

DETERMINATION OF ADDITIVE OR ASPHALT BLEND REQUIRED FOR MODIFICATION OF ASPHALT VISCOSITY

(An Arizona Method)

Scope

1. This procedure is applicable to the modification of asphalt viscosity by the use of additives or blending asphalts. Section 4 is used in the determination of additive quantities. Methods for determining emulsified additive quantities and also spread rate in gallons per square yard for spray applications are provided. Section 5 is used in the blending of asphalts.

Apparatus

2. The apparatus shall consist of the following:

(a) The apparatus as listed in AASHTO T 202 - "Absolute Viscosity of Asphalts".

(b) The apparatus as listed in AASHTO T 201 - "Kinematic Viscosity of Asphalts", when additives are used.

(c) The apparatus listed in either AASHTO T 227 - "Density, Specific Gravity or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method" or AASHTO T 228 - "Specific Gravity of Semi-Solid Bituminous Materials" (refer to paragraph 4 (b)), when additives are used.

(d) The apparatus as listed in AASHTO T 59, Section 13 - "Testing Emulsified Asphalts (Residue by Evaporation)", shall be required when testing with emulsified additives.

Sample Preparation

3. (a) Samples of the materials to be used shall be obtained according to AASHTO T 40 - "Sampling Bituminous Materials".

(b) Sufficient amount of additive residue shall be obtained by ARIZ 504 - "Vacuum Recovery of Asphalt Emulsion Residue", when emulsified additives are used.

(c) In the case of modifying asphalt in existing bituminous mixtures, the asphalt shall be recovered from a sample of the mixture according to ARIZ 413 - "Extraction of Asphalt from Bituminous Mixtures by Soxhlet Extraction" and ARIZ 511 - "Recovery of Asphalt from Extraction Solution".

Procedure (For determination of additive quantities)

4. (a) When using emulsified additives, the percent residue shall be determined by use of AASHTO T 59. (Percent of residue may also be determined by heating 5 gram samples in accordance with ARIZ 512 - "Residue by Evaporation". In case of dispute AASHTO T 59 shall be used.

(b) The absolute viscosity of the asphalt to be modified is determined by AASHTO T 202. The kinematic viscosity, centistokes at 140° F., of the additive (residue if using emulsified additive) shall be determined by AASHTO T 201. The specific gravity shall be determined by AASHTO T 227 (for materials with maximum viscosity of 5000 centistokes) or AASHTO T 228 (for materials with viscosities above 5000 centistokes). The absolute viscosity of the additive (or residue), in poises, is then determined by multiplying the kinematic viscosity by the specific gravity and dividing by 100.

(c) By reference to the chart in Figure 1, the quantity of additive required to modify the viscosity to a desired level may be determined. The absolute viscosity of the asphalt to be modified is found on the left side of the chart. The viscosity of the additive is found on the right side of the chart. A line is drawn between the two points. The desired viscosity of the modified asphalt is found on the chart and by following a straightedge horizontally, the line will be intercepted. From this intercept a vertical line to the bottom of the chart will indicate the percent of additive required as a percentage of the total binder (by weight). An example is shown in Figure 1 for the following data:

1) Absolute viscosity of the asphalt to be modified = 34,000 poises.

2) An emulsified recycling agent has been selected to be used as the additive. It has been determined that the residue has an absolute viscosity of 5 poises. By AASHTO T 59 it has been determined that the emulsion has 63% residue.

3) By following the instruction above, the amount of additive required is determined to be 22% of the total binder (by weight), for a desired viscosity of 2000 poises.

(d) When emulsified additives are used, the amount of emulsion must be calculated so that the desired percent additive is achieved:

1) Calculate the amount of emulsified additive required, "A_e".

$$A_e = \frac{(100) \times (A_p)}{E_r (100 - A_p)} \times A_a$$

Where: A_a = amount of asphalt to be modified

A_p = percent additive required (From Figure 1.)

E_r = percent of residue in the emulsified additive

Example: (For $A_a = 1200$ tons, $A_p = 22\%$, $E_r = 63\%$)

$$A_e = \frac{(100) \times (22)}{63(100 - 22)} \times 1200 = 537.2 \text{ tons}$$

2) The percent emulsified additive as a percentage of the total binder (by weight), " P_e " may be calculated:

$$P_e = \frac{A_e}{A_e + A_a} \times 100$$

Example:

$$P_e = \frac{537.2}{537.2 + 1200} \times 100 = 30.9\%$$

(e) If an emulsified additive is to be applied by spraying a scarified and recompacted bituminous surface, the required amount of the additive may be calculated in gals./sq. yd. by the following:

1) Determine the density (lbs/cu. ft.) of the material to be scarified by AASHTO T 166 - "Bulk Specific Gravity of Compacted Bituminous Mixtures". (The specimens for testing shall be obtained by coring the existing pavement and then removing the top of core by sawing at the depth of scarification.)

2) Determine the percent asphalt in the portion of the existing pavement to be scarified by ARIZ 413 - "Extraction of Asphalt from Bituminous Mixtures by Soxhlet Extraction" or ARIZ 402 - "Bitumen Content of Bituminous Mixtures by Vacuum Extraction".

3) Determine the weight, in lbs., of bituminous mixture in one square yard of scarification, " W_m ":

$$W_m = (D_m) (9) (D_s)$$

Where: D_m = Density of existing material (lbs./cu. ft.)

D_s = Depth of scarification (in decimal feet)

Example: (For $D_m = 140$ lbs./cu. ft., $D_s = 3/4" = 0.0625'$)

$$W_m = (140) (9) (0.0625) = 78.75 \text{ lbs.}$$

4) Determine the weight of asphalt to be modified in scarified material (for one square yard), " A_a ":

$$A_a = (W_m) (P_s)$$

Where: P_s = percent asphalt in existing material (expressed as a decimal)

Example: (For $P_s = 5.5\% = 0.055$)

$$A_a = (78.75 \text{ lbs.}) (0.055) = 4.33 \text{ lbs.}$$

5) Determine the weight of emulsified additive in lbs., " A_e ", required to modify the asphalt in one square yard of scarified material:

$$A_e = \frac{(100) \times (A_p)}{E_r (100 - A_p)} \times A_a$$

Where: A_a = amount of asphalt to be modified

A_p = percent additive required (From Figure 1.)

E_r = percent of residue in the emulsified additive

Example: (For $A_p = 22\%$, $E_r = 63\%$)

$$A_e = \frac{(100) \times (22)}{63(100 - 22)} \times 4.33 = 1.939 \text{ lbs./sq.yd.}$$

6) Determine the application rate in gals/sq. yd., " A_r ".

$$A_r = \frac{A_e}{E_w}$$

Where: E_w = weight of emulsion, lbs. per gal.

Example: (For $E_w = 8.33$ lbs./gal.)

$$A_r = \frac{1.939 \text{ lbs./sq. yd.}}{8.33 \text{ lbs./gal.}} = 0.23 \text{ gals/sq.yd.}$$

NOTE: When the additive is to be used on a heater scarified section of existing pavement, the quantity obtained by the above method necessarily assumes that all of the asphalt in the scarified section will be modified by the additive.

Procedure (For Blending Asphalts)

5. (a) The absolute viscosities of the asphalt to be modified and the blend asphalt to be used are determined by AASHTO T 202.

(b) By reference to the chart in Figure 2, the above absolute viscosity of the asphalt to be modified is plotted on the left side of the chart. The absolute viscosity of the blend asphalt is plotted on the right side of the chart. A line is drawn which connects the two points. The desired viscosity of the modified asphalt is found on the chart. By following a straightedge horizontally, the line will be intercepted. From this intercept a vertical line to the bottom of the chart will indicate the percent of blend asphalt which is required as a percentage of the total binder (by weight). An example is shown in Figure 2 for the following data (The nomograph used in Figure 2 is the same as in Figure 1, but to illustrate the procedure for blending asphalts a separate chart is used.):

1) Absolute viscosity of the asphalt to be modified = 16,000 poises.

2) Absolute viscosity of the blend asphalt = 1,000 poises.

3) By following the instructions above, the amount of blend asphalt required is determined to be 44% of the total binder (by weight), for desired viscosity of 4,000 poises.

Precision

6. The use of this procedure will generally yield close approximations in achieving the desired modified viscosity. A trial mix should always be made to check the actual viscosity.

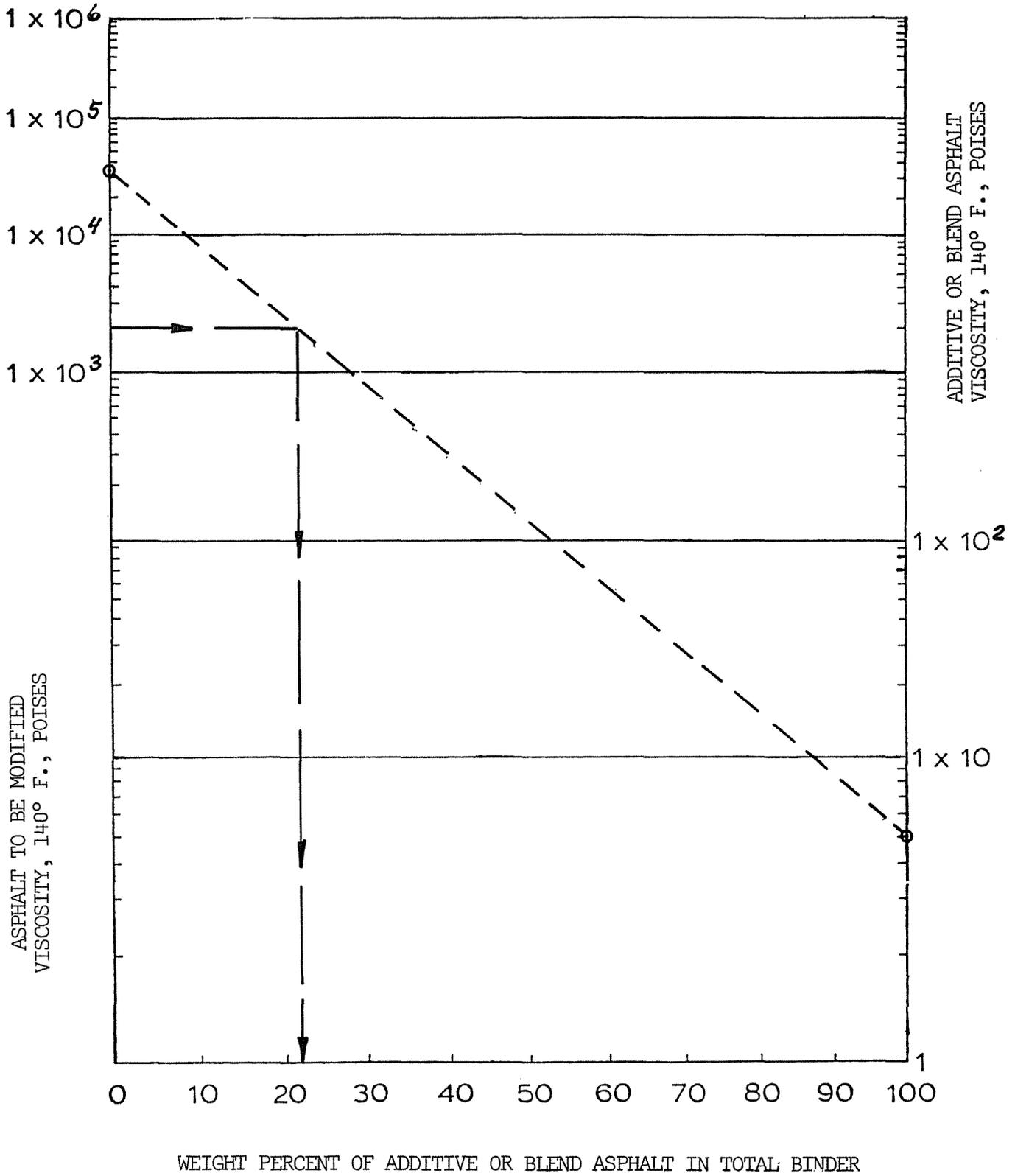


FIGURE 1

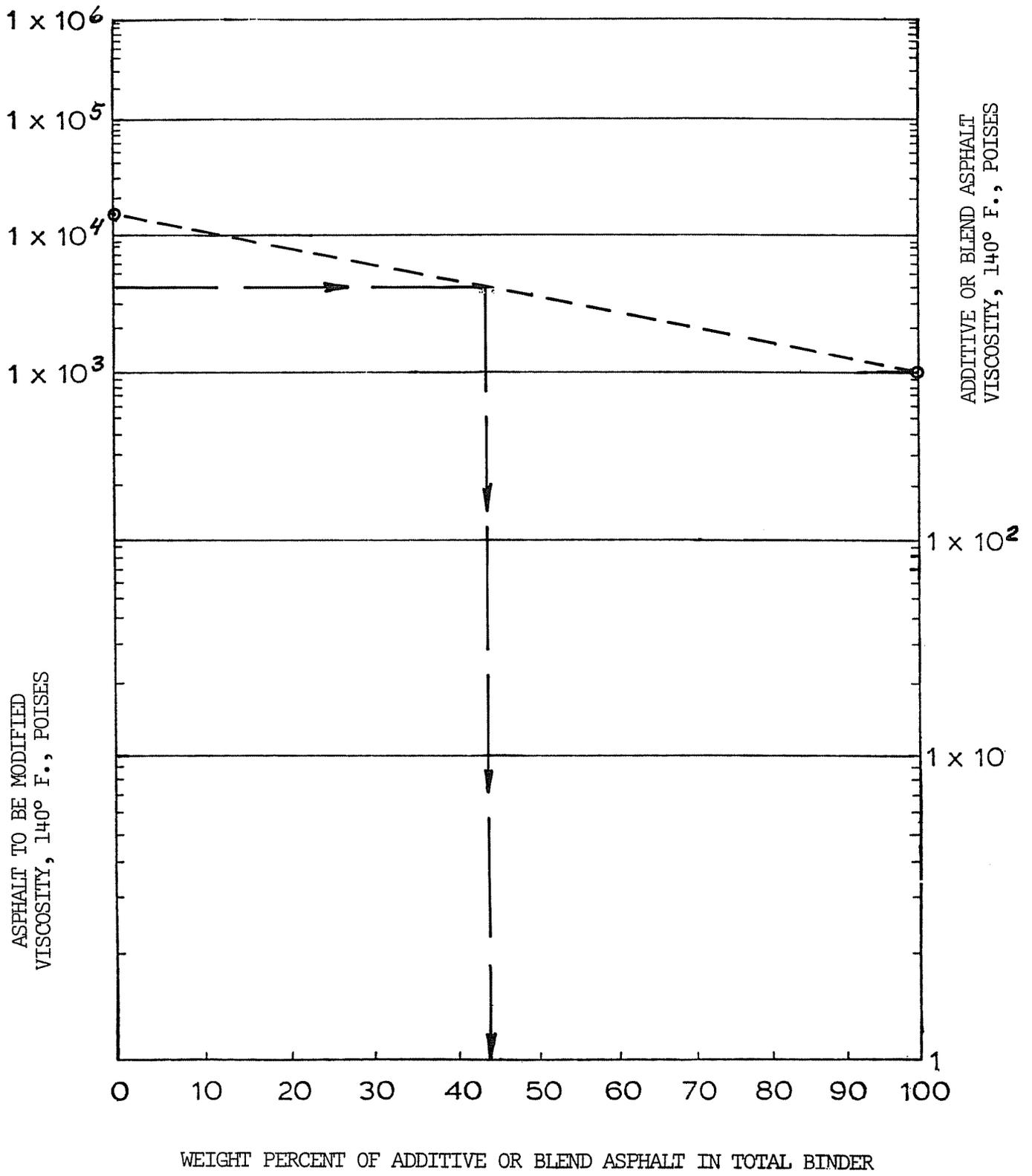


FIGURE 2