Lab Work No. 1

Determination of the true density of the material

True density is the mass of a unit volume of material in an absolutely dense state, i.e. without pores and voids. True density ρ (g/cm^3, kg/m^3) is calculated by the formula:

$$\rho = m / V_a, \qquad (1)$$

where m – material mass; V_a – volume of material in an absolutely dense state.

The true density of the material is determined either using a special glass flask - a Le Chatelier volume meter, with a capacity of 120-150 cm^3, or using a pycnometer - an exact volume flask, usually with a capacity of 100 cm^3.

To determine the true density of the stone material using a Le Chatelier volume meter, 200-220 g are weighed from a selected and thoroughly mixed sample. Pieces of the selected sample are dried in an oven at a temperature of (110±5)^{0}C to constant weight; then it are finely ground in an agate or porcelain mortar. The resulting powder is sieved through a No. 02 sieve (mesh size in the light 0.2 mm). Weighing about 180 g of the sifted powder in a porcelain cup, it is again dried at a temperature of (110±5)°C, and then cooled to room temperature in a desiccator, in which the powder is stored until testing. The volume meter is filled to the bottom zero with a liquid (water, anhydrous kerosene or alcohol), inert with respect to the material powder. After that, the liquid-free part (above the line) is carefully wiped with a tampon of filter paper. Then the volume meter 4 is placed in a glass vessel 5 with water and a thermometer 3 (Fig. 1). Water has a temperature of 20 ° C (the temperature at which its scale was graduated). In water, the volume meter remains all the time while the test is in progress. So that the volume meter in this position does not float, it is fixed on a tripod 1 so that the entire graduated part of the neck is in water.

From the prepared sample in the desiccator, 80 g of material powder is weighed with an error of up to 0.01 g on an scales and poured with a spoon through a funnel 2 into the device in small portions until the liquid level in it rises to the line with division 20 cm^3 or to hell within the upper graduated part of the

device. The difference between the final and initial liquid levels in the volume meter indicates the value of the volume of powder poured into the device. The remainder of the powder is weighed. The mass of powder poured into the flask will be equal to the difference between the results of the first and second weighings.

True density of material (g/cm^3):

$$\rho = (m_1 - m_2)/V_a, \qquad (2)$$

where m_1 – initial mass of material before experience, g; m_2 – remainder mass, g; V_a – volume of liquid displaced by material (volume of powder in a Le Chatelier flask), cm^3.

The true density of the material is calculated with rounding to 0.01 g/cm^3 as the arithmetic average of two determinations, the difference between which should not exceed 0.02 g/cm^3.

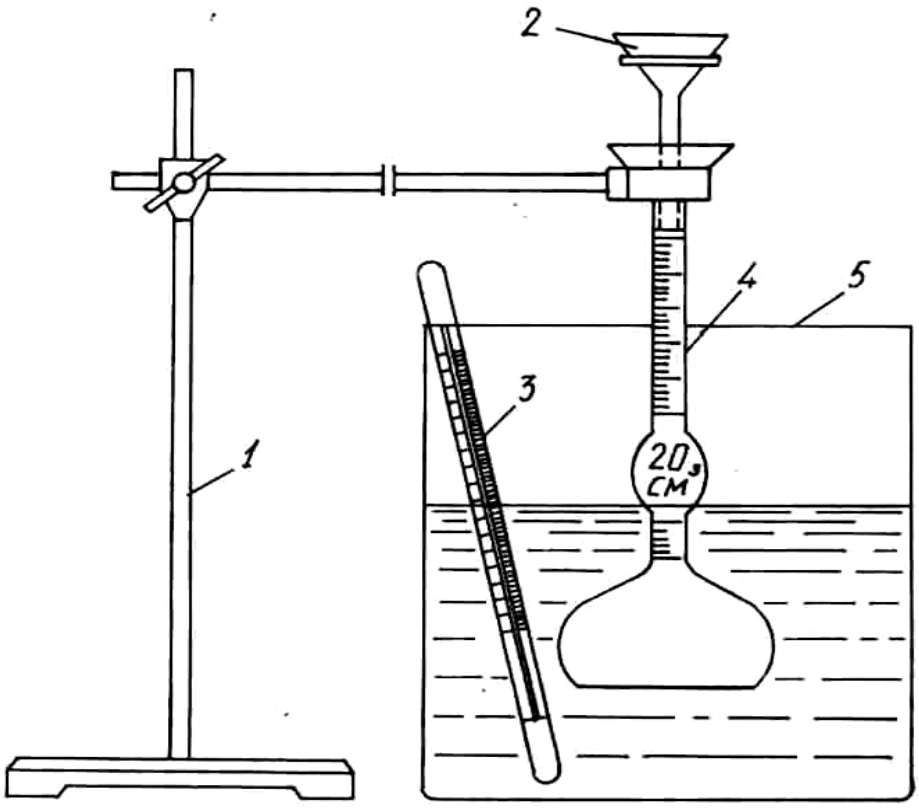

Fig.1. Device for Determining the True Density

The results of the experiments are recorded in table 1.

Table 1

The Results of Determining the True Density Using a Le Chatelier Flask

Material Name	Exp. №	Initial Mass of Sample, g	Remainder Mass, g	Volume of Displaced Liquid, cm^3	True Density, g/cm^3	Average, g/cm^3