TRENDS AND DEVELOPMENT OF PETROLEUM FUEL QUALITIES IN INDONESIA

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ABSTRACT

Petroleum fuels must meet the technical requirement of their intended uses. In that sense, the technical description of each type of petroleum fuels in different countries are basically similar. The detailed specifications, however, may vary slightly because of the different conditions and situations existing in each country, such as equipment or car population, crude available, processing facilities, government policies with regard to the safety, supply, distribution, as well as energy conservation, environment, and many other considerations.

This paper describes the particular conditions in Indonesia as part of a survey on the trends and development of petroleum fuel qualities in ASEAN countries. It was prepared as the Indonesian contribution to ASEAN Council on Petroleum (ASCOPE) Technical Committee's Survey on the Trends and Development of Petroleum Fuel Qualities in ASEAN Countries, and discussed in the 12th Annual ASCOPE Laboratory Workshop held in Manila, Philippines, on September 26–28, 1991.

I. INTRODUCTION

In Indonesia, Pertamina is the sole oil company responsible for the supply and distribution of petroleum fuels. The prices of petroleum fuels are set by the Ministry of Finance, while their qualities and specifications are decreed by the Ministry of Mines and Energy, c.q. Directorate General of Oil and Gas.

Seven types of petroleum fuel fall under this scheme, namely aviation gasoline, motor gasoline, jet fuel, kerosene, automotive diesel oil (ADO), industrial diesel oil (IDO), and fuel oil.

The total annual consumption in 1989 excceded 30 million kiloliters with the distribution for each type of fuel in second half of the decade of 1980s as presented in Table 1. The evolution in their prices during the past twelve years prices are listed in Table 2. Table 3 shows their current prices in the equivalent US dollars and ASEAN currencies.

Since their specifications were first decreed in 1979, the qualities of petroleum fuels in Indonesia have undergone some changes. The following sections discuss the development

Table 1
INDONESIA
Domestic Consumption of Petroleum Fuels
(in '000 kilolitres)

	1985	1986	1987	1988	1989
Aviation gasoline	10.5	10.0	9.2	9.5	9.7
Jet fuel	705	725	796	874	960
Super gasoline	117	163	228	292	390
Premium gasoline	3998	4306	4619	4906	5279
Kerosene	6860	6935	6893	7102	7410
Automotive diesel fuel	7497	7548	8610	9450	10355
Industrial diesel fuel	1624	1416	1344	1424	1554
Fuel Oil	3750	3051	3270	3066	3129
Total :	24685	24153	25768	27124	30675

and trends in the specification of each type of petroleum fuels in the country.

II. MOTOR GASOLINE

Prior to May 1990, two grades of motor gasoline were produced and supplied by Pertamina, namely "Premium" gasoline and "Super-98". Premium gasoline had an octane rating of 87 RON minimum, with TEL content of 2.5 ml/US gallon (0.70 g/litre) maximum. The super gasoline is 98 RON minimum and contained a maximum of 3.5 ml TEL/US gallon (0.84 g Pb/litre). "Premium" was coloured yellow and "Super-98" red. Otherwise, "Premium" and "Super-98" had similar characteristics with regards to distillation, Reid vapour pressure (RVP), gum, sulphur, corrosion, and various other minor properties. The specifications for "Premium" and "Super-98' are shown in Table 4. It must be noted that both these types of gasoline are no longer produced now.

As of May 1990, the government applied a new policy in the supply of gasoline, known as the monograde gasoline policy, in which Pertamina is responsible for the supply of one grade of gasoline only, namely "Premium 88". This constitutes an improvement of one point in the octane number compared to the old "Premium" gasoline and a reduction in lead content to 1.5 ml TEL/US gallon (0.42 g Pb/litre). Their complete specifications are contrasted in Table 4. With the exception of two minor parameters, other characteristics remain practically unchanged. One of these is mercaptan sulphur which is relaxed from 0.0015% weight maximum in the older specification to 0.0020% weight in the newer one. The other is the temperature difference of 20% – 10% evaporated in the distillation test (ASTM D-86), which was set at 8°C in the older specification and eliminated in the newer one.

These two changes relax somewhat some of the constraints in gasoline production, especially that Indonesia is now processing Middle East crudes which have higher sulphur contents than most Indonesian crudes. The difference between 20% and 10% distillation

temperature had long been discarded in gasoline specifications in many other countries and its significance to gasoline performance as fuel for spark ignition engine is not well established.

The reduction in lead content is an expression of the government drive to reduce air pollution, in this case from lead in exhaust emission of motor vehicles. The longer term objective is to produce only unleaded gasoline in Indonesia, in the future, when the production facilities and economics allow. To achieve this condition more reformer units will need to be installed to produce more high octane mogas components.

Table 2
INDONESIA
Development in the Princes of Petroleum Fuels
(in Rp/litre)

	1979 May 3	1980 May 1	1982 Jan 2	1983 Jan 7	1984 Jan 12	1985 Apr 1	1986 Juli 10	1990 May 25	1991 Jul 11
Aviation gasoline	100	150	240	300	300	330	250	330	400
Aviation jet fuel	100	150	240	300	300	330	250	330	400
Super gasoline	140	220	360	400	400	440	240	–	–
Premium gasoline	100	150	240	320	350	385	385	450	550
Kerosene	25	37.5	60	100	150	165	165	190	220
Automotive diesel oil	35	52.5	85	145	220	242	200	245	300
Industrial diesel oil	30	45	75	125	200	220	200	235	285
Fuel oil	30	45	75	125	200	220	200	220	220

Notes : Premix was introduced in May 1991 with price ranging from Rp. 495-510 per litre, which later increased to Rp. 570-575. With the increase in price of Premium gasoline in July 1991, Premix is now sold at Rp. 670 per litre.

Table 3
INDONESIA
Current Princes of Petroleum Fuels
in Rp/1 and equivalent foreign currencies

	Rupiah	US.$	Bru. $	Mal. $	Phi.P	Sin. $	Tha. B
Aviation gasoline	400	0.204	0.350	0.565	5.449	0.350	5.237
Jet fuel	400	0.204	0.350	0.565	5.449	0.350	5.237
Premium gasoline	550	0.280	0.481	0.778	7.492	0.481	7.201
Kerosene	220	0.112	0.192	0.311	2.997	0.193	2.880
Automotive diesel oil	300	0.153	0.262	0.424	4.087	0.263	3.928
Industrial diesel oil	285	0.145	0.249	0.403	3.882	0.249	3.731
Fuel oil	220	0.112	0.192	0.311	2.997	0.193	2.880

Note : Rp. 1000,– = US.$ 0.5092 = Bru. $ 0.8744 = Mal. $ 1.4137 = Phi.P 13.6221 = Sin.$ 0.8752 = Tha.B 13.0924 (Bank Indonesia, Aug. 30, 1991).

The production of high octane "Super-98" has been terminated for several reasons. First octane requirement measurement by LEMIGAS R/D Centre for Oil and Gas Technology indicated that only very small percentage of the car population requires such high octane gasoline. (The study showed that 90% of car population would require only an octane rating 0f 95 RON).

The actual market also showed that the sales of "Super-98" were only about 6% of gasoline consumption, and concentrated only in a few major cities in Java and some in Sumatra. The supply of two types of gasolines, especially with such unequal proportion imposed unnecessary burden for Pertamina. In the drive to improve operational efficiency of Pertamina, it was decided to relieve Pertamina from the need to supply such minor product. For car owners wishing to use higher octane gasoline than the new "Premium–88" of Pertamina, the opportunity is opened to use the various octane boosters available in the retail market, as well as a new oxygenated gasoline sold by private companies.

This oxygenated gasoline is called "Premix", which specification is established by the Directorate General of Oil and Gas, Ministry of Mines and Energy. Five private companies are currently granted permission by the government to prepare "Premix" by buying "Premium-88" gasoline in bulk from Pertamina and blending it with 10% volume of methyl tertiary butyl ether (MTBE). Currently, "Premix" is sold in Pertamina's refueller stations (which are, in fact, operated under contract by private operators).

The specification of "Premix" stipulated an octane number of 91.5 RON and orange colour. Other specification items are exactly similar to those for "Premium-88". These are compared in Table 4.

Table 4
INDONESIA
Specification of Motor Gasoline

Characteristics		Test Method	Min Max	Before May 1990		After May 1990	
				"Premium"	"Super 98"	"Premium 88"	"Premix"
Knock Rating		D-2699					
Research Octane Number	ON		min	87	98.0	88.0	91.5
T.E.L. Content	ml/AG	D-526	max	2.5	3.0		
		D-2547	max			1.3	1.3
Distillation :		D-86					
10% vol. evap. to	°C		max	74	74	74	74
50% vol. evap. to	°C		min	88	88	88	88
			max	125	125	125	125
90% vol. evap. to	°C		max	180	180	180	180
End Point	°C		max	205	205	205	205
20% - 10% vol. evap.	°C		min	8	8		
Residue	% vol		max	2.0	2.0	2.0	2.0
R.V.P at 100°F	psi	D-323	max	9.0	9.0	9.0	9.0
Existent Gum	mg/100 ml	D-381	max	4	4	4	4
Induction Period	min	D-525	min	240	240	240	240
Sulphur Content	% wt	D-1266	max	0.20	0.20	0.20	0.20
Copper-strip Corrosion	3 hrs(122°F	D-130	max	No. 1	No. 1	No. 1	No. 1
Doctor Test				Negative	Negative	Negative	Negative
or alternatively							
Mercaptan Sulphur	% wt	D-1219	max	0.0015	0.0015	0.0030	0.0030
Colour				Yellow	Red	Yellow	Orange
Dye Content :							
Yellow	gr/100 AG		min	0.3	0.3	0.3	0.3
MTBE	% vol.						
Odour				Marketable	Marketable	Marketable	Marketable

Note : Ref. No. 002/P/DM/Migas/1979 of May 25, 1979, No. 18/K/72/DDJM/1990 of April 20, 1990, and No. 21/K/72/DDJM/1990 of April 25, 1990.

III. AVIATION GASOLINE

Two grades of aviation gasolines are specified in the government decree on petroleum fuel specifications issued in 1979. One is "Avgas 73" with lean mixture motor octane rating F-2 of 73 MON, unleaded. The other "Avgas 100/130" with lean mixture octane rating of 99 MON and rich mixture F-4 performance number of 130 with 4.0 ml TEL/US gallon. The specifications for these gasoline, generally followed the widely used specification D Eng RD 2485 as issued by the Director General of Engine Research and Development, British Ministry of Defense. The exception is TEL content of "Avgas 100/130" which is limited at 4.0 ml/US gallon instead of 4.60.

The quantity sold in Indonesia is very small, only about 60 barrels, or less than 10 kiloliters, in 1989.

IV. JET FUEL

Similar to aviation gasoline, the specification for aviation turbine fuel (jet fuel) followed exactly the British specification, in this case D Eng RD 2494.

V. KEROSENE

Kerosene is the major domestic fuel, especially in the rural areas of Indonesia. Its national consumption is quite large, comprising 25% of all petroleum fuel consumed in the country. Its price is especially set at a low level, less than the production cost. It is thus a product subsidized by the government.

Kerosene is used in Indonesian households as fuel for cooking stove and lamps, both of wiek-fed as well as pressure burner type.

The burning characteristics of fuel for this use, the smoke points, is set at 16 mm (if measured by ASTM D-1332 test method or 15 mm by IP-57 method . Its char forming tendency, as determined by char value, is set at 40 mg/kg (IP-10).

As such, the quality is not very high and this is due to the high volume of kerosene needed in the country which has a population of over 180 million. The refineries are required to produce a high yield of kerosene so as to push the cut to make a product with a rather high, 310°C, distillation end point (ASTM D-86). Other properties are flash point (100°F Abel or 105°F Tag), and sulphur content, (0,20% by weight), also reflect the special need in Indonesia ot this domestically important fuel. The complete specification for Indonesian kerosene is presented in Table 5.

VI. DIESEL OIL

Two grades of diesel fuel are produced in Indonesia, namely automotive diesel oil (ADO) and industrial diesel oil (IDO). The first is known in Indonesia as "Solar", the second "Diesel".

Automotive diesel oil, also known as high speed diesel oil (HSD), is the fuel for compression ignition engines used in road transport vehicles as well as some prime movers stationary power generators. Its ignition and burning characteristics are controlled by cetane number, which in Indonesia is set at 45 (ASTM D-613); the calculated cetane index (ASTM D-976) may also be used, in which case the minimum value is set at 48.

The viscosity, as a measure of its resistance to flow and indication of its handling characteristics by pump and injection system, is set at a range of 1.6 to 5.8 centiStoke at 100°F (or 35-45 seconds Saybolt unit).

Another measure of pumpability is the pour point which, in Indonesia, is set at a rather high 65°C (ASTM D-97) This allows for a high yield of diesel oil with a quality suitable for this tropical country.

The higher limits for the properties relating to the cleanliness of the fuels are: for sulphur content, 0.5% weight (ASTM D-1551/-1552); copperstrip corrosion, No. 1 at 3 hours at 100°C

Table 5

INDONESIA
Specification of Kerosene

Characteristics		Test Method	Min Max	Kerosene
Spec. Gravity at	60/60°F	D-1298	max	0.835
Colour Lovibond 18" cell		IP-17	max	2.50
or Colour Saybolt		D-156	min	9
Smoke Point	mm	D-1322	min	16
		of IP-10	min	15
Char Value	mg/kg	IP-10	max	40
Distilation		D-86		
Recovery at 200°C	% vol		min	18
End Point	°C		max	310
Flashpoint Abel	°F	IP-170	min	100
or alternatively				
Flashpoint TAG	°F	D-56	min	105
Sulphur Content	% wt	D-1266	max	0.20
Copperstrip Corrosion	(3 hrs/50°C)	D-130	max	No. 1
Odour			Marketable	

Note : Ref. No. 002/P/DM/Migas/1979 of May 25, 1979.

(ASTM D-130); Conradson carbon on 10% volume bottom, 0.1% by weight (ASTM D-189); water content, 0.05% volume (ASTM D-95) sediment; 0.01% by weight (ASTM D-473); ash content, 0.01% by weight (ASTM D-482); total acid number, 0.6 mg KOH/g; and strong acid number, nil (ASTM D-974).

The distillation characteristic which exerts influence on diesel oil performance is defined by 40% volume minimum recovered at 300°C (ASTM D-86). For handling safety, the Pensky-Marten close cup flash point is set at a minimum of 150°F (ASTM D-93).

Other stipulations are that the specific gravity at 60/60°F ranges between 0.820-0.870 (ASTM D-1298), and ASTM colour of 3.0 maximum (D-1500).

In view of the drive to reduce emission from diesel vehicle the government plans to introduce additive into the diesel oil shortly this year. Laboratory and road tests made by Lemigas indicated that such additive can give appreciable fuel economy in addition to cleaner emission.

Diesel oil specifications in force in Indonesia are shown in Table 6. Industrial diesel oil in Indonesia has Redwood viscosity of 45-65 seconds, 65°F pour point, and sulphur content of 1.5% by weight maximum.

Table 6
INDONESIA
Specification of Diesel Oil

Characteristics		Test Method	Min Max	ADO "Solar"	IDO "Diesel"
Spec. Gravity at 60/60°F		D-1298	min	0.820	0.840
			max	0.870	0.920
Colour ASTM		D-1500	max	3.0	6
Cetane Number		D-613	min	45	
or alternatively					
Calculated Cetane Index		D-976	min	48	
Viscosity					
Kinematic at 100°F cS		D-445	min	1.6	
			max	5.8	
or Viscosity SSU at 100°F secs		D-88	min	35	
			max		
Viscosity Redwood 1/100°F	secs	D-445			35
					45
Pourpoint	°F	D-97	max	65	65
Sulphur Content	% wt	D-1551/1152	max	0.5	
Copperstrip (3hrs/100°C)		D-130		No. 1	
Conradson Carbon Residue					
(on 10% vol. bottom)	% wt	D-189	max	0.1	1.0
Water Content	% vol	D-95	max	0.05	0.25
Sediment	% wt	D-473	max	0.01	0.02
Ash Content	% wt	D-482	max	0.01	0.02
Neutralization		D-974			
Strong Acid Number	mg KOH/gr			Nil	Nil
Total Acid Number	mg KOH/gr		max	0.6	
Flash Point P.M. c.c.	°F	D-93	min	150	150
Distilation		D-86			
Recovery at 300°C	% vol		min	40	

Notes : Ref. No. 002/P/DM/Migas of May 25, 1979.

VII. FUEL OIL

Two grades of fuel oil are made available in Indonesia, namely "Fuel Oil 1" and "Fuel Oil 2". "Fuel Oil 1" has Redwood viscosity of 400-1250 seconds and pour point of 80°F maximum. For "Fuel Oil 2", they are 400-1500 seconds and 90°F respectively. Other characteristics are the same, e.g. their sulphur content is 3.5% by weight and Conradson carbon residue is 14% by weight.

Originally, in the first decree issued in 1990, only on type of fuel oil was recognized, namely what is now known as "Fuel Oil 1". In order to satisfy the demand and to produce

Table 7
INDONESIA
Specification of Fuel Oil

Characteristics		Test Method	Min Max	"Fuel Oil 1"	"Fuel Oil 2"
Spec. Gravity at	60/60°F	D-1298	max	0.990	0.990
Viscosity Redwood 1/100°F	secs	D-445	min	400	400
			max	1250	1500
Pourpoint	°F	D-97	max	80	90
Calorific Value Gross	BTU/lb	D-240	min	18000	18000
Sulphur Content	% wt	D-1551/1552	min	3.5	3.5
Water Content	% vol	D-92	min	0,75	0.75
Sediment	% wt	D-473	min	0.15	0.15
Neutralization Value					
Strong Acid Number	mgKOH/gr			Nil	Nil
Flash Point P.M. c.c.	°F	D-93	min	150	150
Conradson Carbon Residue	% wt	D-189	max	14	14

Notes : Ref. No. 03/P/DM/Migas/1986 of April 14, 1986.

sufficient volume. Pertamina has had to apply, on many occasions, for the relaxation of the fuel oil quality it supplied, particularly with regard to its viscosity and pour point. This product was supplied to consumers known to have facilities to handle such products. This was later officialized in 1986, where two fuel oil types were recognized with specifications as shown in Table 6. A claus in this decree specifies that "Fuel Oil 2" is to be supplied only to consumers having facilities to handle high pour, high viscosity, fuel oil.

VIII. CONCLUSION

Petroleum fuel qualities in Indonesia are designed to satisfy the special need of the country. In a country undergoing economic development such as Indonesia the need changes rapidly and so do petroleum fuel specifications.

Basically, the specifications reflect the compromise between four different interests and considerations, namely the consumers, the producers, the public in general, and the government. The consumers would like to have a product of the best quality at a reasonable price. The producers would try to satisfy try to satisfy the consumers need at reasonable profit. The public in general insists that its safety, health, and environment be guaranteed. And the government, as the guardian of long term national interest, would express its policy with regulatory power.

In Indonesia the following considerations are also taken into account in setting the specification of petroleum fuels. The products must conform to the technical requirement of their intended use as well as the technical

constraints and capabilities of the refineries to produce them. The products slate and market distribution must also be considered, with special attention to products of general use such as kerosene, motor gasoline and automotive diesel oil. On top of this, the national interest to improve fuel economy, intensify energy conservation, and delay the time when the country would shift to be a net importer of petroleum, as well as the need to control environment in order to guarantce sustainable development, are taken into consideration in the formulation of fuel specifications.

These factors have been taken into account in the present specifications. With the rapid change in the country's economy and development, the specifications for petroleum fuel can be expected to evolve further in the future. The main considerations as mentioned above could be expected to remain the major guidelines in formulating new specifications in the future.

It is to be noted that in face of the current attention to environment and energy conservation, studies are being made in Indonesia on the incorporation of various detergent and combustion improver additives into Indonesia petroleum fuels.

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