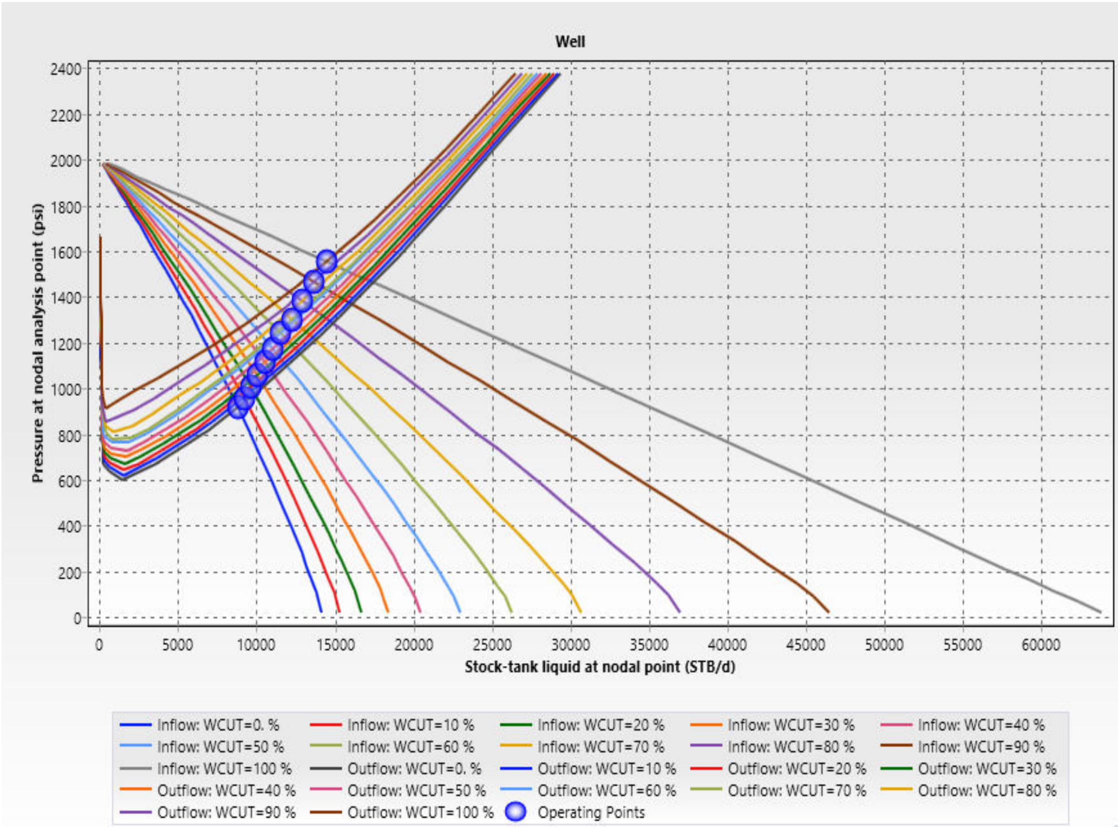
CE 1.10 After developing model I needed to decide perforation depth. I simulated IPR curves using the software PIPESIM along with assumptions for the perforation interval and I found ideal depth of 4737ft as best option.

CE 1.11 Once I had all data. I performed Nodal analysis for J-16 production using the software PIPESIM. The aim of nodal analysis was to determine the optimum tubing size using parameters including, wellhead pressure, water cut and permeability. In order to obtain desired outputs certain inputs I made few more assumptions as described below:

- Post-expanded liner ID = 8.661"
- Tubing with an outside diameter of 7.625 inch has been selected due to it being the maximum size that can fit in the liner.
- The ambient temperature of the well head has been set to 50 ° F.
- The water cut is assumed to be 0% due to this information not being provided in the project brief.

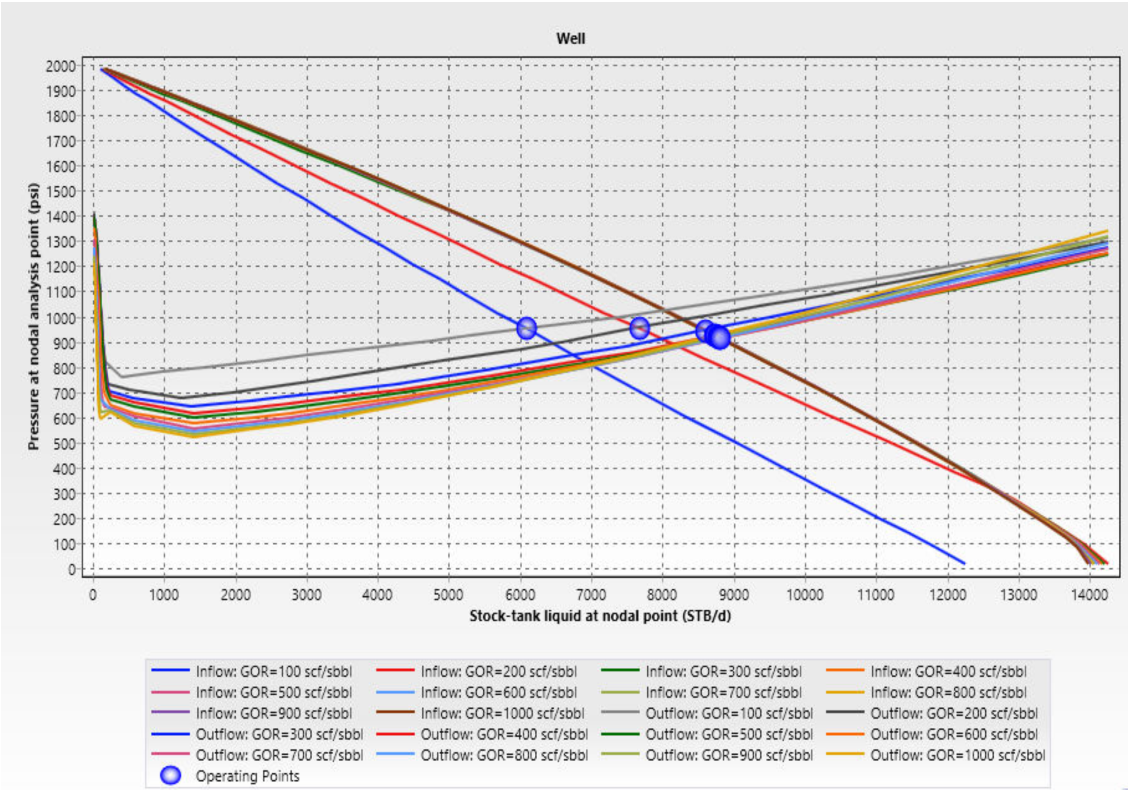
CE 1.12 From PIPESIM nodal analysis I found that optimal 'first stage' completion tubing size was 5" 24.1ppf with 4" ID. This completion tubing ID gave me the greatest incremental production for its size. The corresponding optimal parameters for:

Water cut was 0% (in line with our expectations since there was insignificant mo va ble wa ter in J16),



GOR was 300 scf/bbl

THP was 2000 psi



CE 1.13 Expected oil production in the first stage development from the J16 oil lens was 8605 stb/day based on my PIPESIM modelling and using the optimal parameters listed above. This was the optimal and most economical method for the first stage development of the Curtin Field.

CE 1.14 To complete this project I really needed to put tons of effort and time. I utilized my time very effectively and carried out my study in parallel with the project. It was true example of my time management skills. I had to document all the proceedings, which I did using various MS Office programs.

CE 1.15 Dr Mofazzal guided me to the right direction by giving me review of my progress and valuable feedbacks throughout the project period. I tried my best to be self-motivated, I maintained professional communication with my supervisor, lecturers, tutors and colleagues in this field during the period to achieve every requirements and milestone, and accomplish them before the deadline. I have completed this project in November 2014. Me and Rui gave PowerPoint presentation to illustrate the whole project in front of lecturers and other students followed by a 5 minutes question & answer session.

Summary

By mean of this project I used and developed following skills

- the production mechanisms of petroleum production systems; and illustrate different components and interfaces
- Estimation of the performance of individual components of a petroleum production system by appropriately applying the discipline knowledge
- Selection and analyzation of different well completion options and identify their merits and limitations, and recommend appropriate completion options
- Selection of different artificial lift systems with recognizing their advantages, disadvantages and analyze the performance of different artificial lift systems
- Evaluation of total system performance using nodal analysis

CDR Episode 2

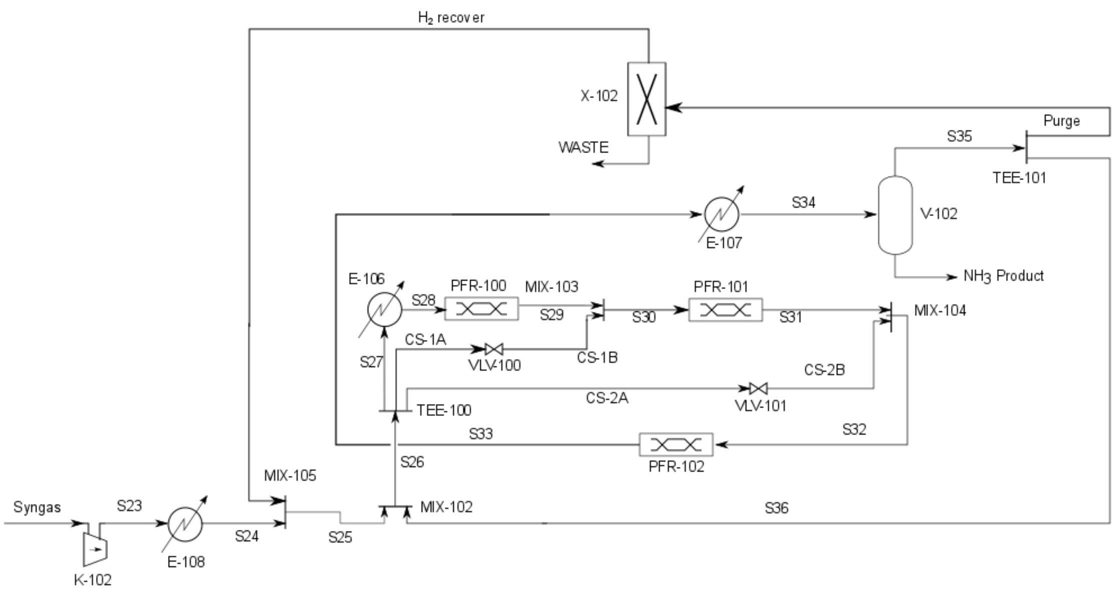
Introduction

CE 1.1 Curtin University is a very reputed Educational institute. It is located at Bently, Western Australia, Australia. I completed Bachelor of engineering in petroleum field in this university. Between July 2015 till November 2015, I was enrolled in unit called Process Engineering and Analysis. As part of assessment, I required to design Ammonia production plant and Optimize it. For this purpose I was provided access to Aspen

Hysys software, which is very reputed among production engineers.

Background

CE 1.2 The overall aims of this project was to develop Simulation model for production of Ammonia from the sysn gas by using skills learned in the unit. I was given industrial process for production of ammonia. I need to develop model to achieve production rate of 385 tonne/day which is equal to 1.604* 10^4 kg/hr. To achieve this production rate I needed to adjust appropriate feed rate, choose correct size of reactors and pipe size. Secondly I needed to most economical way so I needed to Optimize plant for cost effectiveness and energy efficiency. I was given following industrial process.



CE 1.3 The process was an exothermic reaction where the reaction of nitrogen gas and hydrogen gas into ammonia liquid was kinetic. This process involved various components such as compressors, coolers, heaters, separators and most importantly plug flow reactors (PFR). Plug flow reactors affected efficiency of process by its number of tubes. Furthermore these were also adiabatic. While, heaters and coolers had an impact on the amount of energy that was being consumed by the process.The reaction for the process was exothermic is of the following form:

$$0.5N_2 + 1.5H_2 \leftrightarrow NH_3$$

The rate of the reaction was given by following the following kinetic expression:

$-r_{N_2}$ = $10exp$[-9.1 x 10^4/RT]$P_{N_2}^{0.5}P_{H_2}^{1.5}$ – 1.3 x 10^{10}exp[-1.4 x 10^5/RT]P_{NH_3}

Where:

$-r_{N_2}$ = The rate of Nitrogen disappearance in kmol/m^3s

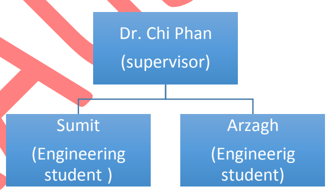
T = The temperature in K

P_i = The partial pressures of the reacting species in atm

The activation energies for the forward and reverse reactions are in KJ/kmol

Personal Engineering Activities

CE 1.4 There were list of designated tasks with regards to the development ofproduction of ammonia   those I needed to complete . Firstly, I needed to develop simulation model using ASPEN Hysys software. Secondly, I needed to choose correct size of reactor. Thirdly I needed to optimize plant for desired production for least cost. Lastly I needed to optimize plan in term of energy saving.

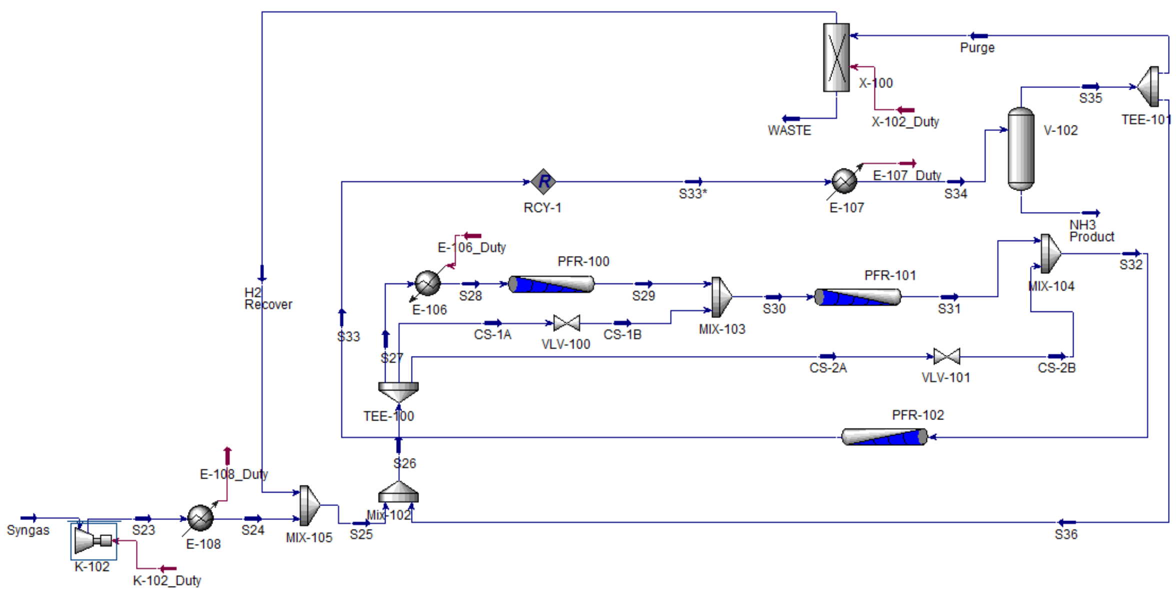


CE 1.5 This project was group project. We had group of two engineering students, me and Arzagh.   This project was done by me and Arzagh. As shown in Figure 1.3, Dr Chi Phan was our supervisor and Instructor. Me and Arzagh divided this project in two part: one development of simulation model and second Report writing.

CE 1.6 My task was to make simulation model, preform calculation, while Arzagh needed to write report based on my findings.Apart from this , I needed to Report the progress of the project to Dr. Chi Phanevery week and record into University log book and in my record book with time and date to prove evidence of the work. I also needed to communicate my findings with Arzagh every week. At the end of semester, me and Arzagh needed to give presentation front of department staff and other students. During this presentation, we also needed to provide two pages of extended summary report to give to all the students in the lecture hall.

CE 1.7 I needed to make simulation model using Aspen Hysys. However I never used ASPEN Hysys before so I had to learn this software from basic. I had practical classes during my course work but they were not enough. They mainly focused on basics while I needed advance knowledge. I did plenty of research on it. I referred book "Aspen HYSYS: An Introduction to Chemical Engineering Simulation: For Chemical Engineering Undergraduate Students" , and improved my skills. It took me more than four week to achieve required skill.

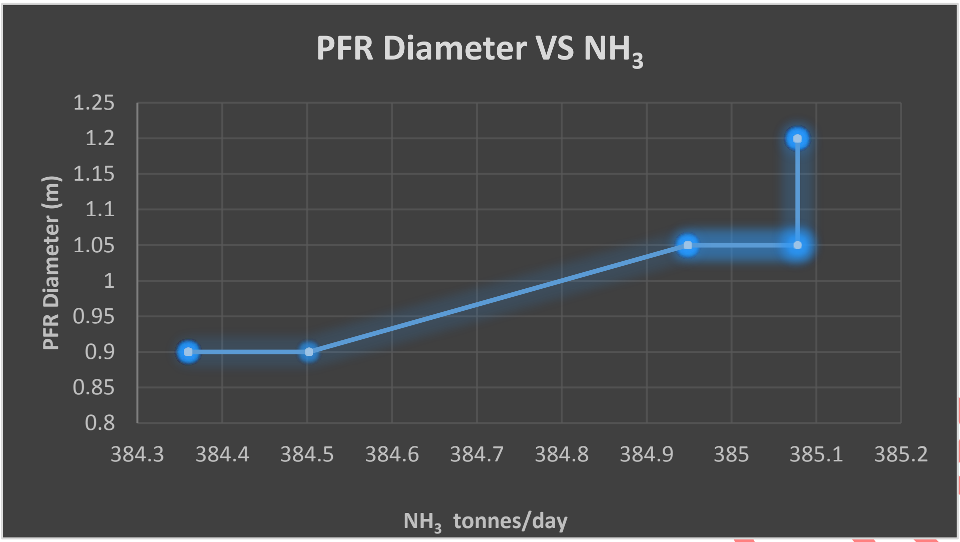
CE 1.8 Secondly, I did not have enough data for creation of simulation model so I had to made few assumption based on knowledge. I assumed that the feed at atmospheric temperature and pressure (shown in above table). I assumed thatto be constant throughout the whole process. Thus, the pressure drop across all heaters, coolers and valves was presumed to be zero. According to the requirements, It was advised to use PFR(Plug flow reactor). So I developed following model.



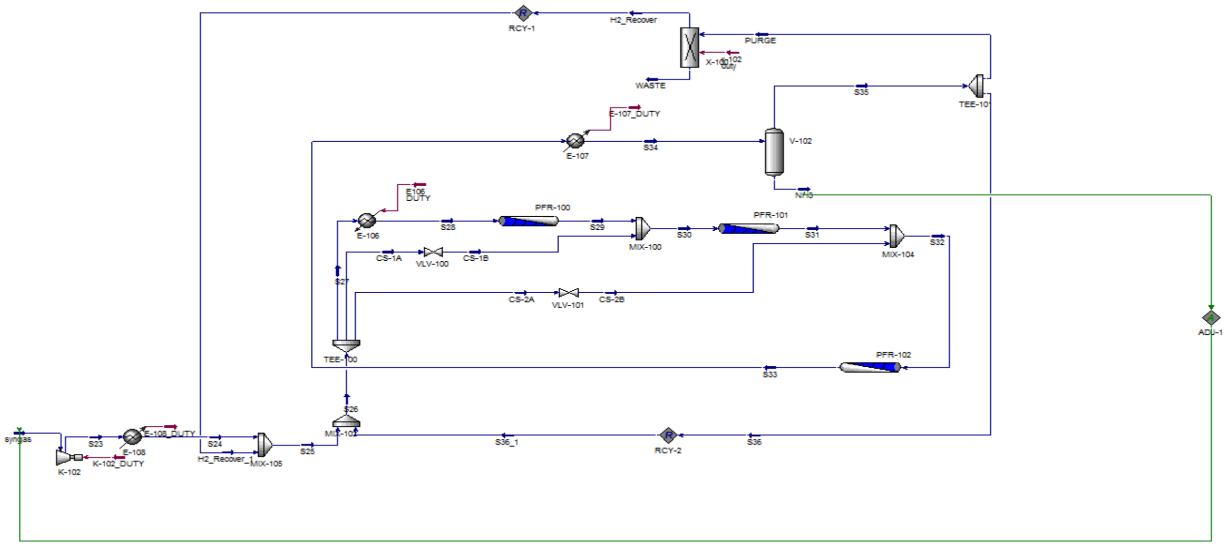
CE 1.9 My second task was to to choose correct size and number of tubes in PFR. To find the minimum number of tubes in PFR-100 I needed needed to be change the tube diameter for this reactor. The tube diameter was in multiples of 0.15 m. So At first, I assumed the mass flow rate of the feed to be a high value of 800 tonnes/day because a production rate of 385 tonnes/day was required for the ammonia, then I assumed Higer value of tube. After that I employed case study to iterate to a smaller value for both of these variables. In the case study, I used three variables tube diameter (PFR-100), Syngas mass flow and NH_3 product mass flow. I found that the tube diameter and Syngas mass flow was deemed to be independent while the NH_3 product mass flow was dependent. So For the two independent variables I set interval bounds based on what is known and previously assumed.

CE 1.10 From close analysis, I found to be more precise to pick a smaller bound with a smaller step size. After the first iteration, I observed the results were from this point. I set new bounds and step sizes in order to reach the optimal tube diameter. I repeated this process until the desired value is found. However, I faced a small difficulty is stumbled upon when performing a case study. Before the onset of a new case study with changed starting values in the PFD, I had to reset the values for feed flow and tube diameter in PFR-100 to zero. Then the new values can be set, from which the case study conducted again. Once I found the optimal value I calculated the number of tubes by finding the inner and outer areas. Consequently, the number of tubes was calculated by dividing the outer by the inner

CE 1.11The optimal tube diameter was 1.05 m, which gave the number of tubes as 49. While the 0.15 m (from above calculation) was for the smaller internal tubes that fitted in the tube (diameter of 1.5 m). I obtained these values for a feed flow rate of 647.9 tonnes/day.



CE 1.12 My Third task was to Optimize production plant in term of production. So I used process provided by the University but I found the conversion rate into product was significantly small. I needed to use higher flow rate of feed. That's why I introduced recycle stream as shown in below figure.

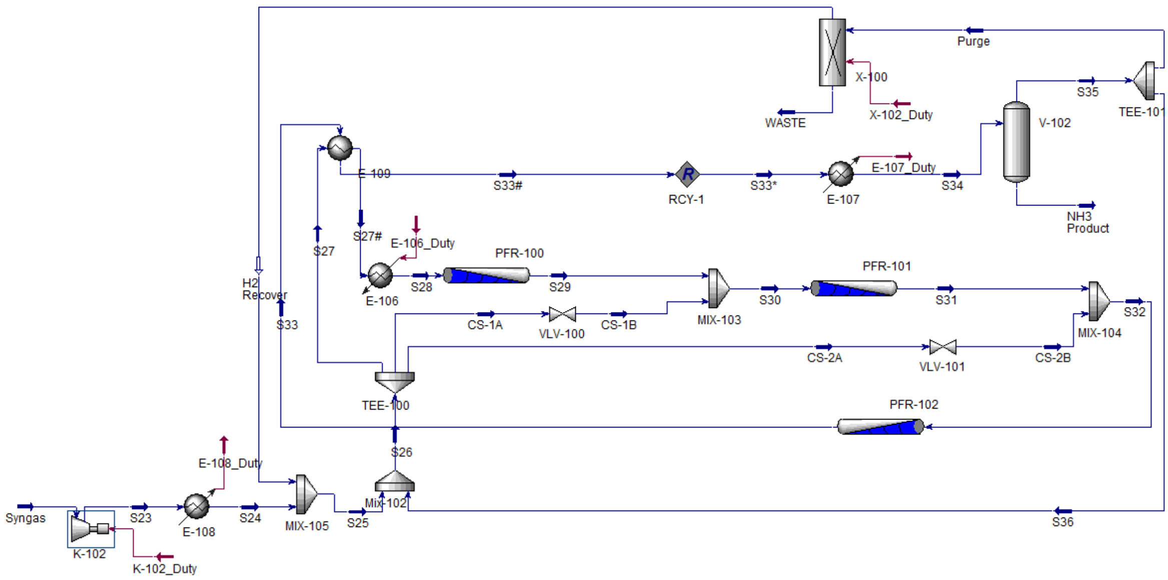


After introduction of recycle I found that the conversation rate increased significantly. As shown in below table molar composition increased to double. Due to this required feed rate decreased from about 800T/day to 422 T/day.

	S33(without recycle stream)	S33(with recycle stream)
Comp mole fraction(Nitrogen)	0.0217	0.0253
Comp mole fraction(hydrogen)	0.8565	0.7262

Comp mole fraction(ammonia)	0.1218	0.2503

CE 1.15 My last task was Optimization of plant in term of energy usage. Due to this I decided to use heat exchanger. I Installed a heat exchanger (**E-100** into the process by connecting S27 and S27# to the tube side, while S33 and S33# connected to the shell side (as shown by figure 5).



CE 1.16 The UA was the overall heat transfer coefficient and this is found to be 1.109 x 10^8 kJ/h for this scenario. Shown in the tablebelow were the results obtained for each of the heaters and coolers in the process before the heat exchanger was added as well as after it is attached. By implementing the heat exchanger I was able to save energy from E-106 and E-108. The amount of energy that was saved for E-106 and E-107 was 1.127 x 10^8 kJ/hand 1.131 x 10^8 kJ/hrespectively. That's why it was very feasible to include a heat exchanger in the design.

Heater/Cooler	Before (kJ/h)	After (kJ/h)	Difference (kJ/h)
E-108	1.112 x 10^8	1.112 x 10^8	0
E-106	1.489 x 10^8	3.620 x 10^7	1.127 x 10^8
E-107	2.266 x 10^8	1.135 x 10^8	1.131 x 10^8

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CE 1.15 Dr Chi Phan guided me to the right direction by giving me review of my progress and valuable feedbacks throughout the project period. I tried my best to be self-motivated, I maintained professional communication with my supervisor, lecturers, tutors and colleagues in this field during the period to achieve every requirements and milestone, and accomplish them before the deadline. I have completed this project in November 2015. Apart from this , I kept record of the progress of the project into University log book and in my record book with time and date to prove evidence of the work. I also communicate my findings with Arzagh and Dr Chi Phan every week. Me and Arzagh gave PowerPoint presentation to illustrate the whole project in front of lecturers and other students followed by a 5 minutes question & answer session.

Summary

CDR Episode 3

Introduction

CE 1.1 Curtin University is a very reputed Educational institute. It is located at Bently, Western Australia, Australia. I completed Bachelor of engineering in petroleum field in this university. Between July 2015 till November 2015, I was enrolled in unit called Crude Oil Processing . As part of assessment, I required to design three phase separator for crude oil processing plant.

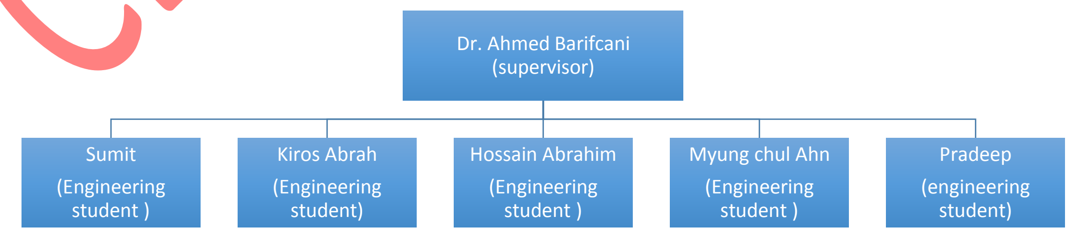
Background

CE 1.2 This project was group project. We had group of five engineering students. In this project we are required to design crude oil processing plant, where each of us need to design one component of it. This project was done by me and other four students. As shown in Figure 1.3, Dr Chi Phan was our supervisor and Instructor.

In this project I was assigned to design three phase separator while other four students designed desalting unit , skimmer tank , emulsion treatment unit and storage tank. As part of group we needed to decide correct line sizing , planning and scheduling. Main task of three phase separator is to separate water gas and oil. I was given flow rate of crude oil as shown in below table which contained gas, water and oil.

INLET STREAM TO SEPARATOR		
Stream	Mass flow , lb/h	ρ , lb/ft^3
Hydrocarbon gas	W_V = 186221.5646	ρ_V = 2.8381
Hydrocarbon liquid	W_{LL}= 103548.7257	ρ_L = 27.6776
Water + TEG	W_{HL} = 125.9087279	ρ_H = 61.3661

CE 1.4 There were list of deferent part I needed to design for three phase separator. I needed to calculate internal diameter of separator , residence time for water and oil, Height of light liquid based on hold up , surge height and vessel height. Second part of the project was to calculate mechanical property of vessel.



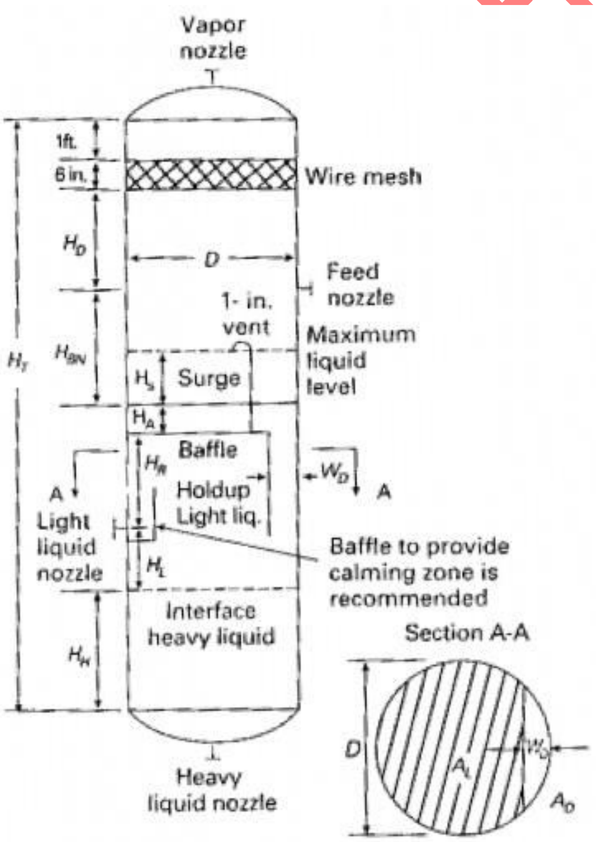
Personal engineering Activity

CE 1.5 I did very detailed research on three phase separator. Referred two books

(1)Oilfield Processing(2)Oilfield Processing of Petroleum: Crude oil . After that I read few journal articles and previous research papers. I had lots of difficulties in understanding benefit of different kind of separator so I communicated with my lecturer and arranged my meeting with him. Dr Ahmed Barifcani helped me choose correct type of separator according to the property of crude oil. I kept record of our meeting and communication by writing meeting minutes After consultation with Dr Ahmed Barifcani I decided to use low temperature pressure three phase separator. After correct selection I needed to design deferent part of separator.

Firstly I needed to decide its internal diameter, which is depend on vertical terminal vapour velocity, vapour velocity and vapour volumetric flow rate. I used Xiuli's theory to find their values. I calculated value of internal diameter as 7 ft.

Second task that I needed to calculate was area for liquid holding which is known as downcomer area. I used Wayne and Williams (1994) to calculate it. I found that I needed 0.523 ft^2 for downcomer. Based on this finding I had 35.152ft^2 for settling.



Third most important task that I needed was to decide the residence time which is known as retention time. It assures that equilibrium between the liquid and gas been reached at separator pressure. By using theoretical knowledge, I calculated them as 0.564 min for Light liquid phase and 2.125 minutes for heavy liquid phase.

Fourth most important task was to calculate surge height and vessel height . Surge height is very important factor for ……….. There are few ways to find surge hight but I choose to use ………. Method and found it as …….. . After than I analysed …… To calculate total hight of vessel . I found it as …… Given table represents all the calculated parameters

Parameter	Value
Feed (kg/h)	131494.0533
feed (Volumetric flow rate) (m^3/s)	364.04
Vertical terminal vapor velocity(m/s)	0.253
Vapor volumetric flow rate(m^3/s)	0.519
Separator diameter (m)	2.139
Area of separator (m^2)	3.5754
Separator height(m)	4.423
Separator volume (m^3)	15.8016
Retention time for heavy liquid (min)	2 .000
Retention time for light liquid (min)	2.450

My second part of project was to calculate mechanical property of sepratore and calculated stresses on them . It was part of mechanical calculation so I was having difficulties with certin mechanical terms so I organised meeting with my mechanical engineering professsr Dr Mohammad Sarmadivaleh. He helped me to understand advanced mechanical terms. I kept record of our meeting and communication by writing meeting minutes. After that I refereed few more books to understand stresses on vessel and I started calculating mechanical propertied of vessel.

Firstly I needed to decide material for vessel . It was very important part for safety of plant operation and employees. For these Reasons I decided to design separator of standard AISI 1065 Carbon Steel due to its low cost and higher mechanical properties. Below table represents it mechanical properties.

Property	Value
Density	7850 (kg/m^3)
Elastic (Bulk) modulus	140 (GPa)
Shear modulus	80 (GPa)
Tensile (Ultimate) strength	635 (MPa)
Poisson's ratio	027 - 0.30
Elongation	10 %
Reduction of area	45 %
Hardness	187 (Brinell)
Allowable tensile stress	88.94 (MPa)

Parameter	Value

Based on its mechanical properties I calculates its calculated minimum vessel thickness. Based on sinnott's theories I found its value as 36.53 mm . However, this vessel get expose to weather and it experience corrosion so it need about 3mm extra thickness for safety reasons so I calculated vessel thickness as 39.53mm. After that I calculated Its dead weight and dead weight stresses. By using sinnott's theory, I found their value as 165123.161 N and 0.629 N/mm^2 respectively.

Vessel thickness, mm	38.48
Longitudinal stress, N/mm^2	72.244
Dead weight stress, N/mm^2	0.629 N/mm^2
Dead weight, N	333522.761
Total longitudinal stresses, N/mm^2	72.873
Skirt support thickness, mm	20
Maximum stress intensity, N/mm^2	71.614

Second part of mechanical design parameter was to calculate stresses on vessel. Using my understanding of engineering theory I calculated Total axial as 72.873 N/mm^2 and total shear stress as 71.615 N/mm^2.

Last part of this designing was the support system. the support system designed for a separator depends on the size, shape, and weight of the vessel. I decided to use a skirt for my separator. I needed to design the skirt thickness such that it withstand under the worst combination of wind and dead-weight loadings. Again I used sinnott's theory to calculate its thickness. I found 40 mm as reliable thickness. Given table represents all mechanical design parameter for crude oil processing plant.

When I have all parameter ready for crude oil separator I communicated with my group. Once all member finished their designing part we arranged meeting and designed flow lines and planned scheduling by discussing. During this time I wanted to use different flow line size than other group member decided. However, I got convinced by their view. Even though I had conflicted view, I maintained professionalism and solved it professional. Due to this we were able to complete this project as one team.

CE 1.14 To complete this project I really needed to put heaps of effort and time. I utilized my time very efficiently and carried out my study in parallel with the project. It was factual example of my time management skills. I had to document all the proceedings, which I did using various MS Office programs.

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