1. Abstract

Measurement of density of crude petroleum and petroleum products is specified in JIS K 2249-1995 Crude petroleum and petroleum products · Determination of density and petroleum measurement tables based on a reference temperature.

Density of crude petroleum and petroleum products is prescribed to express value [density (15°C)] in 15°C normally. The sample which is hard to measure such as solid at room temperature or high viscosity liquid is measured after lowering viscosity by heating with a method converted to density at room temperature. This application note exemplifies a measurement of specific gravity 60/60°F and specific gravity 15/15°C with a built-in temperature conversion formula using multiple sample changer (high temperature specification (electric heater type)) and density/specific gravity meter made by Kyoto Electronics (KEM).

This density/specific gravity meter is equipped conversion formula to density, API degree and specific gravity (temperature: 60°F·15°C·20°C) of crude petroleum(A)·fuel oil(B)·grease(D) based on prescription of petroleum products.

2. Reference

1) JIS K 0061-2001 Test methods for density and relative density of chemical products
2) JIS K 2249-1995 Crude petroleum and petroleum products · Determination of density and petroleum measurement tables based on a reference temperature
3) ASTM D1250-08 Standard Guide for Use of the Petroleum Measurement Tables
6) ISO 91·1:1992 Petroleum measurement tables -- Part 1: Tables based on reference temperatures of 15 degrees C and 60 degrees F
7) API Std. 2540

3. Cautions in measurement

1) Use a fresh desiccant (silica gel). If its color is reddish, change it with new one (blue).
2) Before sample measurement, perform factor calibration with dry air and pure water after degas.
3) Watch out for fire due to use flammable solvent.
4. Post-measurement care

Drain out residue inside the cell. Rinse well the measurement cell with solvent, and dry it completely.

5. Test equipment

Main unit : Density/specific gravity meter
Option : Multiple sample changer (high temperature specification (electric heater type))

6. Reagent

Rinse solvent : Toluene (for cleaning) rinse solvent 1
Rinse solvent : Acetone (for drying) rinse solvent 2

7. Measurement procedure

—Calibration—
1) Set the temperature of density meter to 70℃, and leave it until stabilized.
2) Set the temperature of turn table side of multiple sample changer to 80℃ which is 10℃ higher than measurement temperature and tube heating unit to 75℃ which is 5℃ higher than measurement temperature, and leave it until stabilized.
3) Calibrate the meter with dry air and pure water after degas. The water should be used after heated at 100℃.

—Measurement—
1) Set sample to sampling bottle and multiple sample changer, and make sampling temperature stable.
2) Start measurement.
   (when measurement is started, the series of sampling, measurement, cleaning and drying are automatically operated.)
8. Example of measurement

— Ambient condition —

<table>
<thead>
<tr>
<th>Room temperature</th>
<th>Humidity</th>
<th>Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 °C</td>
<td>54 %</td>
<td>Fair</td>
</tr>
</tbody>
</table>

- Measurement Parameter -

[Method Parameter]

- Measurement Parameter
  - Temperature : 70.00 °C
  - Stability : 1
  - Limit Time : 600 s
  - Viscoc. Corr. : Off
  - Sequence : Off
  - Calib. Mate. : Air&Water
  - Sample[mL] : 0.00

<Contents>

- Contents Name : Density
  - Decimal : 4

- Contents Name : API(S.G.)A 60F
  - API(S.G.)A 15C
  - Decimal : 4

<Temperature Comp.>

- Temp. Comp. : Off

<Sequence>

- Sequence File : Sequence auto
  - No.
  - 01 Sampling
  - 02 Meas.
  - 03 Drain
  - 04 Rince1
  - 05 Rince2
  - 06 Purge

- Sampling Seq. : Auto
- Samp. Limit : 0s
- O.S. Rate : 70%
- Drain Seq. : Auto
- Drain Rate : 100%
- Rince-1 Time : 30s
- Rince-2 Time : 10s
- Purge Seq. : Auto
- Tolerance : 10

- Calibration Parameter -

[Check&Calib]

- One Point Calib. : off
- Calib. Temp. : 70.00°C
- Stability : 1
- Viscosity : Off
- Limit Time : 600 s

(Rest of Calibration parameter)

- Tolerance : 0.0002
- Sequence : On
- Sequence Name : Sequence 1
- Calib. Mate. : Air&Water
- Check : Off

- Result -

*** Result ***

- Sample No. : 01-001
- Date : 2011/04/12 15:41
- Sample ID :
- Method Name : original
- Meas. Temp. : 70.00 °C
- d[g/cm3] : 1.0577

- API(S.G.)A 60F : 1.0897
- API(S.G.)A 15C : 1.0900

- Meas. Time : 00:01 : 19

(Printout examples by DA-640)
--- Measurement result ---

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Density (g/cm³)</th>
<th>API(S.G.)A 60F</th>
<th>API(S.G.)A 15C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>112121</td>
<td>1.0577</td>
<td>1.0897</td>
<td>1.0900</td>
</tr>
<tr>
<td>2</td>
<td>112121</td>
<td>1.0577</td>
<td>1.0897</td>
<td>1.0900</td>
</tr>
<tr>
<td>3</td>
<td>112122</td>
<td>1.0577</td>
<td>1.0897</td>
<td>1.0900</td>
</tr>
<tr>
<td>4</td>
<td>112123</td>
<td>1.0577</td>
<td>1.0897</td>
<td>1.0900</td>
</tr>
<tr>
<td>5</td>
<td>112123</td>
<td>1.0577</td>
<td>1.0897</td>
<td>1.0900</td>
</tr>
</tbody>
</table>

* The above data are the results of 5 tests of the same sample.
* Red underline shows the data from page 3/4.
* The above “API(S.G.)A 60F” shows gravity 60/60°F.
* The above ”API(S.G.)A 15C” shows gravity 15/15°C.

9. Summary

Sample measurement this time shows a good repeatability.

Since the following density/specific gravity meters are equipped with density conversion formula corresponding to JIS K2249・ASTM D1250・ASTM D 4052・ASTM D 5002・ISO91・API Std.2540, can be calculated gravity 60/60°F and gravity 15/15°C of crude petroleum(A)・fuel oil(B)・grease(D) automatically.