RESPONSES OF GASOLINES TO METHANOL/TBA

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ABSTRACT

Low level alcohol-gasoline blends with normally under 10 vol% of alcohols are intended for use in the existing cars. Because the alcohols have differents properties than hydrocarbon components, their impact on critical gasoline properties have to be understood. This article discussed the research results on the properties of MEOH/TBA (50/50) gasoline mixture at different alcohol levels using base fuels from different local refineries.

I. INTRODUCTION

Low level alcohol-gasoline blends with normally under 10 vol% of alcohols are intended for use in the existing cars already on the roads without any adjustments and interchangeable with conventional gasoline.

Methanol with TBA (tertiary butyl alcohol) in the same proportion (50/50 in volume), referred in this article as MEOH/TBA, is considered as an appropriate compositions to be used in gasoline. TBA acts as cosolvest with methanol in order to minimize negative effects resulted in by methanol in gasolines. Because the alcohols have, in several respects, differents properties than hydrocarbon components, their impact on critical gasoline properties have t be understood. These properties are octane rating, Reid vapor pressure, distillation profile and water tolerance. This works investigated the properties of MEOH/TBA-gasoline mixtured at different alcohol levels. The base fuels used were from different local refineries. Some specific results of the research are discussed.

II. BLENDS PREPARATION

Analysis of the base fuels in study this is presented in Table 1. These four base fuels were respectively provided from four different refineries to provide different sources, composition, RVP and octane rating. The base fuels were those usually used for making 87 RON gasoline by adding TEL. From each base fuel were prepared four unleaded alcohol gasoline blends containing 3, 5, 7 and 10 vol % see out copy Methanol and 50 vol% TBA. The blending octane characteristics of the alcohol in leaded gasoline also were studied. The base stocks used were the same as those presented in Table 1. The level of alcohols added to these base stocks was representative of levels used with the unleaded base stocks. The properties measured were octane rating, reid vapor pressure (RVP), distillation profile and water tolerance.

III. EFFECTS ON OCTANE RATING

Results of octane rating determination with various levels of MEOH/TBA are presented in Figure 1. The octane value of the alcohol can be measured by its blending octane index (BOI). This index is determine from the difference between level of alcohol and the base gasoline without any alcohol.

The formula for this calculation is :

$$BOI = \frac{ON - ON\ base\ (1 - X)}{X}$$

Where :

ON	=	Research octane number (RON) of gasoline containing alcohol
ON base	=	RON of gasoline without alcohol
X	=	Volume fraction of the alcohol

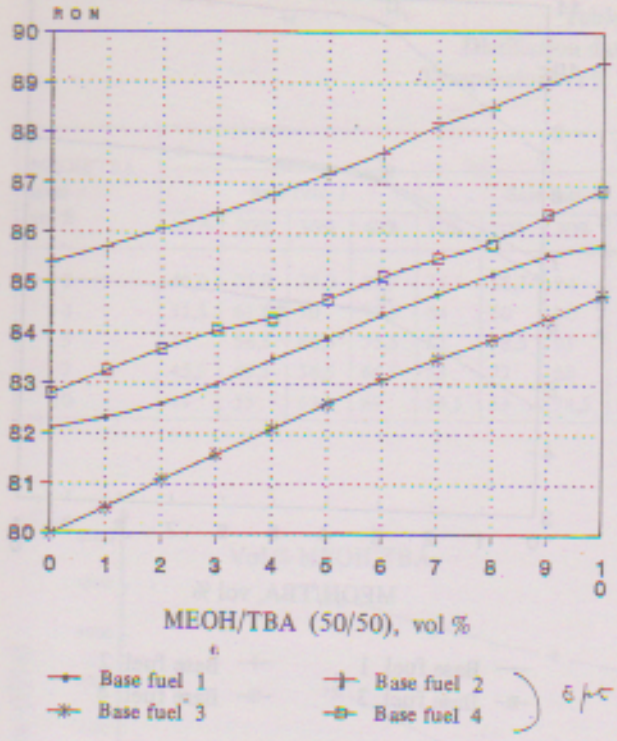

Figure 1
Gasoline–MEOH/TBA blends octane number

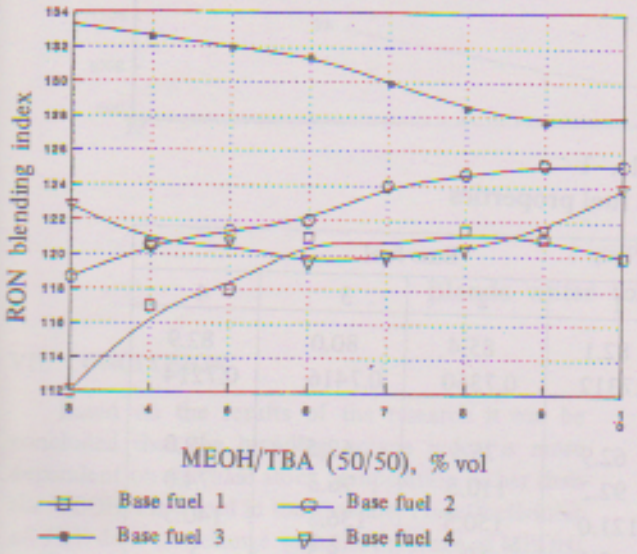

Figure 2
MEOH/TBA contane blending index

The effect of the relative error in the octane measure on BOI variation is to be considered. Error about 0,3 on RON give variation 10, 6 and 3 on BOI at 3, 5 and 10 %vol MEOH/TBA level.

Results of BOI determination are presented in Figure 2. Despite of the effect of the relative error in the octane measure on BOI, the data do show some significant variation in MEOH/TBA BOI between each of the four stock. This variations is though to be due to base stock composition effects, rather than the relative error in the octane measurement. The effects of MEOH/TBA concentration on BOI not significant at MEOH/TBA concentration above 5 vol%.

The effectiveness of TEL on the octane number of MEOH/TBA gasoline blends is show in Figure 3. These data show MEOH/TBA concentration has little effects on blends responses to TEL. The data do show same significant variation in responses between each of the base stocks.

IV. EFFECTS ON RVP

The effects of MEOH/TBA on blends RVP is shown in Figure 4.It can be seen that the effect is higher at low concentration. At the concentrations above 3 vol% MEOH/TBA, the RVP of the blends flatten and almost constant. The increase in vapor pressure caused by MEOH/TBA at these concentration is about 1.5 – 2.2 psia.

V. DISTILLATION

Distillation data or distillation curve characterise also the volatility of gasoline. Table 2 shows that the distillation temperature at 10 to 40 percent evaporated become lower as the alcohol levels increase. At higher percentage evaporated the distillation temperatures do not change.

VI. WATER TOLERANCES

The tolerances of the blends toward the water were also investigated. It was found that the water tolerances are mainly blends aromatic & olefin concentration depended. The results are shown in Figure 5.

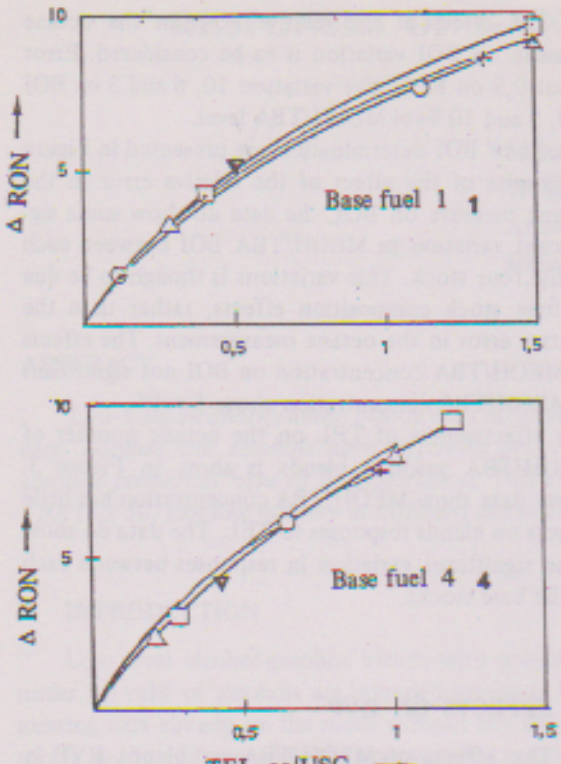

Figure 3

Gasoline–MEOH/TBA blends response to TEL

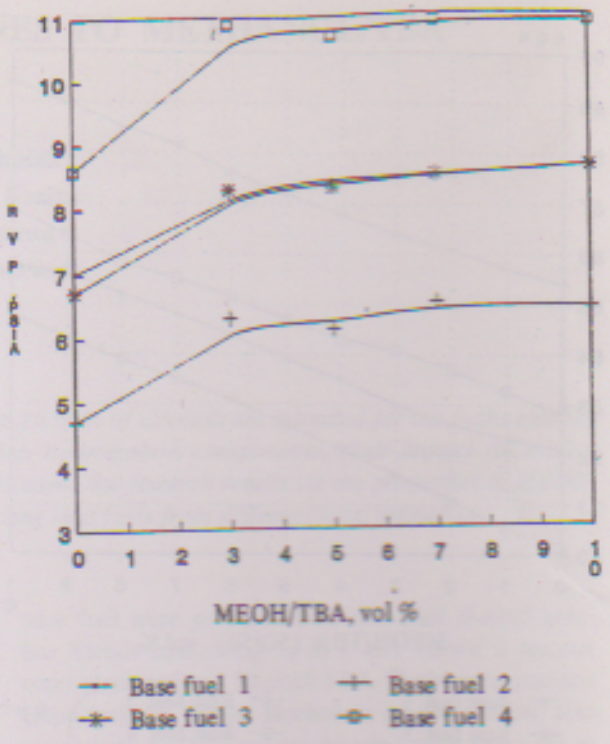

Figure 4

RVP of gasoline–MEOH/TBA blends

Table. 1

Unleaded base fuel properties

Properties	Base fuel			
	1	2	3	4
RON	82.1	85.4	80.0	82.9
Sp Gr	0.7312	0.7360	0.7416	0.7214
D–86 Distribution, % evaporation				
10°C	62.9	75,5	63,5	49.0
50°C	92.2	110.5	96.5	74.0
90° C	121.0	150.5	136.5	140.5
(20 – 10) °C	9.1	10	8.5	5
RVP at 100° F, psia	7.0	4.7	8.7	8.6
Olefin + aromatics, Vol %	31.5	46.8	33.2	29.0

Table 2
Distillation data for blends
Temperature vs % Vol Evaporated

MEOH/TBA level vol %	Temperatur, °C															
	Base fuel 1				Base fuel 2				Base fuel 3				Base fuel 4			
	10 %	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
0	62,9	71,9	79,9	85,7	75,5	85,5	94	102	63,5	72	80	88	49	53,5	59	65
3	51,5	61,5	70	78,5	64	80	90	100	55	68	78	86,5	43,5	51	58	64,5
5	47	56,5	66,5	75,5	61	78,5	91	100,5	51,5	63,5	75	85	43	48	55,5	63,5
7	45,5	49,5	56,5	66,5	58	72	88	99	52	60	72,5	84,5	43	46,5	52	60,5
10	49	53	59	69	55,5	63	74,5	88	51	58	66,5	76,5	43,5	46,5	51	56,5

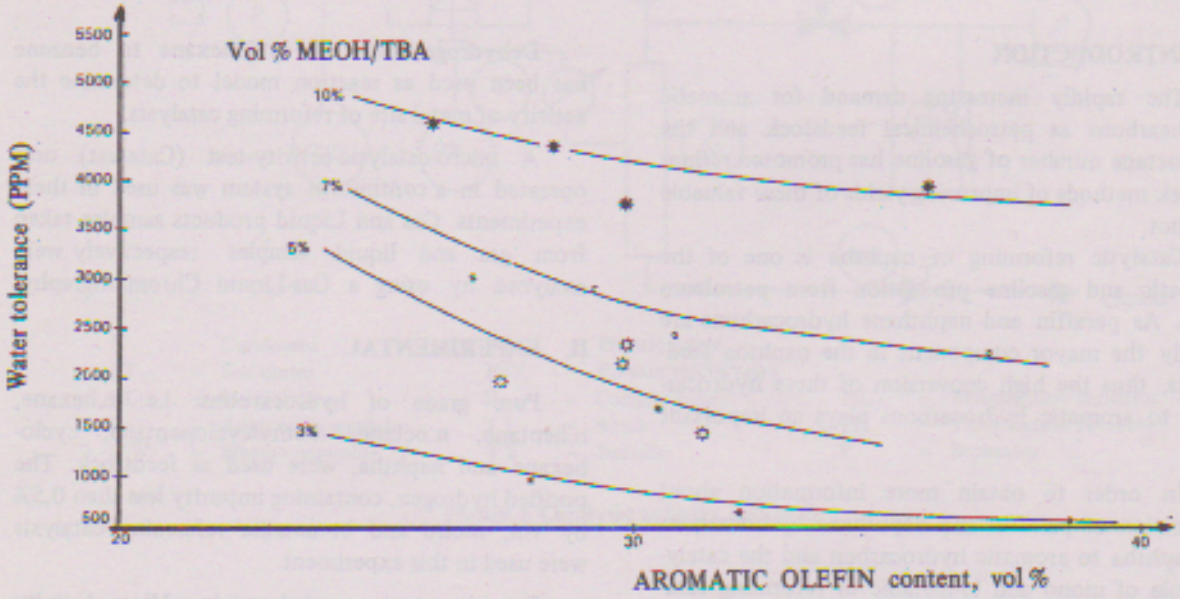

Figure 5
Blends water tolerance (25 C)

VII. CONCLUSION

Based on the results of the research it can be concluded that the blending octane index is more dependent on the base stock composition rather than the MEOH/TBA level in the gasoline. The effectiviness of TEL does not change with the presence of MEOH/TBA in the blend. The effects of MEOH/TBA out see copy level (under 3 vol%). The distillation temperature de-crease when MEOH/TBA concentration increase. Water tolerance of the blend is more dependent on aromatic and olefin content in the base stock.

References.

1. "Alcohols and alcohol blends aa motor fuels", vol II A, Swedish National Board For Technical Development, International Energy Agency, *Information* No. 580 – 1986 (1986).
2. Lemigas *Report*, 1987, No. Project 5.6.02.4.11., December 1987.