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Full Length Research Paper

Quality of commercial high speed diesel and its environmental impact

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Physico-chemical characteristics such as American Petroleum Institute (API) gravity, specific gravity, pour point, kinematic viscosity, flash point, copper corrosion, conradson carbon, water and sediments, total sulphur, residue and hydrocarbon contents (saturates, aromatics and polar) of high speed diesel (HSD) collected from Multan regions of Pakistan have been evaluated using standard ASTM procedures. Results have been compared with the standards specifications of European, Indian and Pakistan to assess the quality and environmental impact.

Key words: Quality, sulphur, aromatics, environmental impact.

INTRODUCTION

Diesel is a complex mixture of hydrocarbons. Its exact composition depends on the source of crude oil from which it is produced and the refining methods used. Substances derived from petroleum have great commercial value. The customary processing of petroleum does not involve the separation and handling of pure hydrocarbons. Indeed, petroleum derived products are always mixtures occasionally simple but more often very complex. Diesel fuel oil (Conservation of Clean Air and Water in Europe, 1998) is composed of molecules with 15 to 25 carbons atoms and a boiling range of 275 to 400°C. It consists of fractions, which distil between kerosene and lubricating oil (Glumov et al., 1997) distillates. Diesel fuel oils with higher cetane numbers have numerous benefits including reduced exhaust emissions and engine noise, improved cold starting and engine durability (Guibet, 1995).

Quality of petroleum products and HSD is generally determined by measuring various Physico-chemical parameters such as specific gravity, kinematic viscosity, cetane number, distillation range, residue, copper corrosion, sediments, conradson carbon, sulphur and ash contents, flash point, etc. following standard test methods (Thiault, 1995; Beer, 1995; Gad, 1991; Skryabyna et al., 1993). Due to speedy mechanization in this era, there has been a tremendous increase in the numbers of light and heavy vehicles in Pakistan, which resulted in a very high demand for good quality (Brown et al., 1999) high-speed diesel products. These petroleum products have gained prime importance in daily life. Gas oil is used as jet and diesel fuel and those fuels need the opposite specification to those of an internal combustion engine. Long chain paraffins which would cause knocking in petrol engine are much more suitable for diesel engine. Iso-octane is the standard for the internal combustion engine and n-hexadecane (cetane) is the standard for the diesel engine reference to the quality (Bureau of India Standards, 1995) measurement. What are the development trends, which attract our attention to diesel engine and what are the influences, which are pertinent to these trends.

In general they can be stated as: the cost and availability of fuel and the demand for increased performance. The urge for higher horsepower per cubic inch of piston displacement, the achievement of maximum portability per brake horsepower and the lowering of maintenance coast and increase of engine life, these factors are all pertinent to fuel economics in diesel operation. The entire refinery situation in the world has changed materially within the last several years.

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Some 30 years ago it was customary to obtain from a barrel of crude, by means of straight-run refining method, 20% gas and gasoline, 40% distillate fuel and 40% residual fuel. With time, the automotive population has increased so rapidly and the demand for gasoline has risen to such an extent that changes in refining methods have been necessary to achieve a higher yield of gasoline from a barrel of crude. Chemical composition of diesel fuel oils depends upon nature of crude oil, distillation process and the design refinery. Generally, diesel fuel oil consists of the following constituents, nitrogen containing compounds which produce nitrogen oxides (NO_x) and free nitrogen.

NO_x presenting HSD have concentration 8.0 to 14.0 g/kg and nitrogen 0.002 to 0.07 g/kg, CO contents range is 4.5 to 11.0 g/kg. Aromatics concentration is 15.00 to 55.00% m/m. Hydrocarbon contents (HC) are 1.1 to 3. % m/m. Particulate matter (PM) in HSD is 0.61% m/m. The concentration of polycyclic aromatic hydrocarbons (PAHs) in HSD is 3.00 to 10.00% v/v and Olefins concentration is 2.00 to 6.00 %v/v. Incomplete (low-temperature) combustion that produces significant amounts of smoke also produces small quantities of PAHs, some of which are known carcinogens. These PAHs present in diesel oil are the more volatile ones. Following are the PAHs found in HSD, naphthalene, anthracene, fluorine, fluoranthene, chrysene, and biphenyl. It has also sulphur and sulphur containing compounds, which produce Sulfur dioxide (Sox), which are not environmentally favorable (Cunningham et al., 2000; Wang and Huang, 1992; Komine and Tomoike, 1997). Low sulphur contents indicate the good quality of the high-speed diesel. Among the techniques, high-resolution capillary Gas chromatography (GC) (Wang and Fingas, 1997) equipped with flame-ionization detection (FID) and capillary Gas chromatography–mass spectrometry (GC-MS) are the most important and most widely used techniques for oil separation, characterization and identification. Complete separation of such complex samples into individual components is difficult or impossible even with high-resolution capillary GC.

MATERIALS AND METHODS

Reagents

All the chemicals used such as decane, n-hexadecane, toluene, benzene, ethylenebenzene, cumene, ter. butyl benzene, biphenyl, 1-propanol, ter. butyl alcohol and Pentanol were of analytical grade of Merk brand.

Sampling

Commercially available high-speed diesel samples were collected randomly in washed and dried plastic bottles from different retail outlets of different marketing companies in Multan district of the Punjab province of Pakistan. The samples taken from each retail outlet was one liter. The samples were shifted to the laboratory and analyzed within 12 h.

Equipments

Equipments that is, distillation apparatus, viscometer bath VHC-220 (Gallenkarap, England), flash point tester (PMCC.) semi-automatic (Cleveland-DIN-51376, Lauda, Germany), muffle furnace FSE-621 (Gallenkamp, England), sulphur analyzer (Asooma T-2000) and Gas liquid chromatograph. (Model 8700, Perkin Elmer, USA) were used in this study.

Methods

Samples were tested using standard ASTM procedures. Distillation measurements, final boiling points (°C) and residual (% vol) of high-speed diesel samples were determined using ASTM D-86 method, kinematic viscosity, flash point Pensky-Martens Closed Cup (PMCC), ash contents, sulphur contents and pour point were determined following ASTM D-445, D-39, D-482, D-4294 and D-97 methods, respectively.

Sulphur analysis

Sulphur was analysed by using sulphur analyzer Asooma T 2000 following ASTM method D-4294.In this analysis X-ray energy dispersive mode was used. The voltage used in X-ray tube was 10 KV, current 400 A and filter number 5 was used. The instrument was calibrated in the range of 0.1 to 1.0 wt% by using commercially available standards supplied by Analytical Services Incorporation.

Analytical procedure for hydrocarbon analysis

A 0.2-uL of each diesel sample was injected with out prior treatment to a Perkin Elmer (PE) 8700 gas chromatograph equipped with a FID with a 1 min purge-off. Oxygen flow rate was (nitrogen free) 3.5 mL /min, hydrogen pressure 14Psi and air pressure was 25 Psi. A Polar capillary column sp-2340 (60 m into 0.25 mm) having stationary phase methyl lignocerate was used. The carrier gas, nitrogen (3.5 mL/min) transport the vaporized sample through the column in which it is partitioned into individual components, which are sensed by FID detector as they elute from the end of the column. The detector signal was recorded with integrating computer. Each eluting component of each diesel sample was identified by comparing its retention time with the retention time of reference standards under identical conditions (Table 1). Following the temperature programme was used: Initial temperature70°C, Ramp rate 4°C, second temperature 120°C, Ramp rate 10°C and final temperature 220°C, Stay time 10 min at 220°C. The concentration of each component in wt % was determined by measuring the peak area. The components were sum up as saturates, aromatics and polars (Yasin et al., 2008). Gradually cleaner fuels are being made available. Efforts are being made to reduce sulphur content in diesel.

The sulphur content in diesel fuel has direct correlation with the particulate emissions and with the implementation of Euro II norms for non-commercial vehicles, the MOST (Ministry of Surface Transport) and the MOI (Ministry of Industries) have already sought the reduction of sulphur in diesel to 0.05%. This limit will be implemented at least for the cars complying with Euro II norms from April 2000. The limit may have to be further tightened to 350 and 50 ppm when emission norms corresponding to Euro III and IV are implemented; where as in Pakistan, still the concentration of sulphur in HSD is 1.0% by weight. This ratio is on a high side as compared to Euro specifications. It means that Pakistan's Standard Institution (PSI) should improve its standards for HSD. On the comparison of Euro IV (Table 2) and PSI specifications (Table 2); the quality of Pakistani HSD is very bad. The sulphur contents

Table 1. Retention times of hydrocarbon standards by gas chromatography.

Standard name	Retention time (minutes)	Standard name	Retention time (minutes)
Saturates			
Decane	3.89	N-Hexadecane	11.75
Heptadecane	14.26		
Aromatics			
Toluene	3.79	Benzene	4.1
Ethylenebenzene	5.28	Cumene	5.60
Ter.Butyl benzene	6.34	Biphenyl	24.53
Polars			
1-propanol	4.19	Ter. Butyl alcohol	4.79
Pentanol	7.17		

Table 2. Standard Specifications of European [15], Indian [16] and Pakistani [17] High Speed Diesel.

Property	* EPEFE (European Parliament 2005)	**AIAM CHARTER 2005 (Indian)	Pakistan's Standard Specifications
Density @ 15°C	845 (max.)	820-850	
Sulphur (wt %) max.	0.005(max.)	0.05	1.0(max.)
Flash point (Abel) max. (°C)		Need to enhance	54(min.)
Pour point in summer max. (°C)		15	+6 °C (max.)
Pour point in winter max. (°C)		3	
Water content (v/v %) Max.		0.025	0.05
Copper strip corrosion @ 100°C		1	1a (max.)
Carbon residue (wt. %) Max.		0.3	0.2 (max.)
Total acid # (mg KOH/g) Max.		0.08	Nil
Sediment by extraction (vol. %)		1.6	0.01(max.)
Kinetic viscosity @40°C (cSt)			1.5-6.5
Ash content (wt %) Maximum		0.01	0.2
(Distillation) 90 v/v % Recovery (°C) max		365	365 °C (max.)
Total aromatics (% m/m) Max.		25	
Polyaromatics (% v/v) Max.	11	3	

* EPEFE: European Programme on Emissions, Fuels and Engine Technologies. **AIAM: Association of Indian Automobiles Manufacturers.

range of TOTAL PARCO (Table 3) samples of HSD is 0.25 to 0.29 (0.265±0.025) wt%, particle swarm optimization (PSO) (Table 4) samples range is 0.27 to 0.46 (0.354±0.099) wt%, SHELL (Table 5) samples range is 0.25 to 0.29 (0.265±0.025) wt%, CALTEX (Table 6) samples range is 0.22 to 0.37(0.295±0.077) wt %, PSI limit is 1wt % (max.), Indian limit is 0.05 5 m/m % (max.) and European limit is 0.005 m/m % (max).

The sulphur contents produces foul smelling and produce SO_x. Low sulphur contents show that the HSD is environmental friendly fuel, so the TOTAL PARCO and SHELL HSD (Table 5) sample has low sulphur contents but according to Indian (Table 2) and European limits, all these HSD samples are not environmental friendly fuel. The average concentration of sulphur in our analyzed samples is 0.393 wt%; no doubt it is less than PSI limits but is still higher. Copper strip corrosion of all the analyzed HSD samples is according to the PSI limit (1a max.) insuring that all the samples are neutral. Strong acid number of all the analyzed HSD samples is according to the PSI limit nanoimprint lithography (NIL). Limit of specific gravity for HSD samples is not specified by the PSI and HSD samples having low specific gravity are of good quality, the specific gravity range of TOTAL PARCO (Table 3) is 0.8308 to 0.8423(0.8357±0.006), the specific gravity range of PSO (Table 4); HSD is 0.8376 to 0.8448(0.8403±0.004), the specific gravity range of SHELL (Table 5) is 0.8308 to 0.8423(0.8357±0.006) and the specific gravity range of CALTEX (Table 6) is 0.8270 to 0.8387 (0.8333±0.006). So the HSD of CALTEX (Table 6) has low specific gravity 0.8333 and is of good quality Low pour point, good is the quality.

All the analyzed HSD samples have +0.00°C pour point while the PSI limit is +6.00°C (max) and Indian limit is 15°C for summer and 3°C for winter. On the basis of pour point Pakistani HSD is better than Indian HSD. Water contents in HSD samples should be zero. All the analyzed HSD samples have water contents less than 0.05 vol./vol % and the PSI limit is 0.05 vol. % and Indian limit for water contents is 0.025 vol. % .The good quality HSD has no sediments. The PSI limit for sediments is 0.01 vol. % (max.) and Indian limit is

Table 3. Analytical results of physico-chemical parameters of high speed diesel of total Parco samples.

Parameter	ASTM method	S-1	S-2	S-3	Range	Mean	Standard deviation
Colour	D-1500	1.00	1.00	1.00	0.00	1.00	0.000
Specific gravity @ 60/60°F	D-1298	0.8342	0.8308	0.8423	0.8308-0.8423	0.8357	0.006
Sulphur (wt %)	D-4294	0.251	0.250	0.293	0.250-0.2930	0.265	0.025
Flash point (PMCC) °C	D-93	78	72	75	72-78	75	3.000
Pour point (°C)	D-97	0.00	0.00	0.00	0.00	0.00	0.000
Water contents (vol. %)	D-95	<0.5	<0.5	<0.5	0.00	<0.5	0.000
Copper strip corrosion	D-130	1a	1a	1a	0.00	1a	0.000
Carbon residue (wt %)	D-198	0.02	0.01	0.02	0.01-0.02	0.016	0.006
Strong acid number (wt %)	D-974	Nil	Nil	NIL	0.00	NIL	0.000
Sediment (vol. %.)	D-473	<0.01	<0.01	<0.01	0.00	<0.01	0.000
Kinetic viscosity @40°C (cSt)	D-445	3.18	3.11	3.17	3.11-3.18	3.153	0.0380
Ash contents (wt %)	D-482	0.005	0.004	0.004	0.004-0.005	0.0043	0.0010
(Distillation) I.B.P. (°C)	D-86	188	180	175	175-188	181	6.5570
10% Recovery (°C)		232	210	218	210-232	220	11.136
50% Recovery (°C)		290	270	290	270-290	283.33	11.547
90% Recovery (°C)		350	340	345	340-350	345	5.000
Recovery@ 365 °C (vol. %.)		95	97	96	95-97	96	1.000
Final boiling point (°C)		375	375	372	372-375	374	1.732
Total recovery (vol. %.)		98	98	98	0.00	98	0.00
Residue/Loss (vol. %.)		1/1	1/1	1/1	0.00	1/1	0.00
Total saturates (wt %)		25.513	20.94		20.94-25.513	23.022	
Total aromatics (wt %)		11.922	8.145		8.145-11.922	10.034	
Total polars (wt %)		6.59	3.705		3.705-6.592	5.149	

1.6 (max.). TOTAL PARCO (Table 3), SHELL (Table 5) and CALTEX (Table 6) analyzed HSD samples have sediments less than 0.01vol. %, PSO (Table 4) range is 0.01 to 0.03 vol. % PSO samples have more sediments and it is not good for good quality. Ash contents must be very low for good quality of HSD. Ash contents range of TOTAL PARCO HSD is 0.004 to 0.005(0.0043±0.001) wt %, PSO (Table 4) range is 0.004 to 0.008(0.0056±0.00208) wt %, SHELL (Table 5) range is 0.004 to 0.005(0.0043±0.001) wt %, CALTEX range is 0.003 to 0.01(0.0056±0.004) wt % and Indian limit is 0.01 m/m %.

It means that PSO HSD is of good quality on the basis of ash contents. Low value of carbon residue show that there is low concentration of aromatics and good quality of HSD. The range of carbon residue of TOTAL PARCO (Table 3) range is 0.01 to 0.02(0.016±0.006) wt %, PSO (Table 4) HSD range is 0.01 to 0.03 (0.02±0.01) wt %, SHELL (Table 5) range is 0.01 to 0.02(0.016±0.006) wt %, CALTEX (Table 6) range is 0.01 to 0.03(0.02±0.01) wt %, PSI limit is 0.2 wt % and Indian limit is 0.3 m/m %. Carbon residue data show that PSO and CALTEX HSD's samples are of good quality. Flash point is the good quality parameter of HSD. It helps in the transportation of the product from one place to the other place of the country. Transportation of the product from one place to the other place of the country depends upon the environment and weather conditions of that region. The Indian limit for flash point is 32°C, which is very low. Low flash point indicates that the HSD has light fraction (kerosene). The Pakistan HSD limit for flash point is 54°C which is better than Indian HSD limit for flash point. The flash point range of TOTAL PARCO (Table 3) is 72 to 78 (75±3.00) °C, PSO (Table 4) range is 60 to 72 (67.33±6.423) °C, SHELL (Table 5) range is 72 to 78 (75±3.00) °C and CALTEX (Table 6) range is 69 to 84 (74±8.66) °C. The flash points for all samples were within limits for transportation, with the SHELL samples having the highest flash point of all measured samples.

Viscosity is the internal resistance of a liquid to flow, high viscosity means low flow rate of HSD from one part of the engine to the other.

Highly viscous liquids burn slowly because they have low concentration of lighter components and produce more smoke. Viscosity and specific gravity are directly related to each other. The kinematic viscosity range of the TOTAL PARCO (Table 3) HSD is 3.11 to 3.18(3.153±0.038) cSt, PSO (Table 4) range is 3.02 to 3.32(3.22±0.170) cSt, SHELL range is 3.11 to 3.18(3.153±0.038) cSt and CALTEX HSD range is 3.04 to 3.18(3.09±0.078) cSt. The PSI limit is 1.5 to 6.5 cSt. So CALTEX (Table 6) HSD is a good one. Benzene, toluene, cumene, ethyl benzene, ter.butyl benzene, propanol, ter.butyl alcohol and pentanol were detected in the range of 1.00 to 5.00 wt % by glycogenin (GLC) in these samples of HSD. All these compounds are the basic components of gasoline in high concentration. Sometimes Tank Lorries used for the transportation of gasoline is also used for the transportation of HSD which is not a good practice. These compounds reduce the viscosity of HSD and help in the burning process. PSO has marketed its HSD with the name of Green XL plus Diesel. Green XL is polymer additive which is used by PSO in diesel to reduce pollution and make HSD environmental friendly.

The market value and market demand of Green XL Plus is very high as compared to the competitive Oil Marketing Companies (OMCs). Green XL gives more millage Coverage. Green XL Plus has Ca contents which reduces the Exhaust pipe deposition.

Table 4. Analytical results of physico-chemical parameters of High Speed Diesel PSO samples.

Parameter	ASTM method	S-1	S-2	S-3	Range	Mean	Standard deviation
Colour	D-1500	1.00	0.5	0.5	0.5-1.00	0.66	0.288
Specific gravity @ 60/60°F	D-1298	0.8376	0.8387	0.8448	0.8376-0.8448	0.8403	0.004
Sulfur (wt %)	D-4294	0.270	0.330	0.463	0.270-0.463	0.354	0.099
Flash point (°C)	D-93	70	72	60	60-72	67.33	6.429
Pour point (°C)	D-97	0.00	0.00	0.00	0.00	0.00	0.00
Water contents (vol. %)	D-95	<0.5	<0.5	<0.5	0.00	<0.5	0.00
Copper strip corrosion	D-130	1a	1a	1a	0.00	1a	0.00
Carbon residue (wt %)	D-198	0.03	0.01	0.02	0.01-0.03	0.02	0.01
Strong acid number (N)	D-974	Nil	Nil	NIL	0.00	NIL	0.00
Sediment (vol. %)	D-473	<0.01	0.03	<0.01	<0.01-0.03	0.016	0.01
Kinetic viscosity @40°C (cSt)	D-445	3.32	3.31	3.02	3.02-3.32	3.22	0.170
Ash contents (wt %)	D-482	0.008	0.004	0.005	0.004-0.008	0.0056	0.00208
(Distillation) I.B.P. (°C)	D-86	190	188	162	162-190	180	15.621
10% Recovery (°C)		230	230	220	220-230	226.66	5.774
50% Recovery (°C)		290	288	286	286-290	288	2.00
90% Recovery (°C)		350	342	348	342-350	346.66	4.163
Recovery @ 365°C		95	97	97	95-97	96.33	1.154
Final boiling point (°C)		380	372	372	372-380	374.66	4.619
Total recovery (vol. %)		98	98	98	0.00	98	0.00
Residue/Loss (vol. %)		1/1	1/1	1/1	0.00	1/1	0.00
Total saturates (wt %)		45.40	45.506		45.40-45.506	45.453	
Total aromatics (wt %)		2.475	1.335		1.335-2.475	2.04	
Total polars (wt %)		7.295	8.074		7.295-8.074	7.685	

Table 5. Analytical results of physico-chemical parameters of high speed diesel shell samples.

Parameter	ASTM method	S-1	S-2	S-3	Range	Mean	Standard deviation
Colour	D-1500	1.00	1.00	1.00	0.00	1.00	0.00
Specific gravity @ 60/60°F	D-1298	0.8342	0.8308	0.8423	0.8308-0.8423	0.8357	0.006
Sulphur (wt %)	D-4294	0.251	0.250	0.293	0.250-0.2930	0.265	0.025
Flash point (°C)	D-93	78	72	75	72-78	75	3.00
Pour point (°C)	D-97	0.00	0.00	0.00	0.00	0.00	0.00
Water contents (vol. %)	D-95	<0.5	<0.5	<0.5	0.00	<0.5	0.00
Copper strip corrosion	D-130	1a	1a	1a	0.00	1a	0.00
Carbon residue (wt %)	D-198	0.02	0.01	0.02	0.01-0.02	0.016	0.006
Strong acid number (N)	D-974	Nil	Nil	NIL	0.00	NIL	0.00
Sediment by extraction	D-473	<0.01	<0.01	<0.01	0.00	<0.01	0.00
Kinetic viscosity @40°C (cSt)	D-445	3.18	3.11	3.17	3.11-3.18	3.153	0.038
Ash contents (wt %)	D-482	0.005	0.004	0.004	0.004-0.005	0.0043	0.001
(Distillation) I.B.P. (°C)	D-86	188	180	175	175-188	181	6.557
10% Recovery (°C)		232	210	218	210-232	220	11.136
50% Recovery (°C)		290	270	290	270-290	283.33	11.547
90% Recovery (°C)		350	340	345	340-350	345	5.00
Recovery @ 365°C		95	97	96	95-97	96	1.00
Final boiling point (°C)		375	375	372	372-375	374	1.732
Total recovery (vol. %)		98	98	98	0.00	98	0.00
Residue/Loss (vol. %)		1/1	1/1	1/1	0.00	1/1	0.00
Total saturates (wt %)		25.509	20.931		20.931-25.509	23.22	
Total Aromatics (wt %)		11.922	8.15		8.15-11.922	10.036	
Total Polars (wt %)		6.592	3.705		3.705-6.592	5.149	

Table 6. Analytical results of physico-chemical parameters of high speed diesel Caltex samples.

Parameter	ASTM method	S-1	S-2	S-3	Range	Mean	Standard deviation
Colour	D-1500	1.00	0.5	1.00	0.5-1.00		
Specific gravity @ 60/60°F	D-1298	0.8270	0.8387	0.8342	0.8270-0.8387	0.8333	0.006
Sulphur (wt %)	D-4294	0.223	0.288	0.376	0.223-0.376	0.295	0.077
Flash point (°C)	D-93	69	84	69	69-84	74	8.66
Pour point (°C)	D-97	0.00	0.00	0.00	0.00	0.00	0.00
Water content (vol. %)	D-95	<0.5	<0.5	<0.5	0.00	<0.5	0.00
Copper strip corrosion	D-130	1a	1a	1a	0.00	1a	0.00
Carbon residue (wt %)	D-198	0.03	0.02	0.01	0.01-0.03	0.02	0.01
Strong acid number (N)	D-974	Nil	Nil	NIL	0.00	NIL	0.00
Sediment (vol. %)	D-473	<0.01	<0.01	<0.01	0.00	<0.01	0.00
Kinetic viscosity @ 40°C	D-445	3.04	3.18	3.05	3.04-3.18	3.09	0.078
Ash contents (wt %)	D-482	0.01	0.004	0.003	0.003-0.01	0.0056	0.004
(Distillation) I.B.P. (°C)	D-86	170	185	178	170-185	177.66	7.506
10% Recovery (°C)		205	235	218	205-235	219.33	15.044
50% Recovery (°C)		268	290	280	268-290	279.33	11.015
90% Recovery (°C)		335	342	345	335-345	340.66	5.131
Recovery @ 365°C		97	98	96	96-98	97	1.00
Final boiling point (°C)		372	370	378	370-378	373.33	4.163
Total recovery (vol. %)		98	98	98	0.00	98	0.00
Residue/Loss vol. (%)		1/1	1/1	1/1	0.00	1/1	0.00
Total saturates (wt %)		24.593	28.00		24.593-28.00	26.297	
Total aromatics (wt %)		0.00	0.00		0.00	0.00	
Total polars (wt %)		7.304	3.46		3.46-7.304	5.382	

Standard specifications for distillation, total aromatic and Polyaromatics are not given by the PSI. While, Indian specifications for total aromatics and Polyaromatics are 25% m/m and 3.00% vol /vol% and European specification for Polyaromatics is11.00% m/m (max.). The PSI should given specified limits for aromatics and polyaromatics. So PSI must give these specifications and its specifications should be improved upon. Total saturates analyzed in Total Parco HSD samples is 20.94 to 25.513 wt %, aromatics 8.145 to 11.922 wt % and polars 3.705 to 6.592 wt %.

HSD enters the human body through inhalation, skin absorption and ingestion. It causes rapid breathing, excitability, staggering, headache, fatigue, nausea and vomiting, dizziness, drowsiness, narcosis, convulsions and coma. If HSD contact the skin, it causes skin dryness, cracking, irritation eyes watering, stinging and inflammation. In case of eye or skin contact, flush with plenty of water, Remove soaked clothing. In case of excessive inhalation move the victim to fresh air. If problem occurs in breathing then give artificial respiration and obtain medical assistance. Gas mask, goggles giving complete protection to eyes and eye wash fountain with safety shower must be used during handling.

Conclusion

The quality of Pakistani HSD is according to the PSI specifications but the quality of these products is low (due to presence of higher levels of sulphur, aromatics and polyaromatics hydrocarbons) as compared to the European and Indian standard specifications. Ministry of Petroleum, Government of Pakistan should emphasize more on supply of HSD according to international standards to minimize the harmful environmental impacts of toxic chemicals present in these petroleum products to make the environment friendly.

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