وزارة التعليم العالي والبحث العلمي
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مختبر الكيمياء العامة

EXPERIMENT (1)

API gravity

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The American Petroleum Institute gravity, or **API gravity**, is a measure of how heavy or light a petroleum liquid is compared to water: if its API gravity is greater than 10, it is lighter and floats on water; if less than 10, it is heavier and sinks.

API gravity is thus an inverse measure of a petroleum liquid's density relative to that of water (also known as specific gravity). It is used to compare densities of petroleum liquids. For example, if one petroleum liquid is less dense than another, it has a greater API gravity. Although API gravity is mathematically a dimensionless quantity (see the formula below), it is referred to as being in 'degrees'. API gravity is graduated in degrees on a hydrometer instrument. API gravity values of most petroleum liquids fall between 10 and 70 degrees.

In 1916, the U.S. National Bureau of Standards accepted the Baumé scale, which had been developed in France in 1768, as the U.S. standard for measuring the specific gravity of liquids less dense than water. Investigation by the U.S. National Academy of Sciences found major errors in salinity and temperature controls that had caused serious variations in published values.

API gravity formulas

The formula to calculate API gravity from Specific Gravity (SG) is:

$$API\ gravity = \frac{141.5}{SG} - 131.5$$

Conversely, the specific gravity of petroleum liquids can be derived from their API gravity value as

$$SG\ at\ 60°F = \frac{141.5}{API\ gravity + 131.5}$$

Thus, a heavy oil with a specific gravity of 1.0 (i.e., with the same density as pure water at 60 °F) has an API gravity of:

$$141.5\ 1.0 - 131.5 = 10.0 \circ \text{API}$$

Using API gravity to calculate barrels of crude oil per metric ton

In the oil industry, quantities of crude oil are often measured in metric tons. One can calculate the approximate number of barrels per metric ton for a given crude oil based on its API gravity:

$$barrels\ of\ crude\ oil\ per\ metricton = \frac{API\ gravity + 131.5}{141.5 \times 0.159}$$

For example, a metric ton of West Texas Intermediate (39.6° API) has a volume of about 7.6 barrels.

Direct Measurement of API gravity (Hydrometer method)

There are advantages to field testing and on-board conversion of measured volumes to volume correction. This method is detailed in ASTM D287.

The factors that effects the hydrometer are:

1. temperature that causes the change in density
2. carbondioxide
3. presence of alcohol

Classifications or grades

API gravity of crude oil produced in the Contiguous United States Generally speaking, oil with an API gravity between 40 and 45° commands the highest prices. Above 45°, the molecular chains become shorter and less valuable to refineries.

Note:

Crude oil is classified as light, medium, or heavy according to its measured API gravity.

- Light crude oil has an API gravity higher than 31.1° (i.e., less than 870 kg/m^3)
- Medium oil has an API gravity between 22.3 and 31.1° (i.e., 870 to 920 kg/m^3)
- Heavy crude oil has an API gravity below 22.3° (i.e., 920 to 1000 kg/m^3)
- Extra heavy oil has an API gravity below 10.0° (i.e., greater than 1000 kg/m^3)

However, not all parties use the same grading. The United States Geological Survey uses slightly different ranges.

Crude oil with API gravity less than 10° is referred to as extra heavy oil or bitumen. Bitumen derived from oil sands deposits in Alberta, Canada, has an API gravity of around 8°. It can be diluted with lighter hydrocarbons to produce diluted bitumen, which has an API gravity of less than 22.3°, or further "upgraded" to an API gravity of 31 to 33° as synthetic crude.

Q/Can the state increase royalty revenue by taking its crude in-kind and blending low gravity and high gravity crudes to produce blends in the 40 to 45 degree API range?

Procedure:-

Hydrometer method: At first we take a suitable graduated cylinder 500 ml and it should be clean. The cylinder should be big enough because when we put the hydrometer it should (move) floats easily in the cylinder. So, we fill the cylinder with the sample (in our experiment we just used kerosene for this method). After filling the cylinder with the kerosene we allowed sufficient time for the hydro meter to come to rest. And when the hydrometer is flowed freely we took the scale reading. And at the end we brought out the hydrometer and cleaned it.

Pycnometer method: At first we took the emptied pyconmeter and weigh it ($M0$). Then we filled the pyconmeter with the sample that we wanted and weigh it again ($M1$). (To yield the weight of the sample we subtract $M1$ from $M0$.) The volume of the pyconmeter that we used was 50 ml and 25 ml. After those steps we measure the density of fluid and API gravity and Specific Gravity according to what we did in the lab.

Calculations:

Pycnometer method

$M0$ of empty pycnometer = ? g

$M1$ of filled pycnometer = ? g

Volume of pycnometer = ? ml

M= $M1$-$M0$

$$D = \frac{M_1 - M_0}{\text{volume of pycnometer}}$$

$$S.G = \frac{\text{DENSITY}}{\text{density of water}}$$

$$API \text{ gravity} = \frac{141.5}{S.G} - 131.5$$