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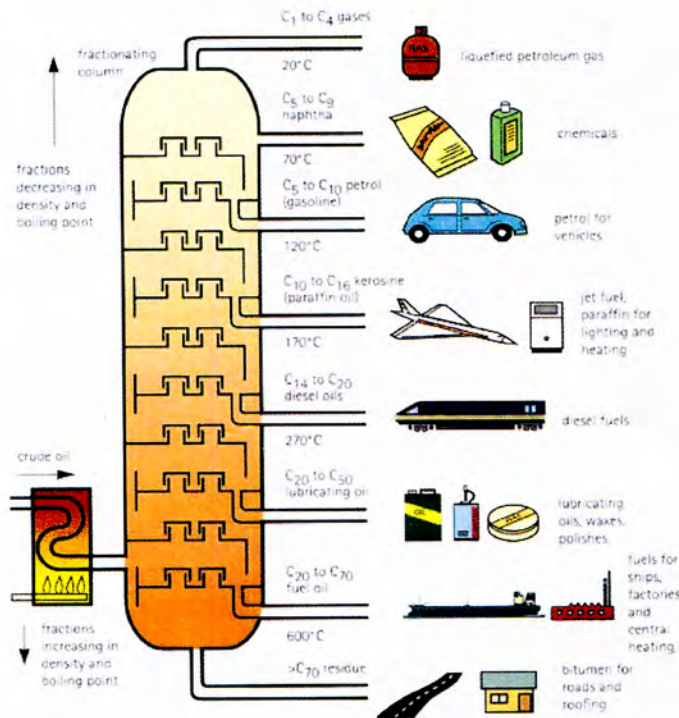


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## Studies of the effect of Fuel stick on the characteristics of high speed diesel (HSD)

Report No. ASD 279 :2012

Oct 2012



**ANALYTICAL SCIENCE DIVISION/CRUDE EVALUATION LABORATORY  
INDIAN INSTITUTE OF PETROLEUM, DEHRADUN-248005**

## PROJECT REPORT DETAILS

(Final Report)

**Project Title** : **Studies of the effect of fuel stick on the characteristics of HSD**

**Sponsor by** : **FS Fuel stick India Ltd**

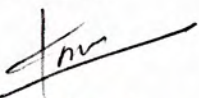
**Month of Issue** : **Oct 2012**

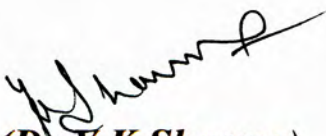
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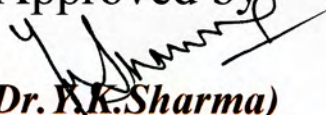
**Sample details.** : **HSD from Retail Outlet of BPCL of DDN Same is Doped with Fuel Stick provided by FS Fuel stick India Ltd.**

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## 1.0 INTRODUCTION

M/S. FS Fuel stick (India) Pvt .Ltd a company importing the fuel stick, a fuel conditioner has sponsored a project to carry out the study of impact of this fuel stick on the characteristics of high speed diesel of Bharat stage III.

For this study the sponsor has sent the Fuel sticks which has been doped with HSD of Bharat Stage III procured from retail outlet of BPCL, Harrawala, Dehradun

### Samples

- HSD sample coded as HSD-1, collected from Harrawala, Dehradun
- HSD sample coded as HSD-2 is HSD-1 doped with fuel stick, a fuel conditioner as per the doping concentration mentioned on the fuel stick. (One capsule in 2.5 liter of HSD)

The HSD samples coded as HSD-1 and HSD-2 were studied as per the IS 1460:2010 (BS III) specifications.

The present studies were conducted as per ASTM /IP/UOP methods.

## 2.0 EXPERIMENTAL

The fuel samples; HSD-1 and HSD-2 were examined for various physico-chemical characteristics using standard test procedures, however Cetane index is determined by calculation (ASTM D- 4737) method based on the density and 10% vol, 50% vol and 90% vol distillation data of ASTM-D86.

## 3.0 RESULTS & DISCUSSION

The physico-chemical characteristics of the HSD-1 and HSD-II are presented in Tables 1-4. The analysis data showed that HSD-1 and HSD-II meet all the specifications of IS 1460:2010 (Bharat stage III). Characteristics such as oxidation stability, were found to be of 0.1 mg/100ml and 0.4 mg/100ml against the specification of 1.6 mg/100ml, particulate matter 1.8 mg/kg and 3.0 mg/kg against the specification of 24 mg/kg and cetane number of 51.1 and 54.1 against specification of 51 for HSD-I and HSD-II respectively. Other characteristics were found to be more or less same. Improvement in the cetane number is observed in fuel stick doped diesel HSD-II which means a shorter ignition delay time and more complete combustion of the fuel charge in the combustion chamber. This, of course, translates into a smoother running, better performing engine with more power and fewer harmful emissions. Conversely, running a diesel engine on fuel with a lower than recommended cetane number can result in rough operation (noise and vibration), low power output, excessive deposits and wear, and hard starting. It also provides a measure of the ignition characteristics of diesel fuel oil in compression ignition engines.

**In real sense, adding fuel stick to HSD keep the fuel within specification lead by BIS standards and it does not harm engine. It gives an advantage to improve the cetane number for complete combustion of the fuel charge in combustion chamber, shorten the ignition delay, smoother the running and better performance of engine in High speed diesel. However, the performance of engine depends upon the optimum cetane number as per the design of engine.**



**Physico chemical characteristics of HSD sample from R.O of BPCL, Harrawala  
Dehradun coded as HSD-1**

**Table -1**

S.No.	Characteristics	Unit	Method	Sample HSD-1	Specification IS 1460:2010 (BS III)
1.	Density, 15°C	kg/m <sup>3</sup>	ASTM D-4052	822.1	820-845
2.	Ash Content	%w/w	ASTM D-482	< 0.005	0.01
3.	Kinematic Viscosity at 40°C	cSt	ASTM D-445	2.89	2.0-4.5
4.	Acidity, inorganic	mgKOH/g	ASTM D-974	Nil	Nil
5.	Acidity total	mgKOH/g	ASTM D-974	0.01	To Report
6.	Flash Point	°C	IP-170	67.0	35 (min)
7.	Water Content	Ppm	IP-386	64.0	200(max)
8.	Cetane index	-	IP-380	59.7	46(min)
9.	Cetane number	-	ASTM D-613	51.1	51(min)
10.	Micro carbon residue 10% bottom	% w/w	ASTM D-4530	0.01	0.30(max)
11.	CFPP	°C	IP-309	-6	Winter 6(max) Summer 18(max)
12.	Pour point	°C	IP-15	-9	Winter 3(max) Summer 15(max)
13.	Copper strip corrosion at 100 °C, 2 hours	Rating	IP-154	One	Not worse than one
15.	Particulate matter	mg/kg	ASTM D-2276	1.8	24
16.	Total sulfur	Ppm	ASTM D-4249	34.9	350(max)
17.	Distillation characteristics • at 360 °C	% v/v	ASTM D-86	95.0	95 (min)
18.	Oxidation Stability	mg/100ml	UOP 413	0.1	1.6(max)
19.	PAH	% wt.	By UV	8.8	11(max)

**Distillation characteristics of HSD-1  
(ASTM-D-86)  
Table-2**

Recovery	Unit	Result
IBP	°C	170.2
5 %v/v	”	198.7
10 %v/v	”	208.0
20 %v/v	”	227.0
30 %v/v	”	244.4
40 %v/v	”	261.4
50 %v/v	”	277.0
60 %v/v	”	292.3
70 %v/v	”	307.2
80 %v/v	”	323.4
90 %v/v	”	344.8
95 %v/v	”	360.0
FBP	°C	368.8
Recovery	% v/v	97.5
Residue	% v/v	2.0
Loss	% v/v	0.5

**Physico chemical characteristics of HSD-1 sample doped with Fuel Stick coded  
as HSD-2 (from Harrawala Dehradun)**

**Table -3**

S.No.	Characteristics	Unit	Method	Sample HSD-2	Specification IS 1460:2010 BS III
1.	Density, 15°C	kg/m <sup>3</sup>	ASTM D-4052	821.7	820-845
2.	Ash Content	%w/w	ASTM D-482	< 0.005	0.01(max)
3.	Kinematic Viscosity at 40°C	cSt	ASTM D-445	2.88	2.0-4.5
4.	Acidity, inorganic	mgKOH/g	ASTM D-974	nil	Nil
5.	Acidity total	mgKOH/g	ASTM D-974	0.04	To Report
6.	Flash Point	°C	IP-170	66.0	35 (min)
7.	Water Content	ppm	IP-386	61.7	200(max)
8.	Cetane index	-	IP-380	59.9	46(min)
9.	Cetane number	-	ASTM D-613	54.1	51(min)
10.	Micro carbon residue 10% bottom	% w/w	ASTM D-4530	<0.01	0.30(max)
11.	CFPP	°C	IP-309	-7	Winter 6(max) Summer 18(max)
12.	Pour point	°C	IP-15	-9	Winter 3(max) Summer 15(max)
13.	Copper strip corrosion at 100 °C, 2 hours	rating	IP-154	One	Not worse than one
15.	Particulate matter	mg/kg	ASTM D-2276	3.0	24
16.	Total sulfur	ppm	ASTM D-4249	36.5	350(max)
17.	Distillation characteristics • at 360 °C	% v/v	ASTM D-86	>95.0	95 (min)
18.	Oxidation Stability	mg/100ml	UOP 413	0.4	1.6(max)
19.	PAH	%wt	By UV	8.7	11(max)

**Distillation characteristics of HSD-2  
(ASTM-D-86)**

**Table-4**

<b>Recovery</b>	<b>Unit</b>	<b>Temperature (°C)</b>
IBP	°C	170.8
5 %v/v	”	197.3
10 %v/v	”	207.6
20 %v/v	”	226.5
30 %v/v	”	244.4
40 %v/v	”	261.3
50 %v/v	”	276.9
60 %v/v	”	291.5
70 %v/v	”	306.4
80 %v/v	”	323.1
90 %v/v	”	343.1
95 %v/v	”	357.5
FBP	°C	369.4
Recovery	% v/v	97.5
Residue	% v/v	2.0
Loss	% v/v	0.5

## Annexure A

## Methods of Test Used

Tests	ASTM/IP/UOP No.	IS No.
Acidity	ASTM D-974/IP-139	P:2
Ash Content	ASTM D-482	P:4
PAH	By UV	
Micro Carbon Residue	ASTM D-4530	P:13
Copper Strip Corrosion	ASTM D-130	P:15
Density	ASTM D-4052	P:16
Distillation	ASTM D-86	P:18
Flash Point (Pensky Martine, Closed cup)	ASTM D-93/IP-34	P:21
Sulphur Total	ASTM D-5354	By UV Fluorescence
Kinematic Viscosity	ASTM D-445/IP-71	P:25
Water Content by Moisture meter	UOP-481	-
Total contamination	ASTM D-4807	-
Metal Content	ICP/AES	-
Cetane Index	ASTM D 4737	
Cetane Number	ASTM D-613	P:9
Oxidation stability	UOP-413	
CFPP	IP-309	P:110
Pour point	IP-15	P:10

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