PRODUCTION OF UNLEADED GASOLINE IN ASEAN COUNTRIES

by
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I. INTRODUCTION

Worldwide crude supply is experiencing a modest trend towards heavier and high sulfur content. The Middle East, being traditionally the world's major oil exporting region, will continue to be the principal supplier of lower quality crude's in the future[1].

For the period 1992-2005, the average annual demand growth rate for light products (gasoline, kerosene, diesel oil) is higher than for residual fuel oil[2]. These data clearly show that the need will continue for converting additional bottom fraction into light products, by both thermal or catalytic conversions.

The passage of the Clean Air Act Amendement of 1990 in the USA has forced American refineries to install new facilities to comply with stricter specifications for fuels such as gasoline and diesel oil such as Asia-Pacific, California Air Resources Board (CARB) and European Commission (EC) [3.4.5]. Various terms in the models address qualities and the gasoline blended such as benzene, total aromatics and olefin contents, RVP, the T90 of distillation range, sulphur content, and oxygenates content.

Comparison of fuel specifications between ASEAN countries and reformulated fuels and typical compositions of gasoline and gas oil components for production of commercial unleaded gasoline is included in this report.

II. PRODUCTION OF UNLEADED GASOLINE IN ASEAN COUNTRIES

Motor gasoline is essentially a complex mixture of hydrocarbons distilling about 30°C and 320°C and consisting of compounds generally in the range C_4 to C_{12}. Gasoline components can be produced by both the distillation of crude oil and the conversion of the crude oil fractions. Out of 3,837 MBPSD total crdue oil currently processed in 26 refineries to procedure fuels oil.

Over 862 MBPSD of feedstock is processed by catalytic conversion to produce about 639 MBPSD of gasoline components in ASEAN countries (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore and Thailand, not included Vietnam, Laos, Cambodia and Myanmar)[6]. Evolution in knock rating and lead content of leaded gasoline, unleaded gasoline, and gasoline property specification in ASEAN countries are given in Tables 1, 2, 3 and 4. The average compositions of gasoline components produced in ASEAN countries contains about 80 vol. % cat. cracked gasoline and reformate[7].

The octane levels of commercial gasolines in ASEAN countries are as follows:

- Leaded gasoline with 0.10-0.30 gPb/l are vary from RON 72 RON 97.
- Unleaded gasoline with 0.05-0.013 gPb/l are vary from RON 87 RON 98.

Octane level of reformulated unleaded gasoline in RON 95 and MON 85. Increasing proposed cuts in gasoline volatility and carbon monoxide emissions are boosting the use of ethers to replace lead antiknocks as octane blending components. Ethers also could help make up lost octane if gasoline's aromatic content is trimmed.

Ethers are attractive as gasoline blending component because of their high octane quality, relatively low vapour pressure, and compatibility with hydrocarbons in the gasoline boiling range.

Limitations in gasoline volatility and aromatics content and increased octane demands also will spur greater use of alkylation and fluid catalytic cracking.

To meet reduction in gasoline vapour pressure, refiners will need to alkylate any C_4 olefins currently

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Table 1
Evaluation in knock rating and lead contents of leaded gasoline in ASEAN Countries (1978 - 1997)

Year (of survey):			1997	1995	1991		1978	
Country	RON mm	MON mm	Pb g/L max	Pb g/L max	Pb g/L max	MTBE % vol. max	Pb g/L max	MTBE %vol. max
Brunei	85*	-	0.84	0.60	0.40	-	0.15	-
Darussalam	95*	-	0.84	0.60	0.40	-	0.15	-
Indonesia	72*	-	-	-	-	-	0.10	-
	87	-	0.70	0.70	-	-	-	-
	88*	-	-	-	0.45	-	0.30	-
	92	-	-	-	0.45	10.0	-	-
	94*	-	-	-	-	-	0.30	15.0
	98	-	0.84	0.84	-	-	-	-
Malaysia	85	-	0.75	0.40	0.15	-	-	-
	91	-	0.75	-	-	-	-	-
	92*	-	-	0.40	-	-	0.15	-
	95	-	-	-	0.15	-	-	-
	97	-	0.84	0.40	0.15	-	-	-
	100	-	0.84	0.84	-	-	-	-
							-	-
Philippines	81*	-	1.16	1.16	0.60	-	-0.15	-
	93	82	1.16	1.16	0.40	-	-	-
	95*	-	-	-	-	-	0.15	10.0
Singapore	85	-	0.84	-	0.15	-	-	-
	98	-	-	-	-	-	-	-
	92	-	-	0.40	-	-	-	-
	97*	-	-	0.40	-	-	0.15	-
	98	-	0.84	0.40	0.15	-	-	-
Thailand	83*	-	0.84	0.45	-	-	-	-
	87	76	-	-	-	-	-	-
	95*	84	0.84	0.45	-	-	-	-
Vietnam	83*	-	-	-	-	-	0.15	-
	92*	-	-	-	-	-	0.15	-

Note: (*) = 1998

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Table 2
Unleaded gasoline in ASEAN

Country	RON min	MON min	Pb g/L max	MTBE vol.% max	Year intro.	1997 share vol.%	Complete phase out
Brunei Darussalam	97	-	0.013	15.0	1993	44	1998
Indonesia	95	-	0.005	10.0	1995	<1	2000
	98	-	0.005	15.0			
Malaysia	97	-	0.013	10.0	1990	85	1999
Philippines	93	82	0.013	10.0	1993	13	-
Singapore	92	-	0.005	15.0	1991	71	1998
	98	-	0.005	15.0			
Thailand	87	76	0.013	-	-	-	May, 1998
	91	80	0.013	11.0	1991	100	1996
	95	84	0.013	11.0	1991	100	1996
Vietnam	-	-	-	-	-	-	-

in the gasoline pool. In addition, refiners have now alkylate available C_3, olefins, which would absorb more iso and normal butane into the alkylate product, and it is probable that refiners will find it profitable to alkylate more C_5 olefins.

Using a non-framework alumina silicate catalyst can present oportunities for LPG in some operations. The catalyst produces LPG stream that provides more isobutane for MTBE feed and a better feed for alkylation units, in addition to good octane performance, particularly motor octane number (MON) of the FCC gasoline. The resulting LPG stream also yield richer propylene feed plus propane and butane that blended with ethanol.

In refinery with a shortage of isobutane, it is likely that isomerization of normal butane will help in balacing the refinery with ethanol.

Pressure to reduce atomspheric pollution are tending towards the reduction or elimination of lead from gasoline in the exhaust gas. Lead acts as a catalyst poison of catalytic converter for reducing the carbon monoxide, nitrogen oxide and hydrocarbon emissions. Lead in the gasoline contributes to particulate matter in sphere atom. From 1987 to 1995 lead content of gasoline in ASEAN countries has been reduced from 1.16 to 0.15 Pb/l for leaded gasoline.

Automakers, seeking to guarantee a long life for catalytic converter, has asked for tougher limits on leaded of 0.005 gPb/1 and sulphur of 500 ppm for unleaded gasoline.

In general, the sulphur contribution in gasoline pool consists of light FCC-naphtha (C_5--132°C) 12 wt.%, heavy FCC-naphtha (132°C-222°C) 86 wt.% and coker (C_5-C_6) 2 wt. %.

Utilization of unleaded gasoline in ASEAN countries was started in 1990 and increasing in 1997 as follows: Brunei Darussalam 44.0 vol. %, Indonesia < 1.0 vol. %, Malaysia 85.0 vol. %, Philippines 13.0 vol. %, Singapore 71.0 vol. %, and Thailand 100.0 vol. %.

Table 3
Gasoline property specification in ASEAN countries (1991 - 1998)

Property		Brunei D.		Indonesia		Malaysia		Philippines		Singapore		Thailand		Vietnam	
		1991	1998	1991	1998	1991	1998	1991	1998	1991	1998	1991	1998	1997	1998
Distillation	DC														
10% evap.	max	-	-	74	74	74	74	70	70	74	74	75	70	70	70
50% evap.	min	-	-	88	88	-	75	77	75	77	85	75	70	120	120
	max	-	-	125	125	120	115	121	121	121	120	125	110	-	-
90% evap.	max	-	-	180	180	180	180	185	185	190	190	190	170	-	190
End point	max	210	210	*205*	205	210	215	221	221	221	225	215	200	210	210
Residue	% vol. max	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	-	2.0
RVP at 37.8DC	kPa max	-	-	62	62	86	70	85	85	70	70	82	62	83	43.8
Sulphur	% wt. max	0.10	0.10	0.20	0.20	0.15	0.15	-	0.20	0.20	0.20	0.15	0.10	0.15	0.15
Copper strip corrosion	max	NO.1	NO.1	NO.1	NO.1	NO.1	NO.1	NO.1	No. I		No.1		No.1	No. I	No.1
Existent gum mg/100 mL	max	-	4	4	4	4	4	4	4	4	4	-	4	5	5
Induction period minutes	min	-	-	240	240	240	240	-	-	240	240	-	-		240

Table 4
Current ASEAN vs. Reformulated Gasoline

		ASEAN	USA	Europe	Asia Pacific
T50,	°C	70-125	98	-	-
T90,	°C	170190	148	75	177
Evaporated at		-	-		-
100 ° C	vol. %	-	-	46	-
150°C	vol. %	-	-	75	-
RVP,	kPa	62-83	49	60	
Oxygen,	wt. %	2.0-2.7	2	2,3	-
Aromatics,	vol. %	50-55	25	45	30
Benzene,	vol. %	3.5-5.0	1	2	3
Olefins,	vol. %	-	-	18	-
Sulphur,	ppm	1.000-2.000	40	200	250

Refiners in ASEAN are actively involved in the movement or gasoline into the reformulated gasoline pool, for which they need good processing ability. Like many refiners in the world, ASEAN's refineries are adjusting their distribution of gasoline components in the gasoline pool. Lead phase down in gasoline will emphasize several processes including catalytic reforming, catalytic cracking, light naphtha, isomerization, alkylation, and methyl tertiary butyl ether (MTBE) synthesis. For prepactionator of reformate and cat. cracked gasoline to meet the specification of reformulated gasoline, deep prefractionator column and the hydrotreating processes will need to be installed.

III. CONCLUSION

Out of 3,837 MBPSD total crude oil currently processed in 26 refineries to produce about 545 MBPSD of gasoline compounds and 1,310 MBPSD of gas oil components in ASEAN.

Current specification for commercial gasoline in ASEAN is lower than specification for reformulated gasoline. ASEAN's gasoline pool has lower persentage of two gasoline components i.e. alkylate and isomerate than that reformulated gasoline pool. RVP. T50 and T90 distillation range, and sulphur, benzene and total aromatic content of specification of commercial gasolines in ASEAN countries are higher that specification of reformulated gasoline.

ASEAN's refineries must be reconfigured to comply with the new. requirements of reformulated gasoline. Differences in approach are depending on the specific product distribution of this fuel oil components.

The average composition data of gasoline components for production of commercial fuels in ASEAN refineries would be useful for refiners to develop the ability to produce reformulated fuel in the year 2000. Composition of gasoline in the fuel oil pools in ASEAN refineries could be collected by a survey.

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