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Diesel Fuel Diluent in Used Engine Oil

S. Shahab Anwar[1] and Nasreen Farah[1]

ABSTRACT

A simple procedure for estimation of diesel oil (HSD) diluent in the used and in-service crankcase/engine lubircating oils through viscosity-dilution curve has been experimentally developed and described in this paper.

INTRODUCTION

In the operation of an internal combustion engine some fuel passes un-burnt into the crankcase and mixes with engine lubricating oil, causing the oil dilution. Fuel dilution of engine oils results from low temperature or short distance stop/start operation (Allinson, 1973). The dilution of an engine crankcase oil in-service or used may also occur if the wrong viscosity grade of the oil is used as make-up to the system.

When a lubricating oil is excessively diluted, metal to metal contact starts because of reduction of viscosity and improper presence of hydrodynamic film between the moving parts. The higher the viscosity of an engine oil, the thicker the lubricating oil film may be produced and the better the protection of moving surfaces is achieved (HDIP, 1989).

Determination of gasoline fuel dilution in the crankcase/engine oil is being carried out by a simple ASTM method (ASTM, 1989, i) in most of petroleum laboratories. The ASTM method is based on steam distillation technique. There is another ASTM test method which utilizes gas chromatographic technique (ASTM, 1989, iv).

The above mentioned ASTM steam distillation procedure can not be used for determining diesel fuel contamination. A separate gas chromatographic analysis for evaluation of diesel fuel contamination level is, however, reported in annual book of ASTM Standards (ASTM, 1989, iii). But the analysis involves advanced technique and is applicable only for SAE-30 grade engine oil, while gas chromatograph itself is a sophisticated and an expensive equipment and in most of petroleum analytical laboratories it is not commonly included in their line of equipments. Since the facility for testing kinematic viscosity is essentially available in almost every POL testing laboratory therefore, method for kinematic viscosity measurment has been adopted in this study to develop a simple procedure for estimation of percentage of diesel fuel diluent in used engine oil.

EXPERIMENTS

The blends of diesel (HSD) of its varying dilution level from 5 to 30% volume were prepared in each of SAE grades engine oil. Physical properties of all these grades of oil and HSD are given in the Tabel 1.

Kinematic viscosity at 100 °C of all these blends were determined according to ASTM method (ASTM, 1989, ii) (Table 2). With these values, viscosity-dilution curve for individual grade was drawn for studying the relationship between kinematic viscosity and varying HSD dilution level in the blends.

DISCUSSION

Through the study of the curves (Figure 1) it is observed that there is a linear correlation between dilution percentage of HSD and kinematic viscosity: the viscosity decreases simultaneously with the increase in percentage

Table 1. Physical properties of HSD and different SAE grades of engine oil.

Products	Flash Point °C	Kinematic Viscosity cSt. at 40 °C	Kinematic Viscosity cSt. at 100 °C	Viscosity Index
HSD	72	3.99	-	-
Engine oil SAE-30	254	121.44	12.01	86
Engine oil SAE-40	258	166.10	14.80	87
Engine oil SAE-50	264	246.28	19.21	88

[1]Hydrocarbon Development Institute of Pakistan, Islamabad.

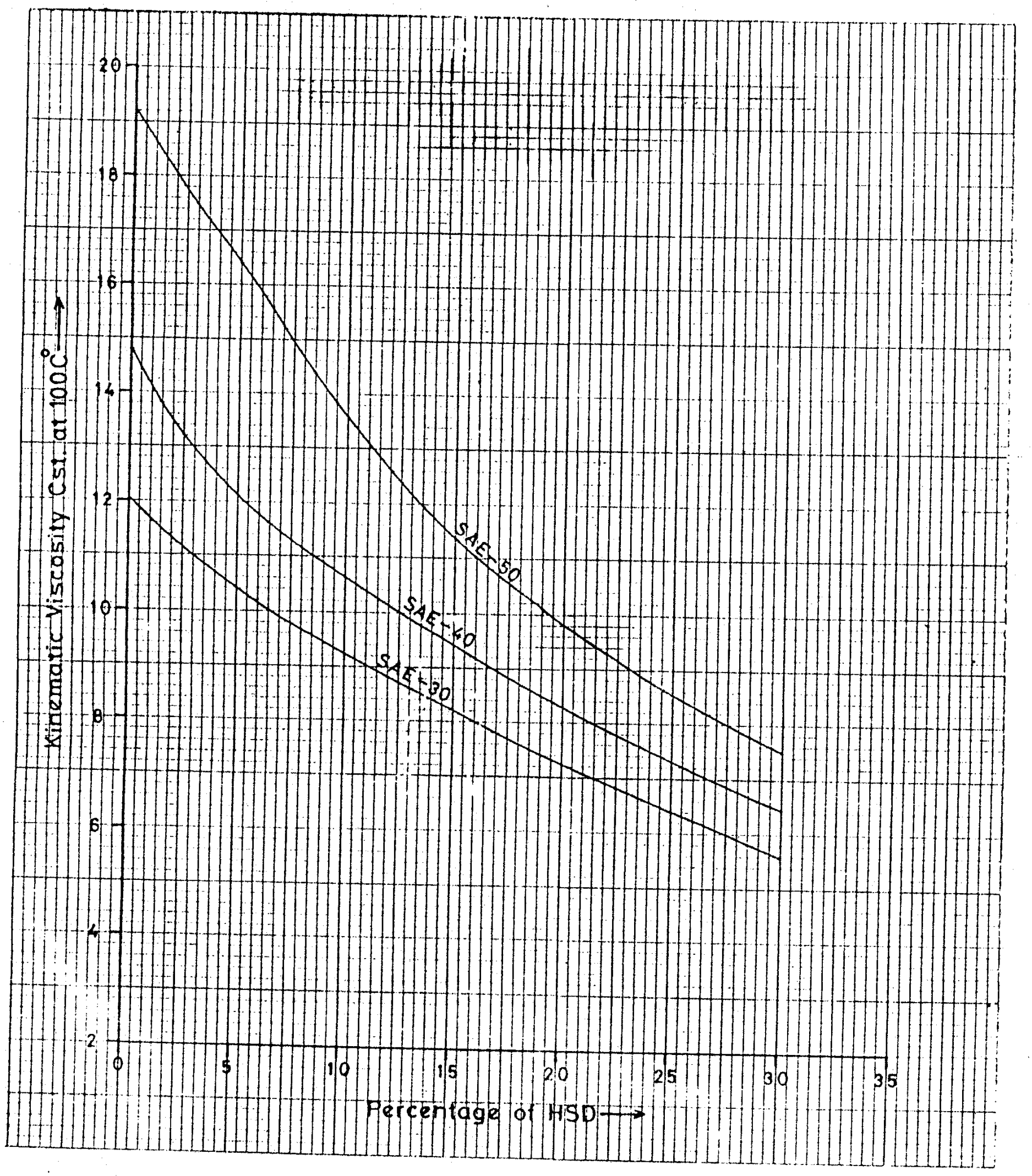

Figure 1—Effect of diesel dilution on viscosity of engine oil.

Table 2. Kinematic viscosity of blends of HSD and different SAE grades of engine oil at 100 °C.

Engine Oil Grade	0% HSD	5% HSD	10% HSD	20% HSD	30% HSD
Engine oil SAE - 30	12.01	10.42	9.21	7.18	5.58
Engine oil SAE - 40	14.80	12.05	10.60	8.34	6.50
Engine oil SAE - 50	19.21	16.49	13.62	9.92	7.45

of HSD in the blend. From these curves the fuel dilution in different SAE grades of engine oil can be estimated by making a comparison of the viscosity determined for the used oil or in-service oil sample against the standard value for an unused (fresh) oil of that grade.

It is also noted that 5 to 8% volume diesel fuel contamination may result in a viscosity reduction equal to approximately one SAE grade of engine oil as it can be seen from the viscosity dilution curves (Figure 1) that with 5% HSD dilution in engine oil (SAE-40) the viscosity falls from 14.8 to 12.05 cSt which is closer to the viscosity (12.01 cSt) of engine oil (SAE-30). Similarly with 8% HSD in engine oil (SAE-50) there is a reduction in the viscosity of the engine oil from 19.21 to 14.75 cSt which is similar to the viscosity exhibited by engine oil (SAE-40).

Deviation in the viscosity of in-service or used oil from unused (fresh) engine oil is normally taken as an indication of significant fuel system problems and the need for the oil drain to protect rubbing metal surfaces against wear and possible bearing failure.

CONCLUSION

The existing ASTM D-3524 gas chromatographic method for determining diesel fuel dilution is limited to SAE-30 grade of engine oil, whereas the viscosity-dilution curve method is applicable to almost all grades of engine oil and it is as simple as ASTM steam distillation technique.

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