PAPER • OPEN ACCESS

Optimization of Blending Octane Number Premium Composition and Blending Sulfur Content Diesel Composition In Refinery I Ru IV Cilacap

To cite this article: Dwi Hadi Sulistyarini 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **494** 012044

View the article online for updates and enhancements.

IOP ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

Optimization of Blending Octane Number Premium Composition and Blending Sulfur Content Diesel Composition In Refinery I Ru IV Cilacap

Dwi Hadi Sulistyarini

Industrial Engineering Department, Faculty of Engineering, Brawijaya University

MT Haryono 167, Malang, Indonesia

E-mail: dwihadi@ub.ac.id

Abstract. Blending simulation is an important tool for blending process in oil and gas companies, for example PT. Pertamina (PERSERO) RU IV Cilacap. Crude oil is processed to become a product that can be used by the public such as Premium, Pertamax, and Pertamax Plus.In this case study, simulation blending is used to determine the optimal composition of Premium and Solar blending. Before the blending process, the Refinery Planning and Optimation division simulates the blending process by calculating so that the mixing process is in accordance with the desired quality. The results of the research showed that there was a decrease in performance units so that reformate cannot be fully entered as a Premium component and requires HOMC for blending, so that the margin in USD/barrel units decreases by 0.82 USD/barrel. In the initial condition of Solar, the margin obtained was 24846.04 thousand USD or 8.04 USD/barrel. From the optimization results, it can be seen that to obtain sulfur content of 0.3% wt, the amount of HGO was 20286.19 TON or 676.21 TPSD and the VGO amount was 11050.01 TON or 368.33 TPSD and the maximum margin that can be obtained was 28381.34 thousand USD or 9.18 USD/barrel. The margin condition in USD/barrel after the optimization of Solar sulfur content increased by 1.14 USD/barrel. At optimum conditions, the amount of Solar produced increases because it gets an additional from Solar components with high sulfur content VGO and HGO.

Keywords: blending simulation, optimization, refinery planning, margin

1. Introduction

Petroleum is a natural resource obtained from the bottom of the earth. Petroleum obtained from the earth's base is still in the form of raw material or known as crude oil . The amount of raw material that must be obtained certainly affects the production of the company. The raw material component has an important role in processing crude oil which will be processed into MOGAS (*Motor Gasoline*). MOGAS in PT. Pertamina (PERSERO) is often called a finished product consisting of Premium, Pertamax, Pertamax Plus, and Solar [1].

Components that are processed to be used as raw material for manufacturing products must be measured and adjusted to meet the demand of the marketing unit. The product produced must also meet the specified specifications or standards. One technique for processing petroleum is mixing or blending. Blending is mixing two or more intermediate product components to produce a finished product by fulfilling particular specifications.

Blending simulation is an important tool for blending in oil and gas companies, for example PT. Pertamina (PERSERO) RU IV Cilacap [1]. Crude oil is processed to become a product that can be used by the public such as Premium, Pertamax, and Pertamax Plus. In this case study, blending simulations were used to determine optimal Premium and Solar blending compositions. Before conducting the blending process, the Refinery Planning and Optimation division simulates the blending process by calculating so that the mixing process in accordance with the desired quality.

Simulation that was performed using calculation template simulation which is useful so that the blending results are not overquality / quality give away or do not meet the expected specifications. From simulation calculation template there are still many shortcomings that can be corrected so that the process performed is more precise or targeted so that before the blending process is done, this tool can describe how many components and volumes are needed.

The research can be aimed as follows, that is to determine the optimal composition of HOMC and Reformate to obtain Premium with octane number (ON) 88 and maximum margins, it can be determined the optimal composition of HGO and VGO to obtain Solar with sulfur content 0.3% -wt and maximum margins, and can explain the effect of Premium and Solar volume before and after the optimization of the margin.

So that the benefits obtained can be known as the optimal composition of HOMC and Reformate to obtain Premium with octane number (ON) 88 and maximum margins. It can be seen the optimal composition of HGO and VGO to obtain Solar with 0.3% -wt sulfur content and maximum margin, and can be seen the effect of the volume of Premium and Solar before and after the optimization of the margin.

2. Method

The procedure of the research conducted at PT Pertamina (PERSERO) RU IV Cilacap began with the general orientation of PT PERTAMINA (PERSERO) RU IV Cilacap and the general orientation of the Refinery Planning section, then data collection, simulation templates using Microsoft Excel, were given Case study. The case study provided was an optimization of the composition of the Premium blending and Solar blending in FOC I and LOC I, II, IIII, carried out case study data processing, carried out reports and carried out consulting guidance, carried out report presentations, and the report was collected last [2].

The process of collecting data obtained from the Refinery Planning and Optimation section in the form of yields from streams produced in Refinery I and LOC, capacity of each unit operating in Refinery I and LOC, NRP prices in February 2016, and Sulfur content from streams of Solar products.

3. Results And Discussions

*3.1 Making Templates Simulation of FOC I and LOC I / II / III Processes*

In facilitating data processing, previously made a template simulation in the process at FOC I and LOC I / II / III. Following are the steps for creating a template simulation.

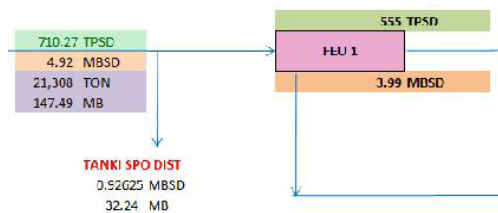1. Creating process block diagrams in FOC I and LOC I / II / III
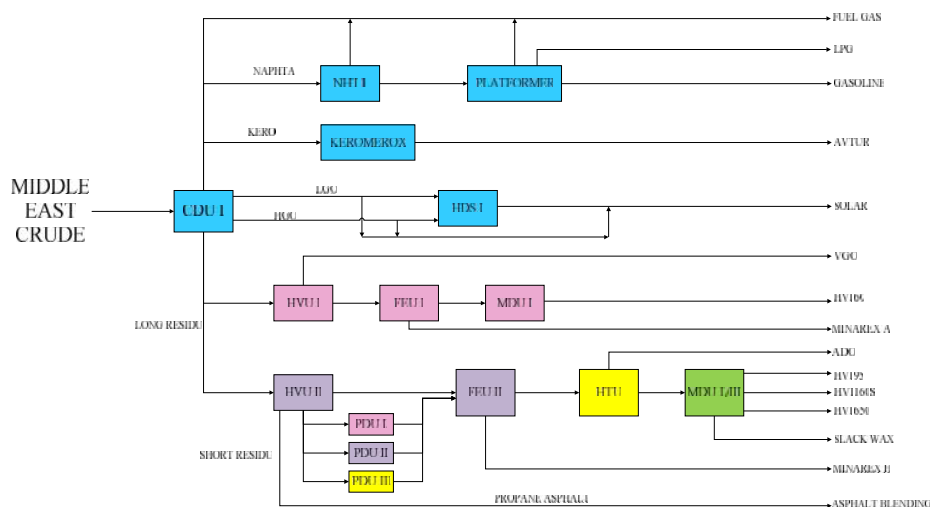
Figure 1. Process Block Diagrams in FOC I and LOC I / II / III

2. Calculating the number and volume of streams per unit.
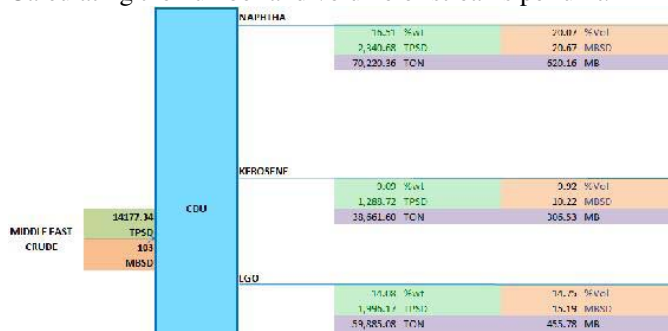
Figure 2. Calculation example of the number and volume of streams per unit

3. Calculating the operational capacity of each unit and tank.

Figure 3. Calculation example of the operational capacity of each unit and tank in
FEU 1

The operational capacity value is obtained if the streams number that incoming (feed) is smaller than the design capacity, then the operational capacity of the unit is the number of incoming streams (feed). Whereas if the number of feed streams is greater than the design capacity, then the unit's operational capacity is the unit's design capacity [3].

Table 1. Operational Capacity of the Initial Condition Unit

FUEL OIL COMPLEX I			LUBE OIL COMPLEX I			LUBE OIL COMPLEX II/III		
UNIT	TPSD	MBSD	UNIT	TPSD	MBSD	UNIT	TPSD	MBSD
CDU1	14177.34	103	HVU I	2574	17.3	HVU II	3883	25.45
NHT 1	2340.68	20.6721	PDU I	538	3.5	PDU II/III	784	5.1
HDS	2300	17.3	FEU I	555	3.99	FEU II	2270	15.64
PLATFORMER	1,443	12.2	MDU I	338.55	2.574	MDU II/III	841	6.19
KEROMEROX	1288.72	10.22				HTU	1700	12.13

Table 2. Initial Condition Tank Capacity

NAME	CAPACITY (TON)	CAPACITY (MB)
SPO DIST.	4658.10	32.24
SPO RAFF	-	-
LMO DIST	2899.55	20.11
LMO RAFF	2226.40	16.17
LMO HDT	1697.00	11.96
MMO DIST	456.50	3.10
MMO RAFF	1622.00	11.64
MMO HDT	-	0

DAO DIST	4378.80	29.59
DAO RAFF	-	-
DAO HDT	-	0.00
HGO	14347.71	103.44
Total (Day)	1076.2	7.61
Total (Month)	32286.06	228.26

The following is the mode capacity in FEU II, HTU, MDU II / III units with the number of operational days for each mode.

Table 3. Mode Capacity

MODE	TPSD	MBSD	Day
FEU II			
LMO	2180	15.36	8
MMO	2200	15.19	13
DAO	1786	12.07	9
MDU II			
LMO	841	6.19	7
MMO	768.9	5.5	23
HTU			
LMO	1700	11.98	7
MMO	1700	12.13	12
DAO	1687.77	11.61	8
HGO	1200	8.65	3
MDU III			
LMO	841	6.19	4
DAO	456.996	3.14	26

3.2 Creation of Diesel Template Simulation Blending

The Diesel *Template Simulation Blending* was made with the aim of obtaining the optimal amount of HGO and the amount of VGO so that the resulting sulfur content is 0.3 and the resulting margin is maximum. Making this diesel template blending is aided by a solver feature on Microsoft Excel.

Table 4. Diesel blending optimization results

Optimum Stream				
Stream	**Weight (Ton)**	**Fraction**	**Sulfur**	**Sulfur comp.**
HGO CDU I	20,286.19	0.1968831	1.8	0.354389629
DLGO HDS	64618.28	0.63	0.06	0.037628308
VGO LOC 3	3,482.22	0.03	0.15	0.005069392
VGO HVU 1 & 2	11,050.01	0.11	2.61	0.279905437
HGO ex HTU	3600	0.035	0.01	0.00034939
Total	**103,036.71**	**1**		**0.677342156**
ex refinary 1	**103,036.71**	**0.3229619**		**0.677342156**

ex refinary 2	**216000**		**0.12**
		0.68	
Sulfur content refinary 1	**0.21875572**		
Sulfur content refinary 2	**0.08**		
Sulfur content Solar	**0.30**		

3.3 Premium Blending Analysis

From the results of the Premium blending optimization the results of the comparison before and after optimization were obtained. To obseve the changes condition in margins, it is assumed that the platformer unit performance reaches 100% and all reformates can be processed into Premium.

Table 5. Comparison of initial conditions with conditions after optimization

	Initial Condition		After Optimum Condition	
ON	88		88	
Vol Reformate	306.71376	MB	99.990	MB
Vol HOMC	0	MB	99.99	MB
Harga HOMC	41.4		41.4	
Price HOMC	0	RIBU USD	4139.586	RIBU USD
Vol Premium	306.71376	MB	199.980	MB

Table 6. Comparison of initial conditions with conditions after optimization (Continued)

Premium Price	**54.59**	**Thousand USD**	**54.59**	
Premium Price	16,743.50	Thousand USD	10916.91	Thaousand USD
PL Capacity	43290		33000	
Sisa reformate	0	MB	233.63	MB
Harga Naphtha	32.47		32.47	
Total Harga Naphtha	0	Thousand USD	7585.85	Thousand USD
Margin	24,845.15	Thousand USD	22316	Thousand USD

In the initial conditions, it is assumed that all reformates become Premium and produce a margin of 24845.15 thousand USD or 8.04 USD / barrel. The existence of HOMC products produced by other refineries and blended with reformate products from FOC I. Trial and error experiments were conducted to determine the composition of HOMC and reformate which produce Premium with ON 88 and maximum margins. From table 6 it can be seen to produce Premium with ON 88, reformate volume and used HOMC volume is 99.99 MB or 394.5431 TPSD, and the resulting Premium volume is 199.98 MB. In conditions after optimization, the maximum margin obtained is 22316 thousand USD or 7.22 USD / barrel. Margin in USD /

barrel has decreased by 0.82 USD / barrel because the optimum performance of the platformer unit is not optimal.

3.4 Blending Solar Analysis
The results of Solar blending optimization are compared before and after optimization.

Table 7. Solar initial condition before optimization

Stream	Weight (Ton)	Fraction	Sulfur (%wt)	Sulfur comp.
HGO CDU I	4,156.90	0.0504	1.8	0.090719257
DLGO HDS	64618.28	0.78	0.06	0.047007162
VGO LOC 3	3,482.22	0.04	0.15	0.006332937
VGO HVU 1 & 2	6,621.45	0.08	2.61	0.209532307
HGO ex HTU	3600	0.044	0.01	0.000436476
Total	82,478.85	1		0.354028139
ex foc 1	**82,478.85**	**1**		**0.354028139**
Sulfur conten trefinary 1	**0.35 %wt**		**Solar (TON)**	**82,478.85**
Sulfur content Solar	**0.35 %wt**		**Solar (MB)**	**608.54**

Table 8. Solar Condition after optimization

Stream	Weight (Ton)	Fraction	Sulfur (%wt)	Sulfur comp.
HGO CDU I	20,286.19	0.1968831	1.8	0.354389629
DLGO HDS	64618.28	0.63	0.06	0.037628308

Table 9. Comparison of Solar conditions before and after optimization

	Initial Condition		After Optimization	
IFO used by HGO	0	MB	16,129.29	MB
IFO used by VGO	0	MB	4,428.56	MB
IFO after optimization	544.7035	MB	410.61	MB
Income without solar and IFO	76985.76715	Thousand USD	76985.76715	Thousand USD
Solar Price	42.12		42.12	
Income Solar	25631.79188	Thousand USD	32020.51	Thousand USD
IFO Price	21.28		21.28	
Income IFO	11591.29014	Thousand USD	8,737.86	Thousand USD
Total Feed Cost	89362.8	Thousand USD	89362.8	Thousand USD
Margin	24,846.04	Thousand USD	28,381.34	Thousand USD

In the initial condition of Diesel, the margin obtained was 24846.04 thousand USD or 8.04 USD/barrel and the resulting sulfur content exceeded the desired specifications, which was 0.35% -wt. While from the optimization results it can be seen that to obtain sulfur content of

0.3, the number of HGO is needed for 20286.19 TON or 676.21 TPSD and the amount of VGO is 11050.01 TON or 368.33 TPSD and the maximum margin that can be obtained is 28381.34 thousand USD or 9 18 USD/barrel. Margin in units of USD/barrel has increased by 1.14 USD/barrel. At optimum conditions, the amount of Diesel produced increases because it gets an additional from Diesel components with high sulfur content VGO and HGO [4].

4. Conclusions

From the results of the research that has been conducted, it can be concluded that to produce Premium with ON 88, the reformate volume and volume of HOMC used were 100 MB or 394.5431 TPSD, and the volume of Premium produced was 200 MB. In conditions after optimization, the maximum margin that can be obtained was 22316 thousand USD or 7.22 USD/barrel. From the results of the research conducted, it is explained that there is a decrease in performance units so that reformate cannot be fully entered as a Premium component and requires HOMC for blending, so that the margin in USD/barrel decreases by 0.82 USD/barrel.

In the Diesel initial condition, the margin obtained was 24846.04 thousand USD or 8.04 USD/barrel. From the optimization results, it can be seen that to obtain sulfur content of 0.3% wt, the amount of HGO is 20286.19 TON or 676.21 TPSD and the VGO amount was 11050.01 TON or 368.33 TPSD and the maximum margin that can be obtained was 28381.34 thousand USD or 9.18 USD/barrel. The condition of the margin in USD/barrel after the optimization of Diesel sulfur content increased by 1.14 USD/barrel. At optimum conditions, the amount of Solar produced increases because it gets an additional from Diesel components with high sulfur content of VGO and HGO.

From the results of the research that has been conducted, it can be seen that Premium and Diesel are very influential on company margins, because Premium and Diesel are valuable products with higher selling prices compared to crude prices.

References

[1]   Peraturan Pemerintah RI No.79 2014 Kebijakan Energi Nasional (Indonesia)
[2]   Spark-Ignition Engine Fuel D7862 – 13. West Conshohocke US: ASTM Intl.
[3]   Niemistö J, Saavalainen P, Pongrácz E and Keiski R L2013 Biobutanol as a potential sustainable biofuel - assessment of lignocellulosic and waste-based feedstocks Journal of Sustainable Development of Energy, Water and Environment Systems 1 58-77.
[4]   Atsumi S, Cann A F, Connor M R, Shen C R, Smith K M, Brynildsen M P, Chou K J Y, Hanai T and Liao J C 2007 Metabolic engineering of Escherichia coli for 1-butanolproduction Metabolic Engineering 10 305-311