

## LIMITATIONS OF RESULTS OF TESTS OF BITUMINOUS MATERIALS.

**H**AVE analyses of bituminous materials any real meaning to the municipal or highway engineer or road contractor? Are chemists' tests reliable; and when made on bituminous materials, are they anything but means of identification?

These questions are raised by a lecture on the limitations of the value of making tests on bituminous materials, which was given in the graduate course in highway engineering a couple of weeks ago at Columbia University by Chas. N. Forrest, of Maurer, N.J., who is chief chemist of the Barber Asphalt Paving Co.

Mr. Forrest says that the first application of bituminous materials for paving purposes was not likely preceded by laboratory tests of any kind, and that, at any rate, the earlier schemes for testing such substances did little, if anything, more than to identify the material under examination.

After a bituminous pavement was laid that was enough of a success to cause it to be conspicuous, Mr. Forrest says, the services of a chemist were employed to take the thing apart and determine of what it was made.

The function of all bituminous materials in a pavement is physical rather than chemical, as they are all chemically inert so far as concerns any influences to which they are subjected in normal service. An exception to this is the creosote oil used for impregnation of wood paving block, which must have certain chemical properties to perform its proper function. With the exception of creosote, however, Mr. Forrest claims that practically all of the tests now applied to bituminous materials, by those who are concerned in their application to roads, come within the classification of proximate analyses, and do not disclose the ultimate composition of the substances. He says they merely reveal certain of its characteristics, chiefly physical, when applied in very strict accordance with some prescribed method.

A great deal of time and thought has been given to the question of standardization of the methods employed in bituminous analyses. The standardization of methods for tests is of more importance, thinks Mr. Forrest, than the drawing of general specifications, as there can be no proper understanding of specifications until there is unanimity of opinion as to how the characteristics mentioned in them are to be determined. The following is an abstract of the portion of Mr. Forrest's lecture which deals with the difficulty in making, and the value or otherwise, of tests on bituminous paving materials:—

The standardization of the methods for performing tests of bituminous materials has not yet been satisfactorily accomplished, but is progressing slowly, and in the meantime a full description of the method which is to be employed should accompany all specifications, if confusion is to be avoided.

That there is considerable divergence of opinion as to the most suitable method for performing many of the tests, and a still greater divergence upon the results obtained, is appreciated by all who have been concerned in either the manufacture, sale or purchase of bituminous materials for any length of time.

**Specific Gravity.**—There is not much room for honest disagreement upon the subject of specific gravity, yet in view of the fact that that characteristic varies with temperature and such viscous substances as many of those involved are, are prone to entangle air and moisture, there has been more or less controversy over this simple matter. As this characteristic of bituminous materials

frequently plays an important part in the computation of quantity delivered, and slight errors in the laboratory determination of specific gravity multiply into very considerable differences between what is shipped at one point and received at another, it is worthy of careful consideration.

The temperature of bituminous materials affects practically all of the physical tests to which they are subjected, and too much care cannot be exercised to insure the specific temperature specified, being the actual condition of the material under examination and not merely that of the surrounding air or water which may envelop it at the time. This class of material absorbs and radiates heat slowly and the period of time stated in a method, through which a sample is to remain in water, or the procedure to be followed in heating or cooling it, must necessarily be based upon considerable experience in such matters and must also be religiously followed if accuracy is important.

While there may not be much room for honest disagreement upon the subject of specific gravity, there is no limit to either the room for or the degree of disagreement

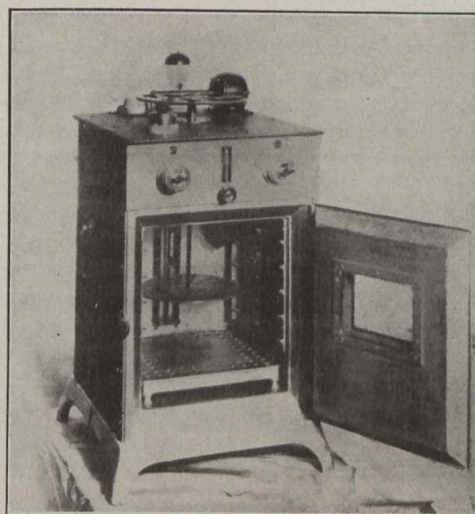


Fig. 1.—Improved Freas Oven for Loss on Heating Test of Bitumens.

in regard to practically all of the other tests to which bituminous materials are submitted.

**Flash Point.**—In addition to the dozens of miscellaneous independent methods used for the determination of the flash or fire point, or both, there are as many as at least eight more or less standard methods for the same purpose which may be described under the name of the apparatus used for the purpose. The eight standard methods are as follows: Tagliabue, open and closed cup; New York State, closed cup; Cleveland, open cup; Abel, closed cup; Abel-Pensky, closed cup; Pensky-Martin, closed cup; Bureau of Mines, closed cup.

No open-cup method will yield results capable of duplication in the hands of different operators, and the value of any results so obtained is questionable. The results obtained under unlike conditions, either as to type or cup, or its manipulation, are not comparable. The closed cup tests can be checked to a single degree.

**Penetration.**—At the present time there are several different instruments (Bowen Penetration Machine, Dow Machine, N.Y.T.L. Penetrometer, Abraham's Consistometer) and methods for the determination of the consistency or penetration of bituminous materials, although but one of each is in general use. As is well known, the principle of this test is to determine the depth to which a standard needle under a definite load will penetrate at a