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COMMENTARY TO AG:PT/T109 - EASE OF REMIXING OF POLYMER MODIFIED BINDERS

PREFACE

This modified binder test method was developed by the Bituminous Surfacing Research Reference Group on behalf of Austroads. Representatives of Austroads, ARRB Group and the Australian Asphalt Pavement Association have been involved in the review of this test method.

FOREWORD

Polymer modified binders (PMBs) are prepared from mixtures of polymers, additives and bitumen selected to achieve their required properties. Some of these binder systems can segregate leading to variations in measured properties and in some instances significant reductions in desired field performance. For manufacturers and users of PMBs to be confident in their ability to recover their “as manufactured” properties through available mixing protocols, a procedure capable of assessing “ease of remixing” is required. This test method provides a uniform approach to this task based on a well defined mixing protocol established for the laboratory handling of PMBs.

SCOPE

This method describes a procedure for determining whether a PMB can be easily returned to a homogeneous state after subjecting a sample of the PMB to an elevated temperature for a prolonged period. This ease of remixing is assessed by determining any differences in softening point measured for the top and bottom halves of the sample after the sample has been remixed.

Further Development

There are no further plans for the development of this test method.

EASE OF REMIXING OF POLYMER MODIFIED BINDERS

1 REFERENCED DOCUMENTS

The following documents are referred to in this method:

AUSTROADS

AG:PT/T101 Method of sampling polymer modified binders, polymers and crumb rubber.

AG:PT/T102 Protocol for handling polymer modified binders in the laboratory.

QUEENSLAND MAIN ROADS

Q344-1993 Handling and preparation of polymer modified binders.

Q346-1998 Ease of remixing of polymer modified binders.

AS

2341.18 Method 18 Determination of Softening Point (ring and ball method)

2 APPARATUS

The following apparatus is required:

- a. **Soft metal cylindrical treatment container**, such as an aluminium drink can, open at the top and sealed at the bottom. Diameter of the containers shall be 66 ± 2 mm and height 130 ± 5 mm (i.e. 375 mL capacity).
- b. **Tin lid**, of suitable size to fit loosely over the top of the container.
- c. **Drill or punch** or other suitable means for creating a hole in the tin lid.
- d. **Forced convection oven** - able to maintain a temperature of $180 \pm 2^\circ\text{C}$.
- e. **Hotplate, heating block, stirrer and paddle** (AG:PT/T102).
- f. **Spatula**, a flat-bladed, stainless steel spatula with a rounded end, approximate blade length of 150 mm and approximate blade width of 20 mm.
- g. **Sharp knife**.
- h. **Fridge/Freezer** (for sample cooling - domestic unit satisfactory)
- i. **Softening Point apparatus** (AS2341.18).

3 PROCEDURE

3.1 General

PMBs are complex mixtures of polymers and a variety of petroleum products. If handled in accordance with the directions of the suppliers, there should be no significant risk. The hazard of burns with PMBs is greater than with standard bitumens, due to the (normally) higher handling temperatures. It is recommended that notices, describing the action to be taken in the event of bitumen or PMB burns, should be displayed in the laboratory in the areas where bitumen and PMBs are handled. A suitable warning could be as follows:

WARNING: HOT BITUMEN MULTIGRADE & PMBs CAN CAUSE BURNS

The following precautions should be taken when handling bitumen, multigrade or PMBs:

- a. Eye protection, such as safety glasses and/or face shields, shall be worn when handling hot bitumen, multigrade or PMBs.
- b. Heat-resistant gloves, with close-fitting cuffs, and other suitable protective clothing, shall be worn when handling hot bitumen, multigrade or PMBs.
- c. There shall be no smoking while handling hot bitumen, multigrade or PMBs.
- d. While the material is still cold, loosen the lid of the sample container (invert the can and warm the lid, if necessary), or punch a hole in the lid.

3.2 Sample preparation and procedure

Samples for testing shall be provided in accordance with AG:PT/T101 and AG:PT/T102.

- a. Prepare the PMB sample in accordance with AG:PT/T102 and pour the sample into the treatment container, filling it to between 5 mm and 10 mm from the top.
- b. Punch or drill a hole of 3 mm diameter in the tin lid and fit the lid over the top of the treatment container.
- c. Place the treatment container with the PMB sample vertically into the oven set at 180°C.
- d. After 48 hours, transfer the treatment container from the oven to the hotplate and manually stir the contents with the flat-bladed spatula for approximately 10 minutes. Use the spatula in a combination of movements involving rotating and lifting the binder to optimise the mixing process. Mixing should occur at a rate of approximately 100 movements per minute by the blade. Ensure no air is entrained in the process.
- e. Immediately place the treatment container with sample in the freezer for at least one hour to quickly reduce the sample temperature.
- f. Remove the treatment container from the freezer and cut the container and sample horizontally in half using a sharp knife.

- g. Prepare the two halves of the sample for testing using the method described in Appendix A.
- h. Test each sub-sample in duplicate for softening point according to Test Method AS2341.18.

4 CALCULATIONS

Calculate the absolute percentage variation in the softening point results from the top and bottom halves of the sample using the equation:

$$E = \frac{200(T_t - T_b)}{(T_t + T_b)}$$

where

E = Ease of Remixing (%)

T_t = Softening point for top sub-sample (°C)

T_b = Softening point for bottom sub-sample (°C)

5 INFORMATION TO BE REPORTED

Report the following:

- a. Softening point for each half of the sample to the nearest 0.2°C.
- b. Ease of remixing to the nearest 0.5%.

6 PRECISION

The criteria given in AS2341.18 should be observed for each of the duplicate softening point determinations. No precision data exists for the pre-treatment or the measure of Ease of Remixing.

APPENDIX A

TEST SPECIMEN PREPARATION NORMATIVE

The samples prepared in this test method require rigorous and reproducible mixing prior to softening point determinations. The following procedure is based on Queensland Main Roads method Q344-1993 and uses the hotplate, heating block, stirrer and paddle specified in AG:PT/T102.

- a. Heat each of the test samples (2 halves) in the fan forced oven at 180°C until fluid transferring each to a 400 mL beaker for subsequent mixing.
- b. Preheat the heating block (see note A1) to 180°C using the hotplate or fan forced oven.
- c. Place beaker and hot sample in the pre-heated block with hotplate and assemble with mixer and paddle.
- d. Using a low rotational speed, mix the sample until its temperature reaches $180 \pm 5^\circ\text{C}$.
- e. Stir the sample at a speed capable of maintaining an incipient vortex for 60 minutes (see note A2).
- f. Cast each of the softening point moulds while the sample is hot.

Note

A1: The procedure uses a heating block to maintain the sample at the correct temperature throughout the mixing process. Different blocks can be used for different size beakers. This test method uses 400 mL glass beakers for approximately 150 mL of sample.

A2: The combination of stirrer and paddle with an appropriate rotational speed ensures that during the stirring process, the surface of the sample will be on the verge of cavitation. The maintenance of this incipient vortex ensures adequate mixing without the entrainment of air into the sample. Appendix B in AG:PT/T102 provides greater detail on the mixer, paddle and mixing process.

AMENDMENT RECORD

Amendment No.	Clauses amended	Action	Date
1	This method has been developed from Queensland Main Roads test method Q346-1998. No substantive changes have been instituted. The sample preparation protocol has been aligned with the procedures presented in AGPT/T102.	New	July 2001
	Sample cooling requires the use of a freezer and at least 1 hour for the cooling cycle	New	
2	Commentary Page	New	June 2005
	Footer and header	Format	
	Applied revised test method number	Format	
	Applied new styles	Format	
3	New test method number	Substitution	March 2006

Key

Format	Change in format
Substitution	Old clause removed and replaced with new clause
New	Insertion of new clause
Removed	Old clauses removed