KES

Testing Method for Carlorific Value of Petroleum Product by Bomb Calorimeter

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1. Scope of application

This standard shall specify the method that measures the calorific value of liquid fuel by bomb calorimeter. Here, the liquid fuel includes the petroleum products except petroleum gas.

Remark : The unit and the number expressed in the square brackets { } shall follow the international standard (SI) and be added for reference.

2. Terminology

2.1 Total calorific value

This is the calorific value including the latent heat of evaporation when the quantitative sample is burned in the quantitative bomb and the vapor in the burning gas is condensed. And, this is expressed in terms of Cal/g { J / g }.

2.2 True calorific value

This is the calorific value that doesn't include the latent heat of evaporation when the quantitative sample is burned at the atmospheric pressure and the vapor in the burning gas isn't condensed. And, this is expressed in terms of Cal/g { J / g } and is calculated from total calorific value.

2.3 Thermal capacity of device

This is the heat capacity required to increase the temperature of water in calorimeter to 1 °C more and is expressed in terms of Cal / °C { J / °C }.

3. Introduction of testing method

After the sample is burned in the bomb of calorimeter containing the compressed oxygen, the calorific value is calculated by the thermal correction of the value calculated from the temperature difference before and after combustion.

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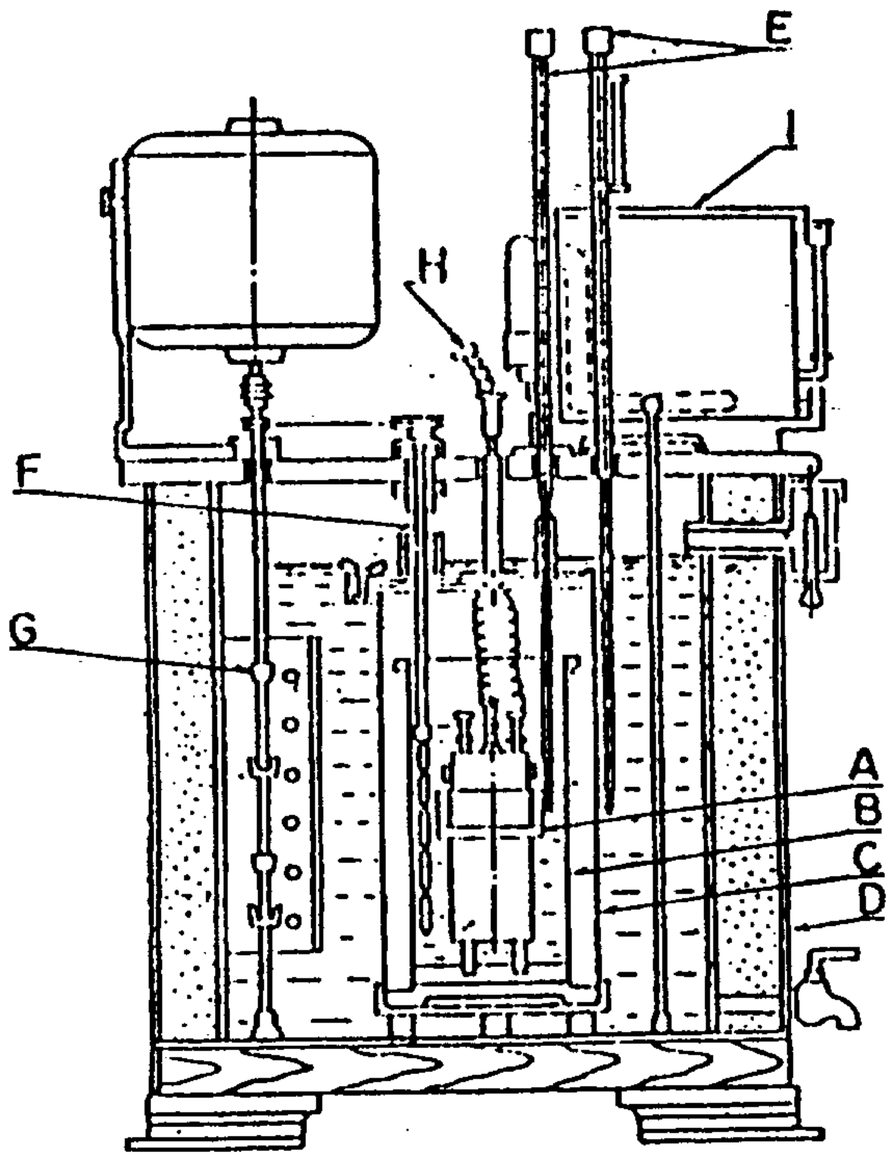
4. Device

The bomb calorimeter is used.

The Figure 1 shows the example.

Remark : The calorimeter should be installed at the place where the variation of temperature is small, for example, at indoor isolated from the outside air and shouldn't be directly exposed in sunlight



A : Bomb

B : Inner tube

C : Middle tube

D : Outer tube

E : Bechmann thermometer

F : Stirrer for inner tube

G : Stirrer for outer tube

H : Wire for ignition

I : Water tank for heating

Figure 1. The example of calorimeter

4.1 Thermometer

4.1.1 Bechmann thermometer

This can measure the temperature difference coming to 5 ~ 6 °C and the fine scale is 0.01 °C and is used with the magnifying glass certificated from the test.

The thermometer in the inner tube is used after the correction by the Gay-Lussac method.

4.1.2 Standard thermometer

This is used to measure the temperature of water and indoors and set the starting

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point of a Bechmann thermometer. The thermometer whose measuring range is 0 ~ 50 °C and fine scale is 0.1 °C can be used.

4.2 Vessel containing the sample

The vessel made of platinum, 18-8 stainless steel or melting quartz is used.

The volatile sample such as gasoline should be contained in the slight glass capsule whose volume is 5 mℓ. The example of the size of vessel is as follows. The outer diameter of the bottom, the outer diameter of the above and the height is about 24 mm, 27 mm and 12 mm respectively.

4.3 Wire of ignition

The pure nickel wire or pure steel wire whose diameter, about 0.1 mm, and length, about 100 mm, can be used.

4.4 Electric circuit for ignition

The 15V ~ 30V is proper for ignition of the sample. To confirm whether the ignition happens or not, it is useful to connect serially an ammeter or a pilot lamp to the electric circuit for ignition

4.5 Connection tube for inserting the compressed oxygen

This is the device for inserting the compressed oxygen which is in the compressed oxygen tank to bomb. The connection tube equipped with a reducing value and a pressure steel(The largest scale is 50 ~ 60 kg f cm^2 { 4.90 ~ 5.88 Mpa } and the fine scale is 2 kg f { 0.2 Mpa }), in the middle of the tube is used.

4.6 Device manufacturing tablet

The tablet whose diameter is 10 ± 1 mm can be made form the benzoic acid and the wire for ignition.

4.7 Scale

4.7.1 Chemical scale

The chemical scale whose sensitivity is 1 mg and weight is 100 g or 200 g is used.

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4.7.2 A pair of scales

A pair of scales whose sensitivity is 1 g and weight is 4 kg or 5 kg is used.

5. Reagent

5.1 Benzoic acid

The benzoic acid should be regulated in KS D 3507.

5.2 0.07 N, alkali standard solution

The 1,000 mℓ solution made from the 3.84 g absolute sodium dissolved in distilled water is used. Or, the solution which is as normally dense as sodium hydroxide can be used.

5.3 Solution of barium chloride (10 %)

The 1,000 mℓ solution made from the 100 g barium chloride dissolved in distilled water is used.

5.4 Hydrochloric acid (1 : 1)

The hydrochloric acid mixed with the same amount of distilled water is used.

5.5 Indicator

The methyl orange or methyl lead for analysis is used.

5.6 Oxygen

The compressed oxygen is used.

6. Operation

6.1 Preparation for boiling water

The water is heated to 90 °C in heating vessel.

6.2 Preparation of bomb

The sample([1])([2]) whose calorific value is 6,500 Cal { 27209 J } when it is heated in bomb is placed in the strut of bomb. And its weight is measured to the precision, 0.1 mg in the vessel. And then, the wire for ignition whose weight is measured

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previously is placed the surface of the sample in the vessel([3])([4]) and its both end sides are connected to the electrode for ignition and are covered.

Note([1]) : If you know the general calorific value of the sample, the proper weight of the sample can be calculated from following equation.

$$S = \frac{6500}{h} \{ S = \frac{6500 \times 4.1805}{hh} \}$$

Where, S : The weight of the sample (g)

H : The general calorific value of the sample (Cal / g) { J / g }

([2]) : Because the volatile sample is burned so abruptly ,which causes the error, it is recommended to reduce the amount of sample to that amount whose total calorific value is under 6000 Cal { 25116 *J* }.

([3]) : It is recommended to cover the bottom of the platinum or 18-8 stainless steel vessel containing the sample with the red-hot asbestos.

([4]) : In case of using the platinum vessel, it is recommended not to use the pure steel wire for ignition because of the damage on the vessel from this wire.

(2) The 25 ~ 30 kg f / cm^2 { 2.45 ~ 2.94 Mpa } ([5]) oxygen is injected into the bomb. During this injection, the remaining air shouldn't be pushed out of the bomb. And then, it should be checked to seal the bomb hermetically.

Remark : It is required to check the amount of oxygen not to be overly injected into in the bomb.

If the amount of oxygen is over 35 kg f / cm^2 { 3.43 Mpa }, the bomb may be overheated. So, the overly injected oxygen should be emitted throughout the connection tube for inserting the pressed oxygen.

In this case, if the weight of the sample is different from the weight measured previously, it is recommended to discard the sample and go to 6.2

Note ([5]) : In case of the volatile sample, The 20 ~ 25 kg f / cm^2 { 2.45 ~ 2.94 Mpa } oxygen is injected.

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