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Replacement of Furnace oil and light diesel oil (LDO) by Cashew nut Shells oil

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ABSTRACT

The cashew- nut shell oil is extracted from the cashew- nut shells. It is analysed by percent ash, calorific value , relative density , flash point , kinematics viscosity, sediment, sulphur , water content , carbon residue, pour point, and copper strip corrosion. These results are com pared with furnace oil and light diesel oil.

Keywords:- Atomic Absorption Spectroscopy (AAS),Test Methods (p) of IS1448, ASTM Standards, Instrumental Analytical Techniques, Furnace oil, Cashew nut shell oil.

INTRODUCTION

Light diesel oil (LDO) & furnace oil is the residual petroleum products and hydrocarbons. All the impurities and metal content of petroleum are concentrated in these products have many different industrial hitting applications .The reserves of crude petroleum are stiffly depleting and the pries of the furnace oil and light diesel oil are constantly increasing. The rapid industralization in the word has resulted in ever increasing demand for heat and steam (z). However due to uncertain supplies and high cost of these fuels there is urgent need for other renewable source of energy.The western ghats of India are suitable for the plantation of large variety of plants. The government of Maharashtra is implementing the scheme of Horticulture Development since long. Cashew nut is important plant in this scheme. The production of cashew nut is large number of shell help groups are enraged in decortications of cashew nuts and huge quantity of nut shells are produced as byproducts. At present these shells are going waste. The waste material deters its polluting the environment.These shells contain nearly more percent of oil. It can be easily extracted and used for various purposes.

MATERIALS AND METHODS

The cashew nut shells are extracted with n-hexane in soxhlet extractor. Solvent is removed by distillation and the oil is purified. The purified oil is tested for liquid fuels are predominantly used in industrial application Bureau of Indian Standards [p:] IS 1448. Physical and Chemical test methods are used to access the quality of the furnace oil . The various properties of liquid fuels tested bellow.

2.1 Acidity

The oil sample is dissolved in a mixture of toluene and isopropyl alcohol containing a small amount of water. The resulting single phase solution is blanketed by a stream of nitrogen bubbling through it and is titrated with standard alcoholic potassium hydroxide. The end point indicated by the color change (orange in acid and green in base) of the added *p*-naphthalobenzene solution.

2.2 Ash Percentage

The oil sample is ignited and burned until only ash and heated at 775^{o}c to constant weight.

The oil is tested as per *ASTM Standards* D 3242 --- ash percentage is 01% wt. max:- *ASTM Standards* D 874 .

2.3 Gross Calorific value, cal / g

The gross calorific value of the oil is determined.

2.4 Relative Density

The relative density of the oil at 15^{0}c .

2.5 Flash point, (PMCC) ^{0}c , Min.

Min.a brass test cup of specified dimensions, filled to the inside mark with test specimen and fitted with a cover of specified dimensions, is heated and the specimen stirred at specified rates, by either of two defined procedures (A or B).An ignition source is directed into the test cup at regular intervals with simultaneous interruption of the stirring, until a flash is detected (see 3.1.3.1). The flash point is reported as defined in 3.1.3. *ASTM Standards D 93 . 02a*

2.6 Kinematic viscosity in centistokes at 50 ^{0}C

The time is measured for a fixed volume of liquid to flow under gravity through the capillary of a calibrated viscometer under a reproducible driving head and at a closely controlled and known temperature. The kinematic viscosity (determined value) is the product of the measured flow time and the calibration constant of the viscometer. Two such determinations are needed from which to calculate a kinematic viscosity result that is the average of two acceptable determined values. *ASTM Standards* D 445 --- 04 .

2.7 Sediment % wt. max.

Equal volumes of fuel oil and water-saturated toluene are placed in each of two cone-shaped centrifuge tubes. After centrifugation, the volume of the higher density water and sediment layer at the bottom of the tube is read. *ASTM Standards* D 1796 --- 04 .

2.8 Sulphur total % by wt. max

The sample is burned in a closed system, using a suitable lamp (Fig.1) and an artificial atmosphere composed of 70 % carbon dioxide and 30 % oxygen to prevent formation of nitrogen oxides. The oxides of sulphur are absorbed and oxidized to sulphuric acid by means of hydrogen peroxide solution which is then flushed with air to remove dissolved carbon dioxide. Sulphur as sulphate in the absorbent is determined acidimetrically by titration with standard sodium hydroxide solution, or gravimetrically by precipitation as barium sulphate. Alternatively, the sample may be burned in air, the sulphur as sulphate in the absorbent being determined by precipitation as barium sulphate for weighing (see Annex A 2).NOTE 2. In the absence of acid-forming or base forming elements other than sulphur results by the volumetric and gravimetric finishes described are equivalent within the limits of precision of the method 3.3. For sulphur contents below 0.01 mass % it is necessary to determine the sulphate content in the absorber solution turbidimetrically as barium sulphate (see Annex A1). *ASTM Standards* D 1266 . 98 (2003) .

2.9 Carbon residue (Rams bottom) On Whole sample, percent by mass, max.

The sample, after being weighed into a special glass bulb having a capillary opening is placed in a metal furnace maintained at approximately 550°C. The sample is thus quickly heated to the point at which all volatile matter is evaporated out of the bulb with or without decomposition while the heavier residue remaining in the bulb under goes cracking and coking reactions. In the latter portion of the heating period, the coke or carbon residue is subject to further low decomposition or slight oxidation due to the possibility of breathing air into the bulb. After a specified heating period the bulb is removed from the bath cooled in a dessicator and again weighed. The residue remaining is calculated as a percentage of the original sample and reported as Rams bottom carbon residue 4.2 Provision is made for determining the proper operating characteristics of the furnace with a control bulb containing a thermocouple which must give a specified time-temperature relationship. *ASTM Standards* D 524 . 04 .

2.10 Pour/Cloud point max. a winter bisummer

The specimen is cooled at a specified rate and examined periodically. The temperature at which a cloud is first observed at the bottom of the test jar is recorded as the cloud point. *ASTM Standards* D 2500 --- 05 .

2.11 Copper strip corrosion for 3h at 100^{o}C

A polished copper strip is immersed in a specific volume of the sample being tested and heated under conditions of temperature and time that are specific to the class of material being tested. At the end of the heating period the copper strip removed washed and the color, tarnish level assessed against the ASTM copper strip corrosion standard. *ASTM* D130 . 04 .

RESULTS AND DISCUSSION

The table shows that 1st criterion percent ash of cashew nut shell oil is higher than furnace oil and light diesel oil but still it can be used as 1% ash is tolerable in most of heating applicable. The second and most important condition is gross calorific value, which matched in totally. The third criterion is relative density. It who matches exact percent. The next test is flash point. The flash point of furnace and light diesel oil shorted are 66 ^{0}C are above.

Table 1. The results are summarized Relation between. Biofurnace & light diesel oil by the specification of Furnace oil & Biolight diesel oil

NO	CHARACTERISTICS	Test methods p.of is-1448, *ASTM Standards*	SPECIFICATION FOR FURNACE OIL-IS 1448	SPECIFICATION FOR LDO (Light Diesel OI)-IS 1448 CLAUSE-4.2	BIOFURNACE OIL-IS TEST METHODS ANALYZE VALUE GIVEN	BIOLDOOIL-IS TEST METHODS ANALYZE VALUE GIVEN
1	Acidity, inorganic	P-2	NIL	NIL	NIL	NIL
2	Ash, % wt. max.	P-4	0.1	0.02	1	1
3	Gross, calorific value, cal/g	P-6 or /	Not limited but to be 9501.51 9501.51 reported	To be reported	9501.51	9501.51
4	Relative Density at 15 ^{0}C	P-32	Not to be limited reported 0.8934 0.8934 but to be reported	To be reported	0.8934	0.8934
5	Flash point, (PMCC) ^{0}C, Min.	P-21	66	66	170	170
6	Kinematic viscosity in certistokes at 50 ^{0}C	P-25	80	2.5 to 15.0	20	20
7	Sediment, % wt. max.	P-30	0.25	0.10	0.25	0.25
8	Sulphur, total, % by wt., max.	P-33 or P-35	3.5	1.5	0.0105%	0.0105%
9	Water Content, % by vol., max.	P-40	1.0	0.25	1.025	1.025
10	. Carbon residue (Rams bottom) On Whole sample, percent by mass max.	P-8		1.5	1.4	1.4
11	Pour/Cloud point max. a)winter b)summer	P-10		12 ^{0}C 20 ^{0}C	2 ^{0}C 2 ^{0}C	2 ^{0}C 2 ^{0}C
12	cu strip corrosion for 3h at 100^{0}C	P-15		Not morse than no-2	1	1

The flash point of CNSO is 170^{0}C. Thus it is safer than both the oils used. The kinematic viscosity as par specification is 80 centistokes at 50^{0}C. for furnace oil and 2.5-15.0 centistokes for LDO. The viscosity of CNS oil is 20 centistokes. Hence it can replace furnace oil completely. The percent weight of sediment as per specification is 0.25 maximum for furnace oil and 0.1 for LDO respectively. The corresponding value for CNS oil is 0.15 thus it can replace furnace oil as well as LDO. The maximum tolerable weight % of sulphur is 3.5 this value for CNS oil is for below than maximum tolerable unit. The maximum acceptable water content is 1.0 for furnace

oil and 0.25 for LDO. The water content of CNS oil is about 1.025 thus it can straight way used in place of furnace oil but before using in place of LDO water content should be reduced. The Rams bottom carbon residue test of 1.5 is obeyed but 1.4 in tolerable. The pour / cloud point for the LDO winter 120 ^{o}C in summer 20^{0}C CNS oil 2^{0}C winter as well as summer. The copper strip corrosion for 3 hrs at 100^{o}C is 1.0 for CNS oil which is half of the specified value of 2.0.

CONCLUSION

Thus CNS oil, which is renewable easily replace furnace oil and LDO for most of the lilting applications and save valuable foreign exchange by using waste product of cashew nut industry.

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