

As 20 grams of asphalt cement in a dish $2\frac{1}{2}$ inches diameter is but 6 to 7 m.m. deep, or the equivalent of 60 to 70 penetration, it is obvious that such material cannot lose the amount permitted by many specifications in the heating test and still be of sufficient depth for the penetration test. The fact that the needle strikes and stops upon the bottom of the dish is not always appreciated and has led to controversy or unfavorable criticism in some instances.

There are a great variety of instruments available for indicating the viscosity of bituminous materials, and while no particular type has been officially adopted for testing road materials, the "Engler" is more generally used for that purpose than any other. In addition to the Engler, the Lawrence, Redwood, and Saybolt, are sometimes mentioned in specifications for road building materials.

None of these instruments speak the same language, but there is no reason for disagreement between different operators or laboratories with the same type instrument, if the standard directions for its operation are observed by both sides.

The relation of several of the more widely employed viscosimeters to each other has been worked out and published in the Proceedings of the American Society for Testing Materials.

Cementitiousness.—The direct determination of the cementitious properties of bitumen has been attempted by different investigators in a variety of ways, and a recent form of such test which is applicable to road surfacing oils is the Osborne test, devised by Clarence B. Osborne, chemist for the State Highway Department, California, and applied in the examination of the heavy oils or liquid asphalt used extensively in that State.

The Osborne apparatus is illustrated in Fig. 2. It consists of a horizontal hollow brass spindle 2 in. diameter by 3 in. long, through which water at 77° F. is circulated, a brass collar 2 in. long by 2.01 in. inside diameter, which fits loosely over the spindle, and a 3-kilo weight attached by a cord to an eye on the collar. The brass spindle and inside of the collar are coated with the oil under examination, and the latter is then slipped over the spindle. The cord holding the weight is wrapped about the collar and when the weight is released the time elapsed in seconds while the collar makes three revolutions is recorded. Results can be checked within a few seconds and the more cementitious materials interpose greater resistance to the movement of the collar than less cementitious ones of the same consistency. As this device is arranged at present, it is not available for testing and semi-solid bituminous cements or binders for macadam type of construction. A series of tests performed in the writer's laboratory upon a number of heavy oils of about the same consistency available in the east gave the following results:—

Heavy Oils.	Osborne Test.
1	770 seconds
2	600 "
3	250 "
4	175 "

The more solid bituminous materials are tested for adhesive properties by several experimenters by cementing two brass cylinders, or prisms, having an area of one square inch, together with as little of the hot bituminous material as will remain between the parallel faces of two such metal sections when a regulated amount of pressure is applied. After adjusting the temperature of the test piece so prepared, the cylinders are pulled apart in a suitable apparatus, such as a tensile machine for breaking briquettes of hydraulic cement. A large number of tests

of the same material must be made to secure a fair average, and abnormally high and low results should be discarded. Variations amounting to several hundred pounds frequently occur.

A test of this character is employed by G. P. Homstreet, of the Hastings Paving Company, in the control of the manufacture of asphalt blocks, and also by Dr. Kleeberg, chemist, Bureau of Highways, Borough of Manhattan, but the specifications of municipalities for paving materials have not, so far, included such a requirement.

Brittleness.—A test for brittleness is not usually mentioned in connection with bituminous road building materials, but is in use by some investigators for special purposes. One type of such a test is performed at some specific temperature by resting a small prism of the bituminous material upon knife edges standing a definite distance apart, and striking it midway with a ball weight falling a prescribed distance. This test was probably devised in the asphalt laboratory of the District of Columbia.

Another type of test for brittleness is in use in the laboratory of the Highway Department, State of New York, and elsewhere, and is applied to semi-solid bituminous material of a considerable range of consistency. In carrying out the test, six or eight cylinders, 1.25 or 2.00 inches diameter and of equal height, are cast in a split mold and after they are adjusted to a standard temperature, usually 32° F., are removed from the mold and broken under a Page impact or similar machine. A large number of individual tests upon the same material is necessary to arrive at a fair average.

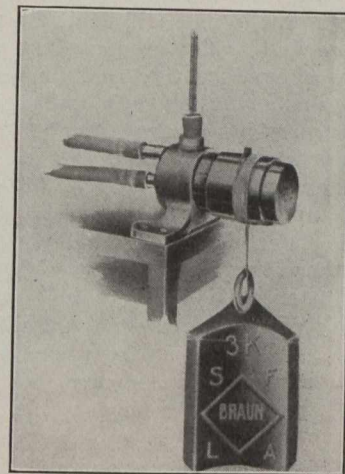


Fig. 2.—Osborne Test for Direct Determination of Cementitiousness.

Solubility.—Bituminous materials are tested in a variety of complete and partial solvents with certain objects in view. The universal solvent for bitumen is carbondisulphide, and bituminous materials and mixtures are therefore treated with that solvent for the purpose of ascertaining their bitumen contents. The bitumen contents of such materials is that portion which is so soluble. Bensole and chloroform are also complete solvents for bitumen, and are sometimes employed for that purpose, but carbondisulphide is in more general use and has wider approval. Carbontetrachloride does not always dissolve as much of a bituminous material as carbondisulphide.

Petroleum naphtha, acetone, and ethyl-ether are only partial solvents of bitumen. The former has been employed extensively in the examination of bituminous materials, but the test is subject to wide variation in the hands of even an experienced analyst, unless the temperature of the solvent, its gravity or limits of boiling point and general nature are collectively always the same.

The results of solubility tests of a given bitumen in 70° naphtha and 80° naphtha are not comparable, nor are the results the same in duplicate tests if one naphtha has been derived from a paraffine oil and the other from an asphaltic oil.