Hydrometers

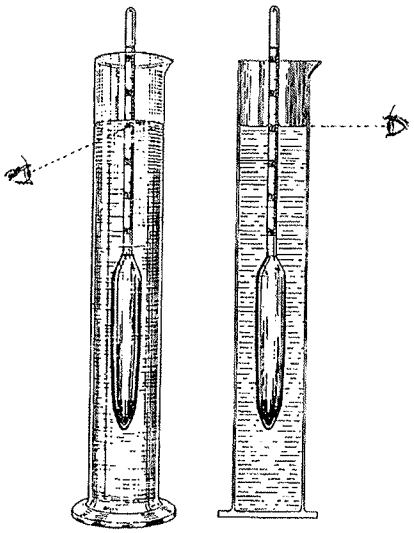

Fig. 1. Fig. 2

The hydrometer is an instrument that is constructed on the principle that a solid body displaces its own weight of the liquid in which it floats. Hydrometers can be divided into two general classes; namely, for liquids heavier than water and for liquids lighter than water. The general standard hydrometer scale is known as the "Specific Gravity Scale," in which distilled water equals 1.000 as the initial point. Liquids lighter than water are scaled below 1.000 specific gravity and liquids heavier than water are scaled above 1.000 specific gravity.

There are also other various scales used which are generally known by the name of their originator such as: Baume, Balling, Brix, etc., which are all convertible into specific gravity by formula.

Hydrometers are ususally calibrated at 60°F/60°F. To determine the density of a liquid, the liquid should be 60°F. If the temperature varies, the liquid will either contract or expand, depending upon the temperature. Therefore, the density fluctuates with the termperature. Where there is a variation from the standard 60°F, corrections must be applied to the hydrometer reading. To assure proper corrections, a separate accurate thermometer should be used, or a hydrometer in combination with a thermometer (thermo-hydrometer).

The correct method of reading a hydrometer is illustrated in Figs. 1 and 2. Where the liquid is transparent, the eye should be placed below the surface (Fig. 1), then raised slowly until the surface, first seen as an ellipse, becomes a straight line (Fig. 2). The point at which this line cuts the hydrometer scale should be taken as the reading of the instrument.

If the liquid is not sufficiently clear for readings to be made in this manner, read from above the surface and estimate as accurately as possible, the point to which the liquid rises on the hydrometer stem. Since hydrometers are calibrated to give correct indications when read at the principal surface of the liquid, correct the reading just taken at the upper edge of the meniscus by an amount equal to this height above the principal surface of the liquid. The amount of correction can be determined with sufficient accuracy for most purposes by taking a few readings on the upper and lower meniscus in a clear liquid of the same character as that being tested and noting the differences.

Meniscus Corrections

In liquids lighter than water and read at the upper edge of the meniscus, a speciic-gravity hydrometer will read too low and a Baume, A.P.I. (American Petroleum Institute), or percent alcohol hydrometer will read too high. The correction for meniscus height should, therefore, be added to a specific-gravity reading and subtracted from a Baume, A.P.I., or percent alcohol reading. In liquids heavier than water, a hydrometer will always read too low so that the correction for meniscus height must be added. The magnitude of the correction must always read too low so that the correction for meniscus height must be added. The magnitude of the correction must obviously depend on the length and value of the scale subdivisions and must be determined for the particular hydrometer.

Accuracy of Hydrometer Readings Depend on:

1. **CLEANLINESS OF THE HYDROMETER, HYDROMETER JAR AND THE LIQUID IN WHICH THE READINGS ARE TAKEN!** For uniform and reproducible readings, the surface of the hydrometer and especially of the stem must be clean so that the liquid will rise uniformly and merge into an almost imperceptible film on the stem. The readiness with which this condition is fulfilled depends somewhat on the character of the liquid. Such liquids as mineral oils and strong alcoholic mixtures readily adhere to the stem. Weak aqueous solutions of sugar, salts, acids, and alcohol require scrupulous cleaning of the hydrometer stem. Before a test is made the hydrometer should be thoroughly washed, rinsed and dried by wiping with a clean, lint-free cloth. The hydrometer jar should be thoroughly washed and rinsed before the clean test liquid is added.

2. **TEMPERATURE:** The hydrometer and liquid should be at nearly the temperature of the surrounding atmosphere to prevent changes in density during the observation as well a any doubt as to the actual temperature. To insure uniformity of density and temperature, the liquid should be completely stirred shortly before the observation is made. Stirring is well accomplished with a perforated disk or spiral on the end of a rod long enough to reach the bottom of the container. Stirring from top to bottom disperses liquid layers of different density. Readings should not be made until both liquid and hydrometer are free of air bubbles and are at rest.

3. **PROPER IMMERSION:** Immerse the hydrometer slowly to a point slightly beyond that at which it floats naturally (not more than 1 or 2 scale graduations), then allow it to float freely.