ASPHALT BINDER CONTENT DETERMINATION OF ASPHALT MIXTURES BASED ON THE MAXIMUM SPECIFIC GRAVITY

1. SCOPE:

1.1. This method describes the procedures for calculating the asphalt binder content (AC) of an asphalt mixture based on the maximum specific gravity (G_{mm}) of that mixture.

1.2. Much of the terminology and many of the formulas presented in this method are from portions of *Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types*, Manual Series No. 2 (MS - 2), Sixth Edition, and *Superpave Mix Design*, Superpave Series No. 2 (SP - 2), 1996 Printing, from the Asphalt Institute.

2. SIGNIFICANCE AND USE: This method is one of a group of approved means of determining the AC of asphalt mixtures. Other means include Kentucky Method (KM) 64-405, *Extraction of Binder From Asphalt Paving Mixtures*; KM 64-436, *Asphalt Binder Content Determination of Asphalt Mixtures by Plant Recordation*; KM 64-437, *Asphalt Binder Content Determination of Asphalt Mixtures by the Nuclear Asphalt Content Gauge (NACG)*; or AASHTO T 308, *Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method*. Use KM 64-438 for acceptance, process-control, or informational testing.

NOTE 1: The suitability of this method is directly dependent upon the *uniformity*, specifically the specific gravity and absorption, of the given aggregate. When the characteristics of the aggregate are significantly variable, do not use this means of AC determination for acceptance purposes.

3. PROCEDURE:

3.1. At the end of the "set-up" period, furnish the Department with two G_{mm} samples. Make these samples from "hand-mixed," not plant-mixed, material. Ensure the samples represent the mixture for the project. Batch the sample: (1) by proportioning the hot-bin material from batch plants; (2) by proportioning the stockpile or cold-feed materials (for all types of plants); (3) by obtaining a composite belt-cut sample after the aggregates have passed over the scalping screen; or (4) from plant-run aggregates. Batch the sample to the actual gradation and AC at which the mixture is reported as acceptable (either from the original mix design report or a revised report issued after the "set-up" period). Ensure each "hand-mixed" sample conforms to the minimum sample sizes in AASHTO T 209, *Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures*.

3.2. After receiving the aforementioned two samples, the Department will determine the G_{mm} of each sample according to T 209. The average of these tests, provided the values are reasonably similar (within ± 0.015 of each other), will then be the target G_{mm}. If the two individual G_{mm} values do not compare within this tolerance, the next step in the effort to establish a target G_{mm} will be at the discretion of the Department. Some possible actions include a request to the Superpave Plant Technologist (SPT) for additional samples, comparison to G_{mm} analyses performed on plant-produced mixture, or reference to earlier laboratory or field verification data from a similar mixture.

3.3. Using these values for G_{mm} (obtained from the samples produced by the SPT and tested by the Department) and AC (obtained from the original or revised mix design report), calculate an effective specific gravity of the aggregate, that will remain constant, using the following formula:

$$G_{se} = \frac{P_{mm} - AC}{\frac{P_{mm}}{G_{mm}} - \frac{AC}{G_b}},$$

where: G_{se} = effective specific gravity of the aggregate;
P_{mm} = total loose mixture, percent by total weight of the mixture = 100;
AC = asphalt content, percent by total weight of the mixture;
G_{mm} = maximum specific gravity of the mixture; and
G_b = specific gravity of the asphalt (normally 1.03).

3.4. After defining the G_{se}, use the results of the sublot's G_{mm} samples to calculate that particular sublot's AC by using the following formula:

$$AC = \frac{100\left(\frac{G_{se}}{G_{mm}} - 1\right)}{\frac{G_{se}}{G_b} - 1}.$$

3.5. Unless the test sample is completely free of moisture, determine the moisture content according to KM 64-434, *Determination of Moisture Content in Asphalt Mixtures (Rapid Field Test)*, and make a correction to the calculated AC to compensate for the moisture.

3.6. The G_{se} will remain constant for the particular mixture and production period. Any change in the aggregates composing the mixture may result in a change in that mixture's G_{mm} value, which in turn will change the G_{se} constant. Therefore, when an appreciable change in the aggregate (e. g., different gradation, specific gravity/absorption, etc.) occurs, repeat the process outlined in Subsections 3.1 through 3.3 of this method, and define a new G_{se} constant.

4. EXAMPLE:

4.1. For example, after the "set-up" period, two G_{mm} samples, produced by the SPT and analyzed by the Department, yield 2.489 and 2.485, with an average of 2.487. The AC specified in the mix design report is 5.0 %. Using these two values, calculate the G_{se} as follows:

$$G_{se} = \frac{P_{mm} - AC}{\frac{P_{mm}}{G_{mm}} - \frac{AC}{G_b}} = \frac{100 - 5.0}{\frac{100}{2.487} - \frac{5.0}{1.03}} = 2.687.$$

4.2. Next, to represent a given sublot of material, obtain two G_{mm} samples to determine the AC. The average of the samples is 2.491. Determine the AC of the sublot as follows:

$$AC = \frac{100\left(\frac{G_{se}}{G_{mm}} - 1\right)}{\frac{G_{se}}{G_b} - 1} = \frac{100\left(\frac{2.687}{2.491} - 1\right)}{\frac{2.687}{1.03} - 1} = 4.9\,\%.$$

4.3. Finally, correct the calculated AC for moisture as described in Subsection 3.5 of this method.

4.4. Refer to the worksheet attached to this method for calculating the AC based on the G_{mm}.

4.5. When supplied with the proper information (the results of the "hand-mixed" G_{mm} samples and the AC at which those samples were produced), the *Asphalt Mixtures Acceptance Workbook* (AMAW) will automatically calculate the AC of each sublot based on the G_{mm} results from the volumetric analysis for that sublot.

APPROVED _____
DIRECTOR
DIVISION OF MATERIALS

DATE 02/21/08

~~APPROVED _____~~
~~Director~~
~~Division of Materials~~
~~DATE 1/15/03~~

WORKSHEET FOR
AC DETERMINATION OF ASPHALT MIXTURES BASED ON G_{mm}
(to be used in conjunction with KM 64-438)

County: _____ Date: _____

Project Number: _____

Contractor: _____ Location: _____

Sampled by: _____Tested by: _____

1. Target G_{mm}: _____ ***(from "hand-mixed" samples)***

2. AC (%): _____ ***(from original or revised report)***

3. Target G_{se}:

$$G_{se} = \frac{100 - AC}{\frac{100}{G_{mm}} - \frac{AC}{1.03}}$$

Target G_{se} = _____ as calculated from the formula above.

4. AC determination from sublot's G_{mm} samples:

$$AC\,(\%) = \frac{100\left(\frac{G_{se}}{G_{mm}} - 1\right)}{\frac{G_{se}}{1.03} - 1}$$

G_{se} is determined in Step 3.

Sample Number	G_{mm}	AC (%)