Softening Point of Asphalts and Tar Pitches
(Ring and Ball Apparatus)

Lab Experiment #6

Submitted to:

Matthew Church

CE 361: Highways Materials Laboratory

Prepared by:

Christopher M. Smemoe
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Brigham Young University
Provo, UT 84602

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II. Results

Table 2.1-Data from the ring and ball softening point test depicting the softening points of each test, the mean softening point, and the percent from mean.

	Softening Point (degrees F)
Group 1 (our sample):	92
Group 2:	99
Mean softening point:	95.5
Percent from mean:	3.66%

*Percent from mean = 100 X (1-(softening point of our sample/average softening point))

The softening points of experimental asphalts from groups 1 and 2 were averaged, and the percent from mean was calculated to be 3.66% according to the above equation. The softening point of the tested specimen was found to be 92 F.

III. Discussion

Procedure

Figure 3.1-Ring and ball softening point test (from ASTM, 1978, D36-76)

Figure 3.1 depicts the ring and ball apparatus used for the softening point test. In this study, the Ring and Ball Apparatus was used to study the consistency and softening point of an asphaltic material. After preparing the brass plate with petroleum jelly and placing the ring on the plate, the asphaltic material was warmed over a Bunsen burner until it liquefied enough to pour into the ring. The material was then allowed to cool. The specimen and ball were then placed in a water bath cooled to approximately 41 F.

After sufficient cooling had occurred, the specimen in the brass ring was placed on the testing apparatus. The cooled steel ball was placed on top of the specimen and the water bath was heated with a Bunsen burner at a rate of approximately 9 F per minute.

As the water bath was heated, the temperature and properties of the each specimen tested were closely observed. As the temperature raised, the asphalt cement softened. Eventually the asphalt cement reached a temperature at which the asphalt softened sufficiently to dip down to the brass plate below it.

The temperature at which the specimen softened sufficiently to reach the brass plate below it (being weighted down by the ball) was recorded as the *softening point*. The softening point obtained for this test was found to be 92 degrees Fahrenheit.

Answers to "Observations and Discussion"

1. Why is it necessary to use freshly boiled distilled water in this test?

The use of freshly boiled water is essential to proper test procedures. If freshly boiled, distilled water is not used, air bubbles will form on the specimen and effect the results.

In addition, accumulation of precipitates from "hard" water which has not been distilled may effect the results of the softening point test.

2. Why must the temperature of the bath be raised at a uniform specified rate?

The temperature of the bath must be raised at a uniform, specified rate so the results from the softening point for the same material will be universally equal. The specified rate of heating for this test is 9 F per minute.

If a higher rate of heating is used, the rate of heating of the water will be much faster than the rate of heating of the solid asphaltic material, causing a higher temperature reading at the softening point than what the actual temperature of the material is.

But if a rate of heating lower than 9 F per minute is used, the softening point of the asphaltic material may be lower than if the test was conducted at a rate of heating of exactly 9 F per minute.

In addition, the uniform rate of heating at 9 F per minute will more accurately measure the susceptibility of the asphalt to temperature changes when the material is used under a uniform rate of heating in the environment. From the knowledge of a uniform rate of heating, the displacement of the specimen with respect to change in temperature (dy/dT) can also be determined. This value was calculated based on the assumptions that the brass plate was 1 inch below the specimen and that the specimen deformed at a constant rate. The actual rate of deformation will be more of an exponential deformation than a linear deformation, but the displacement of the specimen with respect to time is still a useful quantity. dy/dT was found to be .02 inches per degree Fahrenheit raised.

Thus, the only accurate method of determining the exact softening point of a material is to heat it uniformly at the specified 9 F per minute.

3. Discuss the value of this test.

The softening point test may be used in the following ways:

1. In conjunction with the penetration test, the softening point test may be used to determine the susceptibility of a blown asphaltic material to a change in temperature. The penetration values and softening point values of an asphaltic material may be combined to create an idea of how the material would behave under road temperature changes.

2. In addition, the softening point of a material may be useful in selecting asphalts to be used in applications where a thick film is needed, such as in crack fillers. (Budge, *Experiment No. 6*, page 1).

Uses of the test

The ring and ball apparatus is used to determine the softening point of bituminous materials. The softening point, combined with the penetration value, is used to determine the consistency of asphaltic materials. By testing the consistency of asphaltic materials, the grade and properties of asphaltic materials may be determined. The determination of consistency before delivering asphaltic materials to the end user is essential. In addition, highway agencies may use the ring and ball test to determine the consistency of asphaltic materials before applying bituminous mixtures to road surfaces.

Advantages/Disadvantages

Advantages:

The results of the ring and ball softening point test are useful in determining the consistency of asphalts at specific temperatures. The results are particularly useful in determining the type of asphalt to be used in crack fillers, because the consistency of crack fillers is dependent on temperature change.

Disadvantages:

First, the ring and ball softening point test is a long test in which all steps of the procedure must be carefully controlled. The constant temperature increase of 9 F per minute is essential in order for the results to be reproduced. Due to its complexity and relatively small number of uses, the ring and ball test may only be used when the performance of an asphaltic material under temperature changes are required.

Possible Errors

The following errors may have resulted while performing the ring and ball test:

1. The water used in the test may have had some impurities in it (from the ice used for cooling) which caused air bubbles and solids to form on the asphaltic specimens, effecting the results.

2. The rate of temperature increase varied throughout the test, from a value approximately 4 F/min. to 9 F/min. This variable rate of heating, which was below the specified 9 F/min., caused results which may not be accurate. The ASTM guide (1978, D 36-76) specifies that the rate of temperature increase must be kept within +/- 0.9 F of 9 F/min., or the results from the test must be rejected.

3. Drafts throughout the laboratory may have resulted in variations in temperature throughout the water medium, causing inaccurate temperature readings.

4. When preparing the specimen for the ring and ball test by distillation, less volatile material was distilled from the cutback than from a comparable specimen. The tested asphaltic material may have had a lower specific gravity than it should, resulting in a low softening point. This phenomenon is depicted in the results by comparing the softening point of the specimen from group 1 to the specimen from group 2. From an average of the softening point of the specimens, the percent from the mean was calculated to be 3.66%. (See ***Results, table 2.1***).

Limitations of this Lab

The ring and ball softening point is limited to determining a temperature at which the specimen deforms enough to reach the brass plate below it. A specific determination of consistency cannot be obtained, as in the penetration or kinematic viscosity tests.

IV. Conclusions

Properties of the paving material

The bituminous material tested consisted of residue from the distillation test of an MC-250 asphaltic cutback. From the ring and ball softening point test, the paving material was found to have a relatively low softening point, of 92 F. This softening point indicates that the material, when combined with aggregate and used for pavement, may undergo significant deformations when subjected to high temperatures, particularly those above 92 F. In addition, the *average* deformation of the asphalt cement throughout the duration of the test was calculated to be .02 inches/min.

However, the softening point obtained in the laboratory may not be representative of the true softening point of the material. Errors in testing may have resulted such as improper distillation techniques and a rate of increase in temperature which was below the specified limit. The percent from mean was calculated to be 3.66%. And the softening point of 92 F was 7.1% lower than the softening point of 99 F found by group 2 for the same asphaltic material.

Engineering Significance of this lab

The deformation and susceptibility of an asphaltic material caused by increases in temperature may be determined by the ring and ball softening point test. In this lab, it was determined that the asphaltic material tested may undergo significant deformations if temperatures above the softening point of the material (92 F) are applied to the specimen.

When using this material for a pavement or crack filler application, areas with high temperatures must be avoided, or deformations may occur in the pavement or crack filler, causing possible failure.

V. Appendix

The following books were used for reference:

American Society for Testing and Materials. ***1978 Annual Book of ASTM Standards.*** Part 15. American Society for Testing and Materials, 1978.

Garber, Nicholas J. and Lester A. Hoel. ***Traffic and Highway Engineering.*** West Publishing Company, 1988.

Calculations and Data on Next Page.