TEST METHOD T643

BINDER FILM INDEX

REVISION SUMMARY

Date	Clause Number	Description of Revision	Authorised By Gen Mgr Pavements
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TEST METHOD T643

BINDER FILM INDEX

1. Scope

This test method sets out the procedure for the determination of the binder film index of asphalt for both design and production asphalt mixes.

2. Referenced Documents

The following documents are referred to in this test method:

(a)	AS 1141.3	Sampling of aggregates and rock.
(b)	AS 1141.5	Particle density and water absorption of fine aggregate.
(c)	AS 1141.6.1	Particle density and water absorption of coarse aggregate - weighing-in-water method.
(d)	AS 1141.6.2	Particle density and water absorption of coarse aggregate - Pycnometer method.
(e)	AS 1141.7	Apparent particle density of filler.
(f)	AS 2008	Residual bitumen for pavements.
(g)	AS 2150	Hot mix asphalt
(h)	AS 2357	Mineral fillers for asphalt.
(i)	AS 2341.7	Methods of testing bitumen and related roadmaking products. Method 7: Determination of density using a density bottle.
(j)	AS 2891.1	Sampling of asphalt.
(k)	RTA T605	Maximum density of bituminous plant mix.
(l)	RTA T607	Bitumen content and aggregate grading of bituminous mixtures - Reflux method.
(m)	ASTM D4311	Standard Practice for determining asphalt volume correction to a base temperature.
(n)	Hveem, F N	Establishing the oil content for dense graded bituminous mixtures. California Highways and Public Works, First instalment: pp 14-17, July 1942. Second instalment: pp 6-10, August 1942.

3. Definitions

For the purpose of this test method, the following definitions apply:

(a) **Aggregate constituent:** Coarse aggregate, fine aggregate, mineral filler, nominal size aggregate or blend of aggregates.

(b) **Asphalt:** Any type of hot mix asphalt as defined in AS2150

(c) **Binder Film Index:** A measure of the average binder film on the aggregate particles excluding any binder which might be absorbed by the aggregate. BFI is calculated by dividing an estimate of the surface area of the aggregates by the volume of the binder corrected for absorption.

4. Sampling

All materials shall be sampled in accordance with the Australian Standards listed in Table 1:

Type of Material	Australian Standard
Coarse Aggregate	AS 1141.3
Fine Aggregate	AS 1141.3
Mineral Filler	AS 2357
Bitumen	AS 2008
Asphalt	AS 2891.1

Table 1

5. Procedure

5.1. During Design

(a) Determine the proportion of each aggregate constituent by percentage of mass of the combined mineral aggregate.

(b) Determine the densities of all aggregate constituents in tonnes per cubic metre, in accordance with the following test methods:

Coarse aggregate: Dry particle density; in accordance with AS 1141.6.1 or 1141.6.2

Fine aggregate: Dry particle density, in accordance with AS 1141.5

Mineral filler: Apparent particle density, in accordance with AS 1141.7

Note: The particle density of each aggregate constituent may be obtained from relevant test certificates provided by the supplier. Test certificates must be issued by a NATA registered laboratory.

(c) Determine the design density of binder (ρ_b) in accordance with AS 2341.7.

Note: The design density of the binder may be obtained from a relevant test certificate provided by the supplier if in accordance to Clause A4 of AS 2008. This test certificate must be issued by a NATA registered laboratory. The density of the binder in accordance with AS 2341.7 is reported at 15°C. Multiply this value by the correction factor of 9.937×10^4 to calculate the density of the binder at 25°C in tonnes per cubic metre. For other temperatures refer to ASTM D4311.

(d) Determine the design particle density of the combined mineral aggregate (ρ_a) in tonnes per cubic metre, using the proportions and densities obtained in steps (a) and (b) respectively and using the equation given below:

$$\rho_a = \frac{100}{\sum \frac{P_i}{G_i}}$$

where
P_i = Proportion of each aggregate constituent, obtained in step (a).
G_i = Density of each aggregate constituent, obtained in step (b).

(e) Manufacture a trial batch of asphalt to determine the design maximum density of the asphalt mix (ρ_{max}), calculated as the mean maximum density of at least three asphalt samples, in accordance with RTA T605.

(f) Determine the design binder absorption (b) of the combined mineral aggregate using the nominated binder content (B_n) in the equation given below:

$$b(\%) = B_n - \rho_b \left[\frac{100}{\rho_{max}} - \frac{(100 - B_n)}{\rho_a} \right]$$

where
B_n = Nominated binder content, in percent by mass of total asphalt mix
ρ_b = Design density of binder at 25°C, obtained in step (c).

(g) Calculate the design Specific Surface Area (*SSA*) in square metres per kilogram, using the nominated particle size distribution and following Hveem's procedure, in accordance with paragraph 6.

(h) Calculate the design Binder Film Index (BFI) in microns, from the following equation:

$$\text{BFI } (\mu m) = \frac{(B - b)}{(100 - B)} \times \frac{1}{\rho b} \times \frac{10^3}{SSA}$$

5.2. During Production

(a) Determine the binder content (B) and the combined particle size distribution of the asphalt production sample in accordance with RTA T607.

(b) Determine the density of binder (ρ_b) at 25°C in tonnes per cubic metre, sampled during production, in accordance with AS 2341.7.

Note: The density of the binder may be obtained from the relevant batch test certificate provided by the supplier if in accordance to Clause A4 of AS 2008. The batch test certificate must be issued by a NATA registered laboratory. The density of the binder in accordance with AS 2341.7 is reported at 15°C. Multiply this value by the correction factor of 9.937×10^{4} to calculate the density of the binder at 25°C in tonnes per cubic metre. For other temperatures refer to ASTM D4311.

(c) Determine the maximum density (ρ_{max}) of the asphalt production sample in tonnes per cubic metre, in accordance with RTA T605.

(d) Determine the particle density of the combined mineral aggregate (ρ_a) of the asphalt production sample in tonnes per cubic metre, using the equation given below:

$$\rho_a = \frac{\rho_{max}\rho_b(100-B)}{100\rho_b - \rho_{max}(B-b)}$$

where

ρ_a = Particle density of the combined mineral aggregate
ρ_b = Density of the binder at 25°C, obtained in step (b)
ρ_{max} = Maximum density of the asphalt sample, obtained in step (c)
B = Binder content of the asphalt sample, obtained in step (a)
b = Design binder absorption, obtained from design step (f)

(e) Determine the Specific Surface Area (*SSA*) in square metres per kilogram, using the combined particle size distribution obtained in step (a) and following Hveem's procedure, in accordance with paragraph 6.

(f) Calculate the Binder Film Index (BFI) in microns, from the following equation:

$$\text{BFI } (\mu m) = \frac{(B-b)}{100-B}\times\frac{1}{\rho_b}\times\frac{10^3}{SSA}$$

6. Specific Surface Area

Hveem's Procedure

(a) Multiply the percentage passing of each sieve (column b) by the appropriate Surface Area Factor given below (column a) and divide the result by 100. The Total Surface Area is the sum of all values in column c.

AS Sieve (mm)	a) Surface Area Factor (m2/kg)	(b) Combined Particle Size Distribution	(c) %Pass × Factor / 100
Max Size	0.41	100	0.41
4.75	0.41		
2.36	0.82		
1.18	1.64		
0.600	2.87		
0.300	6.14		
0.150	12.29		
0.075	32.77		
		Total Surface Area	

(b)

(c) Calculate the Specific Surface Area (*SSA*) in square metres per kilogram by multiplying the Total Surface Area by 2.65 and dividing the result by the particle density of the combined mineral aggregate (ρ_a).

$$SSA = \frac{Total\ Surface\ Area \times 2.65}{\rho_a}$$

7. Report

The following information shall be reported:

(a) Binder Film Index to the nearest 0.1 μm

(b) Density of the binder at 25°C to the nearest 0.0001 t/m^3

(c) Density of the combined mineral aggregate to the nearest 0.001 t/m^3

(d) Binder Absorption to nearest 0.01%

(e) Reporting Stage (Design or Production)