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D. V. JOGLEKAR, B.E.

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Description of the Apparatus

The porosity meter developed at the Research Station consists of a glass U-tube (shown in Fig. 159) the two limbs *A* and *B* of which are of equal internal diameter. The U-tube is fixed vertically, to a wooden stand, and the two limbs are kept as close as possible. The tube *A* is connected through a *T*-stopcock, to a cylindrical glass container *C* with a volume of about 170 c.c. This glass container can be made air tight by means of a sliding glass lid and vacuum grease. The tube *B* is connected to a 100 c.c. burette *D*, graduated up to 0.1 c.c. Mercury is introduced in the U-tube and the burette. The mercury levels in these tubes can be adjusted by means of two mercury reservoirs, *E* and *F* which can be slid up and down on sliding wooden bases.

Fig. 195

Working Principle

This porosity meter is essentially a volumometer, applying the principle of Boyle's Law. It consists of two parts, *A* and *C* forming one connected air-volume unit, *B* and *D* forming the other connected air-volume unit. The specimen *S* is introduced into the container and the air-volume of the other unit is adjusted by mercury in the burette. The volume of mercury which must be introduced in the burette when the specimen is placed in the container *C* in order to maintain the equality of the air-volume in the two volume units gives the volume of the specimen, the air volume in the two units being first adjusted to be same with no specimen in the container.

First, the volume of the specimen *S* is determined with its surface pores untreated, and then with the specimen lightly wax-coated, so that the surface pores are closed. The difference in volume of these two burette readings gives the volume of connected air space contained in the specimen.

To start with, the container *C* being empty, the tube *D* is filled to a trial level with mercury. The vacuum stopcocks 1 and 2 are open, while the reservoir *F* is raised until mercury rises to a suitable level *G* in the limbs *A* and *B*. The stopcocks are then closed. The mercury reservoir *F* is now lowered until mercury level falls to a suitable level *G* in the U-tube. If the free air-space in the burette side of the apparatus up to the point *G* be equal to that on the container side, the mercury level in the limbs *A* and *B* will remain the same on any lowering of the reservoir *F*. If, however, the air-volumes in the two parts of the instrument are different to start with (at atmospheric pressure) the mercury levels in *A* and *B* will be different on any lowering of the reservoir *F*. If so found, the mercury reservoir *F* is next raised to its original position *G*, the stopcocks are opened and the mercury adjusted in the burette until on closing the stopcocks and lowering the reservoir to *G*, the levels in the limbs *A* and *B* remain equal; this can be accomplished quickly in a few trials. The reading of mercury level in the burette (the mean of three independent observations) is taken as the zero reading of the apparatus. This remains quite constant. Let it be V_0 c.c. say.

The specimen *S* is next placed in the glass container and closed air tight by means of the glass lid with vacuum grease. The process is then repeated, and the mercury level in the burette adjusted until on lowering the reservoir, mercury remains at equal level in both the limbs *A* and *B*. The reading of mercury level in the burette is then taken. Let it be V_1 c.c.

The volume of the specimen with the pores open to atmosphere is $(V_0 - V_1)$ c.c. This gives the volume of the solid material in the specimen.

The specimen is then removed from the container and a thin coating of wax is given to the specimen, by immersing it for a very short period in molten wax. After cooling, the specimen is again introduced into the container and the burette reading taken as V_2 c.c.

The volume of the specimen waxed = $(V_0 - V_2)$ c.c.

∴ The volume of void space = $(V_1 - V_2)$ c.c.

$$\text{Porosity} = \frac{\text{Void space in the specimen}}{\text{External volume of the specimen}} = \frac{(V_1 - V_2)}{(V_0 - V_2)}$$

$$\text{and the percentage porosity} = \frac{(V_1 - V_2)}{(V_0 - V_2)} \times 100$$

A small correction is made for the volume of the thin wax coating depending on the standard size of the samples used for porosity determinations.

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