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A COMPARATIVE METHOD FOR DETERMINING THE FUSING-POINTS OF ASPHALTS.

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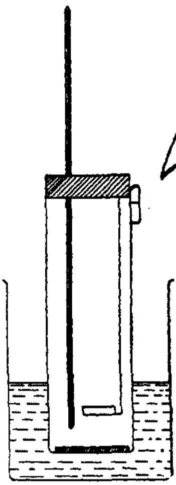
SINCE all asphaltic bodies are complex mixtures of hydrocarbons with different melting-points, it is evidently quite out of the question to determine even approximately the melting-points of the asphaltic mixtures. The elements of time and temperature must be taken into account. A product that softens slowly under the influence of a summer's sun, may not fuse completely below 100° under the influence of heat suddenly applied.

The methods for determining these melting-points hitherto employed by manufacturers and consumers are extremely crude; such for example as inserting a thermometer into the melted material, allowing the adhering mass to harden, and then holding it over a flame and noting the temperature at which it softens and falls off. Every manufacturer, therefore, and those who use his products, have felt an imperative need of a method that should enable them to ascertain with some degree of accuracy the quality of every quantity of material produced. Such a method must be simple and capable of application by any person who is able to read a thermometer. There must be few variable elements, which would affect seriously the accuracy of the observation, and those that must remain constant must be clearly defined.

Having been called upon to suggest a method that should fulfil these requirements, one of us (Mabery) proposed the one to be described which seems to promise reliable results. In a glycerine-bath in a beaker of moderate size is placed a narrow beaker closed with a cork through which is passed a thermometer. There is also inserted through the cork close to the side of the narrow beaker, a strip of metal, one-half inch wide, bent over the side of the beaker as a support, and extending to within $\frac{1}{2}$ inch of the bottom of the beaker. The lower end of the metal strip is bent at right angles and the narrow corners are bent upwards. The bend in the metal is used as a support for the section of asphalt, which is pressed on the points, formed by the corners of the metal. The dimensions of the apparatus used by us are given, but evidently the only constants need be the distance of the thermometer from the specimen, the distance of the metal from the bottom of the beaker, the width of the metal strip, and the dimensions of the specimens to be tested. With the metal strip $\frac{1}{2}$ inch wide the specimen to be tested is cut or molded of sufficient lengh to project $\frac{1}{4}$ inch on either side of the metal. The observation consists in noting the temperature at which the specimen softens and becomes sufficiently fluid to fall on either side of the metal support and just touch the bottom of the beaker. The dimensions of the different parts of the apparatus are given with the illustration. We found it convenient to place a disk of copper or iron on the bottom of the inside beaker; since it could be removed after the observation, and the asphalt that had fallen more conveniently cleaned than from the bottom of the beaker. While a Bunsen gas flame is the more convenient source of heat, an alcohol or an oil lamp can be used when gas is not at hand. Evidently the time of heating should not vary widely, although we have found as will appear that a variation of five minutes had no appreciable effect on the melting-points.



The apparatus used in the determinations described in this paper had the following dimensions which are given in inches that they may be readily understood by any manufacturer. The only dimensions that must be constant were mentioned above :

	Inches.
Width of outside beaker	$2\frac{1}{2}$
Height of "	$3\frac{1}{2}$
Width of inside beaker	$1\frac{3}{8}$
Height of "	$4\frac{1}{8}$
Width of metal support	$\frac{1}{2}$
Length of lower bend of support	$\frac{5}{8}$
Distance of specimen from false bottom of beaker	$\frac{1}{2}$
Distance of thermometer from specimen	$\frac{1}{8}$
Standard size of specimen	$1 \times \frac{1}{2} \times \frac{1}{8}$

In testing the efficiency of this method, the fusing-points of a variety of asphaltic materials were determined. Observations were made of the initial temperature, of the temperature at the time when the softened material just touched the bottom of the beaker, and of the time of heating. The effect of varying the dimensions of the specimen on the fusing-point was also observed.

Specimen 1, byerlyte.

Dimensions of specimen, $1'' \times \frac{1}{2}'' \times \frac{1}{8}''$.

(1) Time, ten minutes; temperatures, 30°–132° fusing-point.

(2) Dimensions of specimen, $1'' \times \frac{1}{2}'' \times \frac{1}{8}''$. Time, five minutes; temperatures, 20°–131° fusing-point.

To determine the influence of thickness, the following experiments were made with the same material as in (1) and (2):

(3) Dimensions, $\frac{7}{8}'' \times \frac{1}{2}'' \times \frac{1}{4}''$; time, eleven minutes; temperatures, 40°–139° fusing-point.

(4) Dimensions, $\frac{7}{8}'' \times \frac{1}{2}'' \times \frac{1}{8}''$; time, 14 minutes; temperatures, 60°–137° fusing-point.

(5) Dimensions, $\frac{7}{8}'' \times \frac{1}{2}'' \times \frac{1}{16}''$; time, ten minutes; temperatures, 30°–135° fusing-point.

Evidently variation in thickness within these limits has little effect on the fusing-point.

The effect of even higher initial temperature was shown in the following experiments on the same material as in (4), with the same dimensions.

(6) Time, eight minutes; temperatures, 50°–135° fusing-point.

(7) Time, nine minutes; temperatures, 70°–135° fusing-point.

Specimen 2, slightly less fusible; same dimensions as in (4).

(8) Time, six minutes; temperatures, 45°–138° fusing-point.

(9) Time, seven minutes; temperatures, 45°–142° fusing-point.

Specimen 3, byerlyte.

(10) Time, twelve minutes; temperatures, 30°–174° fusing-point.

(11) Time, eleven minutes; temperatures, 40°–175° fusing-point.

A series of fusing-points were taken in a bath maintained at a constant temperature, approximately 180°. In all the following determinations the specimens were one inch in length:

(12) Same material as in (1); time, six minutes; temperatures, 40°–130° fusing-point.

(13) Specimen 4, soft byerlyte; time, three minutes; temperatures, 20°–95° fusing-point.

(14) Same starting with cold bath; time, five minutes; temperatures, 20°–95° fusing-point.

(15) Same as (13); time, five minutes; temperatures, 35°–95° fusing-point.

Specimen 5, very hard, nail made no impression.

(16) Starting with cold bath; time, ten minutes; temperatures, 40°–142° fusing-point.

(17) Same as (16); time, eight minutes; temperatures, 50°–145° fusing-point.

(18) Same as (16) and (17), bath at 180°; time, four minutes; temperatures, 45°–143° fusing-point.

Specimen 6, gilsonite; hard, slightly indented with nail.

(19) Time, three minutes; temperatures, 55°–100° fusing-point.

Same starting with cold bath:

(20) Time, four minutes; temperatures, 20°–97° fusing-point.

Same, cold bath:

(21) Time, four minutes; temperatures, 35°–98° fusing-point.

Specimen 7, byerlyte, hard, indented with nail.

(22) Bath, 230°–240°; time, seventeen minutes; temperatures, 50°–217° fusing-point.

(23) Time, sixteen minutes; temperatures, 30°–214° fusing-point.

Specimen 8, gilsonite, brittle.

(24) Bath, 180°; time, seven minutes; temperatures, 25°–150° fusing-point.

(25) Time, six minutes; temperatures, 30°–147° fusing-point.

Specimen 9, Trinidad asphalt, very brittle.

(26) Bath, 180°; time, three minutes; temperatures, 30°–105° fusing-point.

(27) Time, four minutes; temperatures, 40°–103° fusing-point.

Specimen 10, Egyptian asphalt, very brittle.

(28) Bath, 180°; time, three minutes; temperatures, 45°–91° fusing-point.

(29) Time, four minutes; temperatures, 25°–90° fusing-point.

Specimen 11, hard pitch, brittle.

(30) Bath 180°; time, three minutes; temperatures, 30°–93° fusing-point.

(31) Time, three minutes; temperatures, 50°–92° fusing-point.

The substances tested in this examination differ widely as shown above in appearance and structure. Some are very brittle, others are tough and sectile. It is interesting to note that the brittle specimens have much lower fusing-points. In preparing the specimens from the sectile products it is easy to cut the section with a knife. The easier way to prepare specimens from the brittle bodies is to melt a portion and pour the proper amount into a mold of wood or metal.

Evidently the fusing-points are entirely arbitrary, depending on the size of the constants, so that by varying these constants any desirable fusing-points may be obtained. But it is quite clear from the results we have obtained that the fusing-points obtained with any constants adopted may be depended on.

The use of a hot bath as shown above gives the same values, and it saves much time where a large number of specimens may have to be tested.

Inspection of the results given above shows that the variation in fusing-points is not more than two or three degrees at most, and for the most part there is no variation. Probably by close attention to details there need not be a variation of more than one degree. But the variations of two or three degrees is sufficiently accurate for practical application, especially as compared with determination, such as that alluded to above, in which the specimen is melted on a thermometer bulb.

With reference to the dimensions of the specimens, evidently the length of the proportion projecting on either side of the support must not vary; but any slight variation in the thickness or the width does not affect the results. It is also evident that the time between the initial and fusing temperatures need not be rigidly adhered to.

For the determinations of fusing-points above the boiling-points of liquid baths, an air-bath must be used.