SPECIFIC GRAVITY OF CRUDE OIL

OBJECTIVE:

The objective of this experiment is to determine the specific gravity and API gravity of different crude oils, liquid petroleum products, and mixtures of petroleum and non-petroleum products by using a glass hydrometer. This experiment will follow the standard method ASTM D 1298- 85, IP 160/96.

INTRODUCTION:

Density of crude oil is defined as the mass per volume. It is most often for oils in units of gram / ml, and less often in units kg / m^3. Density is temperature dependent; it decreases with increase in temperature. All fresh crude oils and most fuel oils have densities less than 1.0 gm/ml, but bitumen and certain fuel oils may densities greater than 1.0 gm/ml. The density of crude oil changes with time as the more volatile (and less dense) components are lost.

Two densities –related properties of oils are often used: specific gravity (Spgr.), and American Petroleum Institute (API) gravity. Specific gravity or relative density is the ratio, at a specified temperature, of the oil density to the density of pure water.

The API gravity is calculated as:

$$\text{API Gravity } (^{o}) = \frac{141.5}{\text{Specific gravity } (60/60^{o}F)} - 131.5$$

Oils with low densities, and hence low specific gravities, have high API gravity. The specific gravity of crude oil usually range from about 0.8(45.3^{o} API) for lighter crude oils to over 1.0 (10^{o} API) for heavy crude oils and bitumen. The price of a crude oil is usually based on its API gravity, with high API gravity oil commanding higher prices, because it can produce more quantity of the light products in the refining processes, as well as low technical problems associated with high API gravity which is related with low content of sulphur, asphaltenes, metals, -------etc., in the crude. The specific gravity of crude oil and its products are as follows:

	Specific gravity
Crude oil	0.80-0.97
Jet fuels	0.70-0.78
Gasoline	0.78-0.79
Kerosene	0.78-0.84
Gas oil	0.82-0.90
Diesel oil	0.82-0.92
Lubricating oils	0.85-0.95
Fuel oils	0.92-0.99
asphalts	1.00-1.10

APPARATUS:

Hydrometer is used to determine directly the specific gravity of oil. It consists of a thin glass tube closed at both ends, with one end enlarged into a bulb that contains fine lead shot or mercury to cause the instrument to float upright in the oil. In the glass tube is a scale so calibrated that the reading on it level with the surface of the liquid in which the hydrometer is floating indicates the number of times heavier or lighter the oil is than water, i.e., the specific gravity of oil. The hydrometer is based on Archimedes principle. The level at which the hydrometer floats depends only on the density of oil. Hence the level can be used to measure both the density and the specific gravity, which proportional with it. Commercial hydrometers are usually calibrated for ordinary room temperature, which is taken to be 20 ^{o}C. The bath required must be of dimensions such that it can accommodate the hydrometer cylinder with the test portion fully immersed below the bath liquid surface and capable of maintaining the bath at the test temperature ± 0.25 ^{o}C throughout the duration of the test

EXPERIMENTAL PROCEDURE:

1- Clean the hydrometer and the measuring cylinder.
2- Mix the sample wherever possible in the original container or in a close system in order to minimize the loss of light components.
3- Pour the crude oil to be measure in a tall measuring glass cylinder (figure 1)(the type of container is irrelevant as long as it is high enough to allow the hydrometer to float freely). Bring the sample to 15 ^{o}C or 3^{o}C above its cloud point or wax appearance temperature, whichever is the higher.
4- Depress the hydrometer approximately two scale divisions into the liquid and release it. The reminder of the stem of the hydrometer, which is above the level of the liquid shell, be kept dry, since unnecessary liquid on the stem affects the reading obtained. With samples of low viscosity , important a slight spin to the hydrometer on releasing to assist in bringing it to rest floating freely away from the walls of the cylinder. Allow sufficient time for the hydrometer to come to rest, and for all air bubbles to come to the surface. Remove any air bubbles from the hydrometer before taking the reading.
5- Read the hydrometer scale to the nearest one fifth of the scale division. For transparent liquids, record the hydrometer reading at the point on the hydrometer scale at which placing the eye slightly below the level of the liquid and slowly raising it until the surface, first seen as a distorted ellipse, appear to become a straight line cutting the hydrometer scale (figure 1). For obaque liquids, record the hydrometer reading at the point on the hydrometer scale to which the sample rises by observing with the eye slightly above the plane of the surface of the liquid (figure 2).

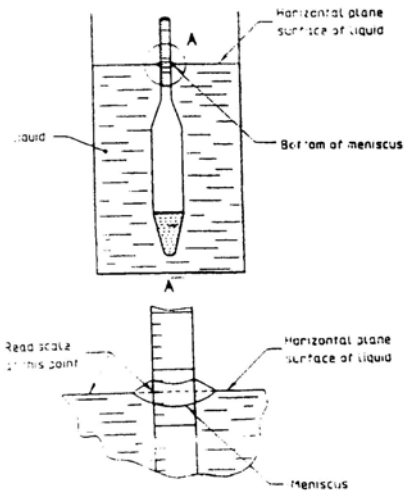

Figure 1
Hydrometer scale reading
for transparent liquids

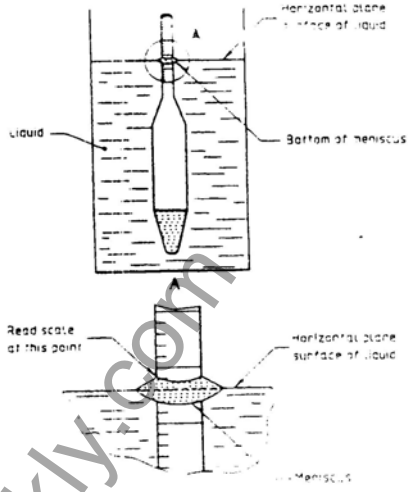

Figure 2
Hydrometers scale reading
for opaque fluids

6- Immediately lift the hydrometer out of the liquid after recording the reading and stir the sample vertically with the thermometer. Record the temperature of the test portion to the nearest 0.1°C. if this temperature differs from the reading taken at the start of the test by more than 0.5 °C, repeat the hydrometer observations and then thermometer observations until the temperature becomes stable within 0.5°C .
7- Repeat points 2 and 6 for two times for each sample.
8- Clean and dry the hydrometer and the measuring cylinder
9- Correct the reading to the standard temperature (the specific gravity of water is equal to 1.000 at approximately 60 degree Fahrenheit (15.5 centigrade).