

AVIATION FUELS

Lecture 9

Aviation Fuels

- The fuels used in aero planes are called aviation fuels.
- Depending on the type of aircraft, like jet planes or turbine planes, different types of aviation fuels are used.
 - They are either gasoline based for jet planes or kerosene based for turbine planes.
 - Aviation gasoline is usually polymer gasoline or alkylated gasoline having an octane number greater than 100, usually expressed as the performance number.
 - Kerosenebased aviation fuel is known as aviation turbine fuel (ATF) and is mostly consumed by passenger aeroplanes.

Characterization of Aviation Fuels

- This fuel is the hydrocarbon fraction **boiling** in the range of 150–250°C and is similar to the kerosene fraction. Though it resembles kerosene, tests are carried out under stringent conditions for the safety of the airborne people in the flying machines.
- **A corrosion test** is carried out using the copper strip test for 2 h at 100°C and a silver strip test is carried out for 16 h at 45°C.
- **Distillation tests** are conducted as for kerosene while the 20% recovery should be at 200°C and the FBP should not be more than 300°C.
- **Freezing point** is to be below –50°C as the sky temperature may be very low at high altitude.
- The product of the **aniline point** and the API gravity of oil should be at least 5,250. The sulfur content should be below 0.20% wt.
- **Aromatic and olefinic hydrocarbons** must be analysed and these hydrocarbons, if present, should be no more than 20% and 5%, respectively.

FURNACE FUELS

Gaseous Fuels

- Off-gases and by-product gases commonly generated in refineries and petrochemical plants consist of methane, ethane, propane, butane, and their olefinic homologues. Gaseous fuel can generate a higher temperature than liquid petroleum owing to its higher heating value.

Liquid Fuels

- **Light diesel oil or LDO** (much heavier than HSD) is a liquid fuel.
 - It is usually a blend of vacuum gas oil, coker gas oil, de-asphalted oil, waxy distillates, etc., and falls into the category of black oil. A few properties measured as given in the table are the flash point, viscosity, total sulfur, pour point, and carbon residue. It is a cheap liquid fuel as compared to HSD and is commonly used in furnaces.
- **Furnace oil or fuel oil** is similar to LDO but with higher viscosity.
 - It is a black petroleum oil, which is a viscous fluid and requires heating up to a temperature of 50°C or higher to maintain liquidity.
- **Internal fuel oil (IFO)**
 - Internal fuel oil (IFO) is the common furnace oil used in refineries. It is predominantly a mixture of asphalt, short residue, and wax.

LUBRICATING OILS

- Lubricating oils are liquid lubricants mainly made from petroleum oils (lube oil base stocks) blended with soaps of fatty acids and other additives. A lubricating oil present between two solid surfaces reduces the friction while in motion and also helps in cooling down the heat of friction.

How to determine the quality of lube oil?

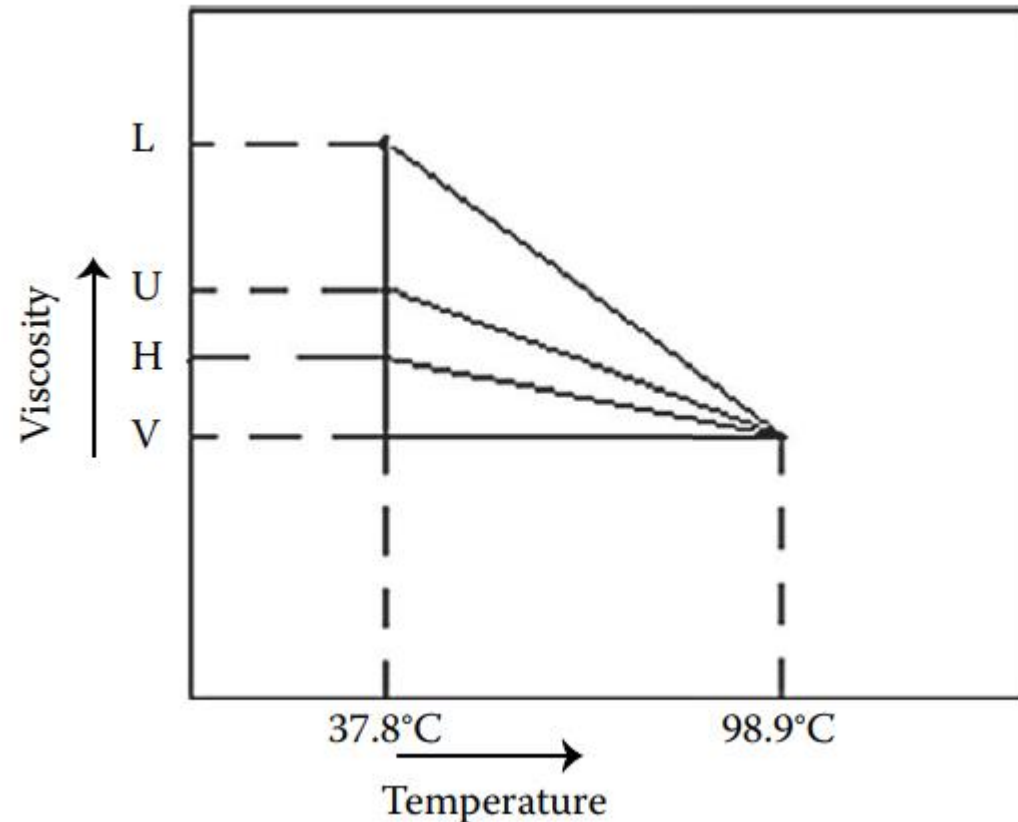


Viscosity index

The viscosity index (VI) is a parameter that indicates the rate of change of the viscosity of the oil due to a variation in temperature. This index is defined as the ratio of the difference of viscosity (U) of the lube oil to be used with respect to the viscosity (L) of petroleum (aromatic) oil having zero VI to the difference of viscosity (H) of high VI oil (paraffinic; 100 VI) to the viscosity (L) of zero VI oil for a temperature change from 37.8°C to 98.9°C. This can be written in the following way,

$$VI = (L - U) / (L - H) \times 100,$$

where L, U, and H are the viscosities of the low VI reference oil (VI = 0), the sample oil, and the high VI reference oil (VI = 100),



Graphical representation of the viscosity index.

CLOUD POINT

- The cloud point is the temperature at which oil becomes hazy or cloudy due to the onset of wax crystallization or solidification.
 - This is tested in a standard tube in an ice bath.
 - The tube fitted with a thermometer is placed in the bath.
 - At intervals, the test tube is removed (without disturbing the oil) to observe cloudiness. The temperature is reported to be the cloud point.

POUR POINT

- The pour point is the temperature at which a liquid hydrocarbon ceases to flow or pour.
 - This is measured by a standard method where a definite quantity of an oil sample is taken in a test jar or tube (with a thermometer properly stoppered), heated to 115°F (46°C) to make all the wax dissolve in oil, and cooled to 90°F (32°C) before testing.
 - An ice bath containing ice and salt is made ready at a temperature of 15°F–30°F (–9°C to –1°C) below the estimated pour point based on cloud point and the test tube containing the sample is placed with the thermometer.
 - At intervals of 5°F, the test tube is removed from the ice bath and tilted to see if the oil is mobile or static. If it is found that at a certain temperature the oil shows no movement even when the test tube is kept horizontal for 5 sec, this temperature is reported to be the solid point. **The pour point is taken as 5°F above this solid point.**