Colorado Procedure – Laboratory 5140-15

Standard Method of Test for

Mix Design for Hot In-Place Recycling of Asphalt Pavements

1. SCOPE

1.1 This procedure is used to determine the properties of an asphalt pavement to be hot in-place recycled, the amount of rejuvenating agent to be used in hot in-place recycling, and to design the hot in-place recycled mix.

2. APPARATUS

2.1 *Vacuum extractor* capable of performing AASHTO T 164, Method D.

2.2 *Distillation equipment* required to perform AASHTO R 59, Recovery of Asphalt Binder from Solution by Abson Method.

2.3 Asphalt binder test equipment required to perform penetration at 77˚F (AASHTO T 49) and viscosity at 140˚F (AASHTO T 202).

2.4 Mix design test equipment required to perform CP 51, CP 44 and CP-L 5106, CP-L 5109, and CP-L 5115.

2.5 *Two ovens*, one capable of maintaining a temperature of 60˚C (140˚F) forced draft and another capable of maintaining a temperature of 135˚C (275˚F).

2.6 *Balance*, 5 kg capacity; accurate to 0.1 gram.

2.7 *Sieves*, U.S. Standard sizes: 1 in., 3/4 in., 1/2 in., 3/8 in., Nos. 4, 8, 16, 30, 50, 100, and 200.

2.8 *Sample splitter* for aggregates, 1 in., riffle type.

2.9 Appropriate *sample pans* and *tools* needed for the above procedures.

3. MATERIALS

3.1 Rejuvenating Agents; ARA, ARA-1, or grades specified in ASTM D 4552.

3.2 Samples of pavement to be recycled. Approximately 50 pounds of each pavement type will be required.

4. PREPARATION OF SAMPLES

4.1 Obtain properties of existing pavement using core samples taken from each separate pavement type to be recycled. Trim cores to the proper depth so that only the portion to be recycled is used for testing.

4.1.1. For each separate pavement type, perform AASHTO T 164 and AASHTO R 59, Recovery of Asphalt Binder from Solution by Abson Method to determine asphalt content, gradation of aggregate, penetration (77˚F) and viscosity (140˚F) of the existing binder.

4.1.2 Reheat and breakup sufficient material from cores to measure the maximum specific gravity of the mix, Hveem stability, voids, and effective VMA of the existing pavement using the appropriate end-point pressure for the road to be recycled. The effective VMA will be higher than the bulk VMA normally reported in CDOT test reports.

4.1.3 Determine the tensile strength ratio of the existing pavement according to CP-L 5109 using reheated and remolded roadway samples.

5. RECOMMENDATION

5.1 For design purposes, the stiffness of the recycling agent should be the same as regular HMA (0.44).

6. DETERMINING THE BINDER FOR THE NEW MIX

6.1 Determining the amount and type of rejuvenating agent to be used.

Using the test results from the existing HMA; the penetration or viscosity of binder, percent binder and aggregate, and gradation of aggregate.

Calculate the asphalt demand of the old pavement using the following formula:

$$P = \frac{4R + 7S + 12F}{100} \times 1.1$$

Where:

P = Total % asphalt required in recycled mix, (old asphalt + rejuvenating agent)
R = Rock (retained on #8 sieve),
S = Sand (passing #8 sieve; retained on #200),
F = Fines (passing #200 sieve).

The following nomographs may be used to predict the penetration and viscosity of the resulting mix of binder and rejuvenating agent. If they are not close to the desired results, a different viscosity / rejuvenating agent may need to be specified.

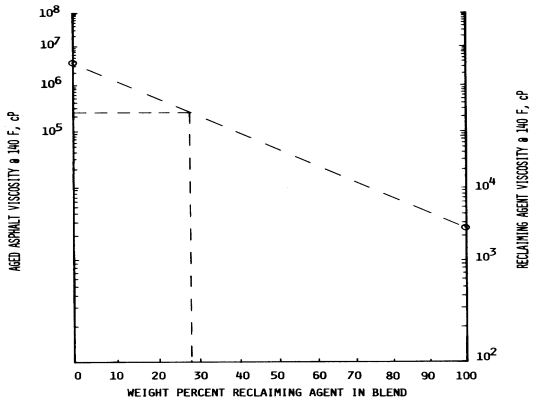


Figure 1, Nomograph for Viscosity.

To use: draw a straight line connecting viscosity of aged asphalt with viscosity of reclaiming agent, draw a vertical line up from the percent reclaiming agent in blend. The two lines intersect at the predicted approximate viscosity of the recycled asphalt.

6.2 An alternate method for determining whether the desired result will be obtained in rejuvenation of the aged binder is to treat the roadway material with the appropriate amount of rejuvenating agent, heat the mix for 90 ± 15 minutes at 300°F (149°C) and perform an extraction (AASHTO T 164 Method D) and AASHTO R 59, Recovery of Asphalt Binder from Solution by Abson Method.

This alternate procedure may also be used when virgin aggregate and asphalt cement are added to the recycled HMA. (A minimum of 55 pounds of virgin mix per square yard of pavement is required for most applications)

7. DETERMINING THE AGGREGATE FOR THE NEW MIX

7.1 Determining the amount and type of virgin aggregate and asphalt cement to be added.

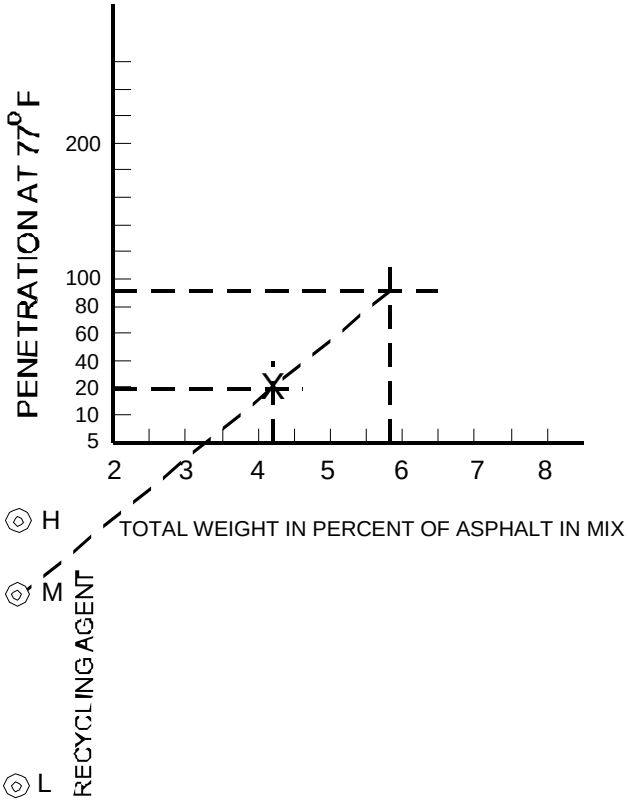
Different amounts and/or gradations of virgin mix may be added to the recycled HMA to bring the final mix to the desired properties specified for the project.

From the original extraction and gradation data of the existing HMA, plot the gradation on a 0.45 power chart to help determine the gradation of virgin mix, which may be needed. Adjust the added mix to optimize the voids, VMA, and stability of the final mix so that it will meet the criteria for the project.

Combined mix may then be tested in the lab according to CP-L 5106, CP-L 5109 and CP-L 5115 to determine if the hot-in-place recycled mix will meet the requirements of the project.

8. REPORTING

8.1 There is no designated CDOT Form used for recording / reporting information for this CP-L.



To use: Enter a point, "X", corresponding to asphalt content and penetration in aged pavement. Draw a straight line from the selected origin,(L- low, M-med, H-high) O, through "X". Intersection of this line with a vertical line representing desired asphalt content of recycled pavement (aged asphalt + recycling agent) gives predicted approximate penetration of rejuvenated asphalt.

Figure 2, Nomograph for Penetration