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FEASIBILITY OF THE UTILIZATION CONDENSATE AS RAW MATERIAL FOR PETROCHEMICAL

KELAYAKAN PEMANFAATAN KONDENSAT SEBAGAI BAHAN BAKU PETROKIMIA

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ABSTRAK

Pemanfaatan kondensat saat ini belum optimal, dimana dari sebagian besar produksinya dicampur dengan minyak mentah yang mengakibatkan terjadinya penyusutan yang cukup signifikan pada volume minyak. Sebagai produk hidrokarbon, kondensat dapat dimanfaatkan sebagai bahan baku industri petrokimia, bahan bakar maupun pelarut. Saat ini bahan baku industri petrokimia di Indonesia diimpor dari manca negara. Untuk mengoptimalkan pemanfaatan kondensat perlu dilakukan pengujian karakteristik beberapa jenis kondensat untuk kemudian dilakukan analisis pemanfaatannya berdasarkan jumlah dan sifatnya tersebut. Hasil uji PONA memperlihatkan bahwa dari keenam sampel kondensat yang di uji memiliki kandungan parafin yang cukup tinggi diatas 60%. Kandungan paraffin tertinggi sebesar 82.84% untuk kondensat B dan terendah kondensat E sebesar 61.40%. Dengan kandungan paraffin yang lebih dominan untuk keenam sampel, kondensat-kondensat tersebut lebih cocok digunakan sebagai bahan baku petrokimia olefin. Hasil perhitungan keekonomian dari pembangunan Unit Proses Olefin Center dengan kapasitas 100.000 BPSD adalah IRR sebesar 22.8%, NPV sebesar 1,801,491,951.12 US$, POT selama 4.1 tahun, dan PI sebesar 1.87. Pembangunan Unit Proses Olefin Center bernilai sangat ekonomis.

Kata Kunci: *kodensat, uji PONA, bahan baku petrokimia olefin.*

ABSTRACT

The utilization of condensate is currently not optimal yet, where most of its production are mixed with crude oil which results in significant shrinkage in oil volume. As a hydrocarbon product, condensate can be utilized as a raw material for petrochemical industry, fuel and solvent. Currently raw materials of petrochemical industry in Indonesia are imported from other countries. To optimize the utilization of condensate it is necessary to conduct a characteristic test of several types of condensate and then conducted a utilization analysis based on their number and its nature. Paraffin, Olefin, Naphthenic and Aromatic (PONA) test results showed that the six samples of condensate in the test had a fairly high paraffin content of above 60%. The highest paraffin content was 82.84% for condensate B and the lowest was 61.4% for condensate E. The six condensate samples contain higher paraffin, which are suitable for use as raw material for petrochemical olefin.The results of the economic calculation of the construction unit Olefin Process Center with a capacity of 100,000 BPSD, which is an IRR as 22.8 %, the NPV as of US $ 1,801,491,951.12 , POT for 4.1 years, and PI as 1.87. Developing of Olefin Process Unit Center being constructed in Indonesia is economical worthy.

Keyword: condensate, PONA test, raw material of petrochemical olefin

I. INTRODUCTION

Condensate as a hydrocarbon product has a C_5 to C_{11} hydrocarbon chain. All of condensate which has separated from natural gas fields is mostly blended with crude oil. Afterwards together with crude oil, condensate will be transported using petroleum pipeline facilities to the petroleum storage tanks. Most of the condensate which has mixed with crude oil can be unstable which will still have a high pressure so that at the time of condensate receiving it evaporates to about 30%. In addition, discrepancy of specific gravity and characteristics are quite different between the petroleum and condensate by causing the mixed results are shrinking volume due to shrinkage in the range 3-5%.

The quality of condensate that has resulted of each well are varies, so it does not all of condensate can be used for commercial in the market. The untapped condensate is usually used for own usage as refinery fuels. One of the industries that can utilize the condensate as a raw material is the petrochemical industry. In addition, the condensate can also be used as fuel as a substitute for LPG and kerosene. The heat value of condensate is 10,000-12,000 cal /gram, almost equivalent to LPG, while the heat value of kerosene is 9.900-11.100 cal/gram (Bakti 2005) are shown in Figure 1.

II. METHODOLOGY

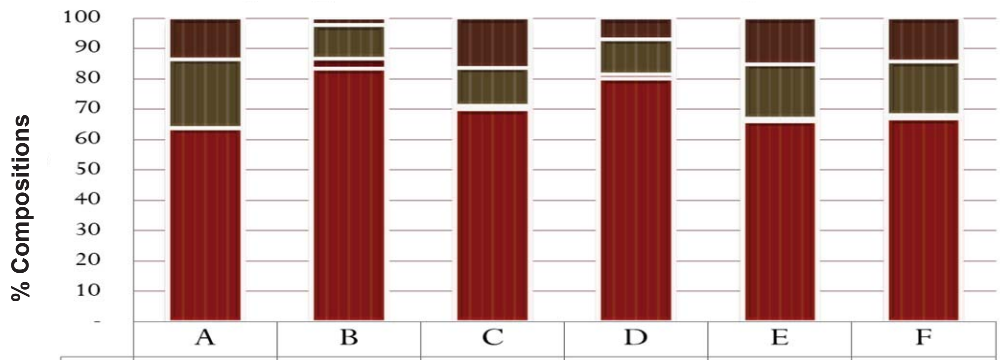
Pona Condensate

Laboratory tests were conducted to determine the characteristics of condensate in Indonesia, consisting of content tests for Paraffin, Olefin, Naphthenic and Aromatic (PONA) which were conducted using the method ASTM D 6729. Results of PONA composition tests for each condensate in each field gas (Fields A through F) are shown in Figure 1.

III. RESULT AND DICUSSION

A. Indonesian Production and Consumption in the Petrochemical Industry

The main petrochemical products from condensate are olefins, aromatics, methanol and ammonia. Olefin products are used as raw materials for the processing of polyethylene (PE), ethylene oxide, ethyl benzene, ethylene glycol (EG), ethylene dichloride (EDC), vinyl chloride monomer (VCM), and vinyl acetate (VAC). Manufacturers of ethylene in Indonesia include Chandra Asri Petrochemical



	A	B	C	D	E	F
A	13.32	2.20	16.19	6.82	14.98	14.22
N	22.61	10.87	12.50	11.58	17.94	17.50
O	0.25	3.44	1.27	1.44	0.95	1.27
P	63.82	83.48	70.05	80.15	66.14	67.01

Fgure 1
PONA test result of many gas field in Indonesia.

Table 1
Manufacturer and production petrochemical volume in Indonesia

Basis	Product	Supply	Capasity (ton)
	Ethylene	PT. Chandra Asri	600.000
Olefin		PT. Chandra Asri	460.000
	Propylene	PT. Pertamina	405.000
	Methanol	PT. Kaltim Methanol Indurtri	660.000
		PT. Pupuk Kaltim	1.848.000
		PT. Kaltim Pasifik Amoniak	660.000
Methane		PT. Kaltim Parna Industri	495.000
	Ammonia	PT. PGK	445.400
		PT. Pupuk Kujang	713.000
		PT. PIM	762.000
		PT. Pusri	1.499.000
	Benzene	PT. Pertamina	120.000
		PT. TPPI	320.000
	Toluene	PT. TPPI	100.000
Aromatik		PT. Pertamina	296.000
	Paraxylene	PT. TPPI	500.000
	Orthoxylene	PT. TPPI	120.000

Table 2
Industry profile olefin indonesia (in metrikc ton)

Pproduct	Demand	Supply	Balance
Ethylene	1.109.000	600.000	(509.000)
Propylene	950.000	813.000	(137.000)
Polyethylene (Pe)	816.000	770.000	(46.000)
Monoethylene Glycol (MEG)	425.000	220.000	(205.000)
Polypropylene (PP)	1.055.000	955.000	(100.000)
Butadiene (BD)	66.000	0	(66.000)

Indonesia masih kekuranganpasokan olefin yang sangat besar

Center (CAPC) and PT Pertamina. Methanol product is produced by PT. Kaltim Methanol Industry, while the aromatic product is produced by PT. TPPI and PT. Pertamina. Table 1 shows the volume of products and manufacturers producing petrochemical products in Indonesia.

Domestic consumption of olefin products consist of ethylene, and propylene which is far greater than the level of domestic production. Domestic ethylene consumption is 1.1 million tons, while supply as 600,000 tons. There are deficit ethylene is 509,000 tons. Domestic consumption of propylene is 950,000 tons, while supply as 813,000 tons. There are deficit as 137,000 tons. Total deficit olefin product as 1.063 million tons (Table 2). It encourages an increase in imported products in order to meet domestic consumption petrochemical needs.

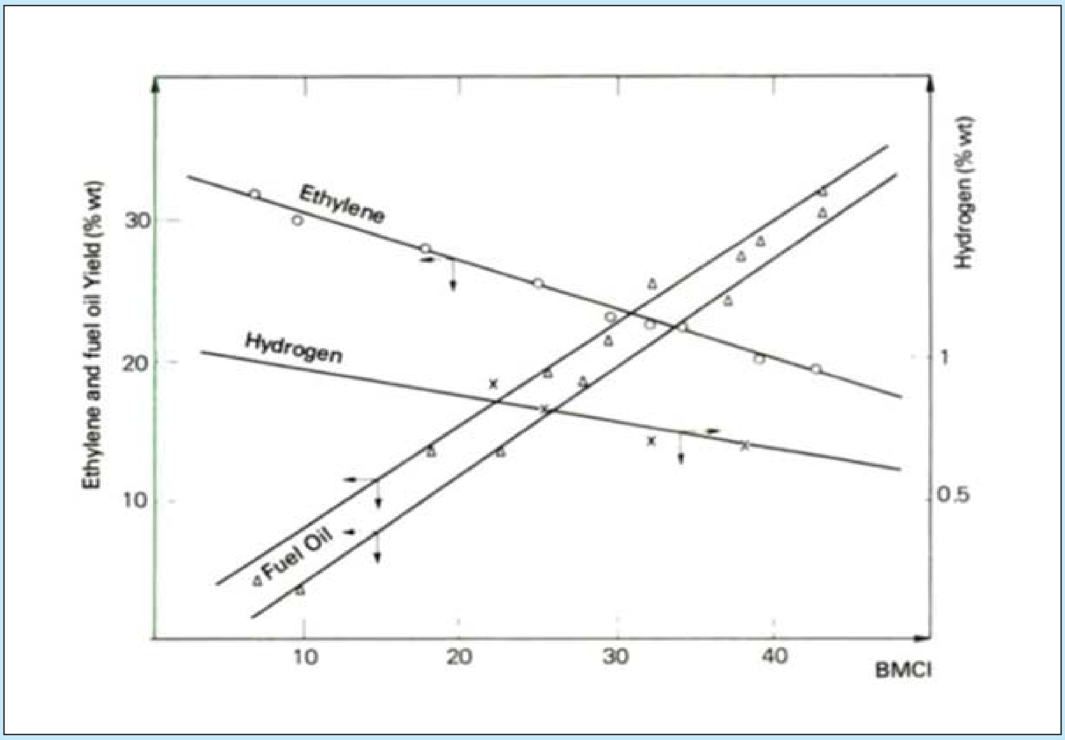


Figure 3
Ethylene conversion as BMCI funtion.

Table 3
BMCI Index

		Indeks BMCI			
A	B	C	D	E	F
25.38	20.58	2.37	14.38	2.06	1.96

B. Condensate as Raw Material for the Petrochemical Industry

Condensate can be derived from the heavy fraction contained in the gas stream or part of the lighter fractions of petroleum. Based on the content of the condensate composition is a mixture of C_3, C_4, and C_5^+ which C_3 composition generally less than 2.5 % -mol , C_4 less than 32.5 % -mol , and C_5^+ more than 65 % -mol . a subpart of of the naphtha. It is hydrocarbon fraction with a boiling point between 30^{o}C to 200^{o}C. Naphtha contains a mixture of various hydrocarbon components ranging from C_5 to C_{12}. Naphtha is classified into two parts: light naphtha with a boiling point between 30-90 °C and containing hydrocarbon composition C_5 - C_6 ; heavy naphtha with a boiling point between 90 -200 ° C and containing composition C_6 - C_{12} hydrocarbons.

As the raw material of petrochemical industry, basically condensate could be a petrochemical industry feedstock however the characteristics and composition differentiation of the hydrocarbons contains will affect to the amount of its product. Laboratory tests were conducted such as a distillation test to find out the fraction of the raw material composition, a Specific Gravity test was undertaken to determine the weight of raw materials and the analysis of Gas Chromatography (GC) to ascertain the composition of the hydrocarbons contained in the raw materials. A PONA test was also conducted to detect the content of paraffin, olefins, naphthenic and aromatics. PONA analysis results will determine whether the raw materials can be used for the center of olefins or aromatic petrochemical industry.

PONA test results showed that of the six samples of condensate sampling has high paraffin content of above 60%. The highest Paraffin content was 82.84% for condensate B and the lowest condensate E was 40%. Dengan kandungan paraffin yang lebih dominan untuk keenam sampel, kondensat-kondensat tersebut lebih cocok digunakan sebagai bahan baku petrokimia olefin. *'Aromaticity'* senyawa hidrokarbon juga dapat dihitung dengan menggunakan pendekatan persamaan BMCI (Bureau of Mines Correlation Index).

It was also proven that the more dominant paraffin content of the six samples, those condensates are more suitable to be used as olefin petrochemical raw materials. 'Aromatics' hydrocarbon compounds can be also calculated by using the equation BMCI (Bureau of Mines Correlation Index) method, as follows:

$$BMCI = \frac{87.552}{VABP(Rankine)} + 437{,}5\ x\ SG - 456{,}8$$

where,

VABP : volume average boiling point (in Rankine)

SG : specific gravity 60/60F

VABP can be calculated using the analysis TBP results for the cutting point 20%, 50% and 80% using the following equation

$$VABP = \frac{T_{20} + T_{50} + T_{80}}{3}$$

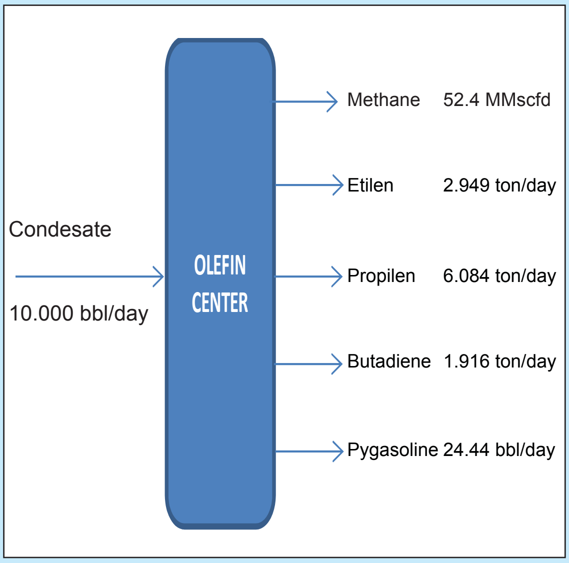


Figure 4
Olefin production asumption.

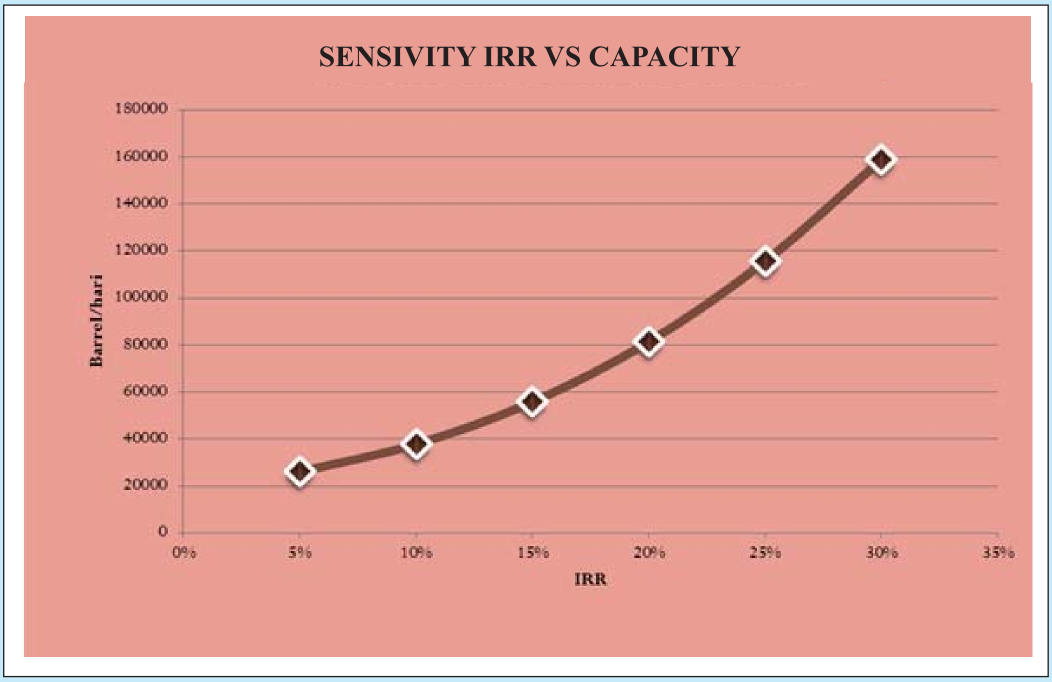


Figure 5
Sensitivity test IRR vs capacity olefin center.

BMCI index of hydrocarbons compound with the amount of ethylene product which developed by The Stone and Webster Company. The equation is stated that the higher the value 'aromaticity' (BMCI higher) so ethylene and hydrogen products lower. Otherwise, liquid fuel product (hydrocarbon fraction above 200^{o}C higher. Ethylene conversion and liquid fuel balance when the BMCI index less than 32. This relationship is shown in Figure 3

The BMCI value of condensate samples are calculated by equation above. Codensate sample A is the highest BMCI's as 25.38. From the figure 3 above, the BMCI index of all samples showed that conversion ethylene product more dominate than the liquid fuel so it is more appropriate to use for feed olefin center. Table 3 shows the results of a sample calculation of the index BMCI condensate.

C. Economy

To determine the feasibility of olefin industrial development in Indonesia is conduct by an economic analysis, which has the following assumptions: operational and maintenance costs outside of the cost of working capital is 5% of the total capital costs, that insurance costs amounting to 3% of the total cost of capital, that the life of the project is for 20 years, there is 100% equity, factor inflation rate is 5%, the purchase price of condensate/naphtha is 106 US $/Barrel, the selling price of ethylene 1,350 US $/MT, the selling price of propylene is 1,214 US $/MT, the selling price of butadiene is 1,310 US $/MT, the selling price of PyGasoline is 108 US $/Barrel, and the selling price of methane is 6 US $/MMBTU. The compotition products of olefin center, as shown in Figure 4.

The result of economic of the development of Unit Process Olefin Center with a capacity of 100,000 BPSD, which is IRR (Internal of Rate of Return) is 22.8%, the NPV (Net Present Value) is 1,801,491,951.12 US $, POT (Pay Out Time) during 4.1 years, and PI (Profitability Index) is 1.87.

Olefin Process Unit Development Center is worth. Based on economic analysis test by carry out the sensitivity of the capacity is seen that the higher the capacity, so the IRR greater. It's as shown in Figure 5.

IV. CONCLUTIONS

Domestic ethylene consumption is 1.1 million tons while supply as 600 thousand tons of propylene. There are deficit ethylene is 509 thousand tons. Domestic consumption of propylene is 950 thousand tons while supply is 813 thousand tons. There is deficit propylene as 137 thousand tons.

Utilization of condensate as an industrial raw material depends on the amount of PONA in its composition. The condensate tested in Sumatra showed that a dominant bparaffin plus olefin components more 60%, so it is worthy feasible to be developed as an Olefin Center. Moreover, this decision boosted with the BMCI value of condensates are low as 1.96 to 25.3.

Olefin industrial development with a capacity of 100,000 BPD requires an investment of approximately US $ 2,275 billion. An Economic indicator is an IRR (Internal Rate of Return) of approximately 22.8% and POT (Pay Out Time) during 4.1 years. However, to realize the raw materials 100,000 BCPD is dificult because the most of condensate produce in Indonesia has been used for TPPI.

The development of industrial olefin raw material condensate achieve economic values on the capacity of 55 742 BCPD, which is IRR (Internal Rate of Return as 15%.

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