

THE DETERMINATION OF THE FOAMING CHARACTERISTICS OF BITUMEN

1. SCOPE

The foaming characteristics of bitumen are defined by the Expansion Ratio and Half Life of the bitumen in its expanded state. The expanded state of the bitumen is achieved when a small percentage of water is introduced into hot bitumen.

The objective is to determine the percentage of water required that will produce the best foam characteristics for a particular source of bitumen. The aim is to produce foamed bitumen with the largest expansion ratio with the longest half-life possible.

2. DEFINITIONS

The expansion ratio is a measure of the viscosity of the foam and provides an indication of how well the binder will disperse in the mix. It is calculated as the ratio of the maximum volume of foam relative to the original volume of bitumen.

The half-life is a measure of the stability of the foam and provides an indication of the rate of collapse of the foam during mixing. It is calculated as the time taken in seconds for the foam to collapse to half of its maximum volume.

3. APPARATUS

3.1 Foamed Bitumen Laboratory Unit, capable of producing foamed bitumen at a rate of between 50g and 200g per second. The method of production shall closely simulate that of full scale production of foamed bitumen on the recycling machine. The apparatus shall have a thermostatically controlled kettle capable of holding a mass of 10kg of bitumen at a constant temperature between the range of 160°C and 200°C, $\pm 5^\circ\text{C}$. The unit shall have an expansion chamber similar to that on the recycling machine in which cold water is injected into hot bitumen. Water injection shall be variable from 0 to 5% (by mass of the bitumen) with an accuracy of 0.25%. The plant shall capable of accurately discharging a predetermined mass of foamed bitumen directly into the mixing bowl of an electrically driven laboratory mixer with a minimum capacity of 10kg.

3.2 Cylindrical metal container, 250mm diameter and at least 20 litre capacity.

3.3 Calibrated Dip Stick, calibrated for the cylindrical metal container with 500g of bitumen as 1 unit measure. Prongs are attached to the dip stick at every 5 or 6 times the unit volume.

3.4 A stop-watch with 60 second dial.

3.5 Heat resistant gloves.

3.6 An electronic balance to weigh up to 10kg, accurate to 1g.



4. METHOD

4.1 Preparation

The foamed bitumen laboratory unit discharge rates are checked in accordance with the manufactures specifications. If the unit is being used for the first time then the pump rate and water flow rates need to be calibrated as per the manufactures specifications. Check that 500g of bitumen is being discharged at the predetermined settings.

Ensure that the cylindrical metal container and dip stick are reasonably clean. Discharge foamed bitumen, at least twice, into cylindrical metal container prior to testing in order to pre-heat the container. Decant excess bitumen from the container into a suitable waste receptacle.

5. Testing

Heat the bitumen in the kettle of the foamed bitumen laboratory unit with the pump circulating the bitumen through the system until the required temperature is achieved (normally starting with 160 °C). Maintain the required temperature for at least 5 minutes prior to commencing with testing.

Set the water flow-meter to achieve the required water injection rate (normally starting with 2 % by mass of the bitumen).

Discharge foamed bitumen into the preheated steel drum for the calculated spray time for 500 g of bitumen. Immediately after the foamed bitumen discharge stops, start a stopwatch. Using the calibrated dipstick measure the maximum height the foamed bitumen achieves in the drum. This maximum volume is recorded as the expansion.

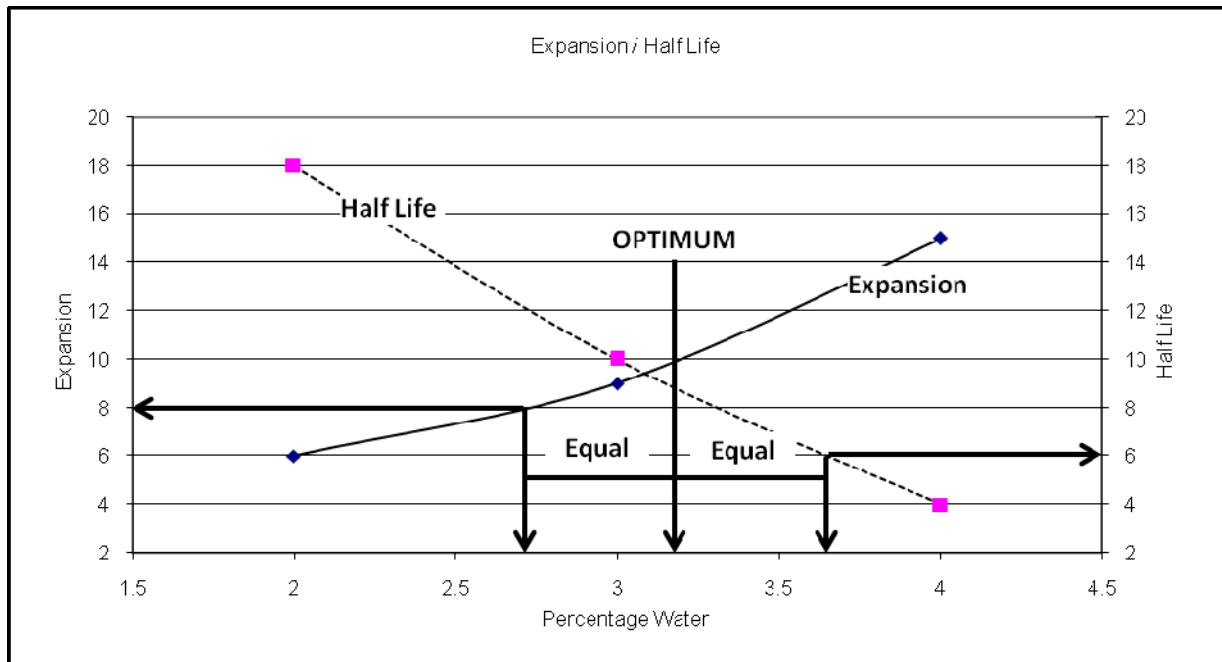
Continue to measure the time in seconds that the foam takes to dissipate to half of its maximum volume. This is recorded as the foamed bitumen's half-life.

Repeat the above procedures three times or until similar readings are achieved.

The expansion and half life are determined at different percentages of water. Typically, values of 2 %, 3 % and 4 % by mass of bitumen are used.

Plot a graph of the expansion ratio versus half-life at the different water injection rates on the same set of axes. The optimum water addition is chosen as an average of the two water contents required to meet the minimum criteria.

If the required properties are not met at 160°C, further testing should be carried out with the bitumen at higher temperatures (typically 170°C and 180°C).



6. Reporting

The foamed bitumen characteristics and optimum water content are reported as;

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| Optimum water content (%) | Percentage by mass of bitumen; |
| Expansion (times) | Ratio of maximum expansion to original volume of bitumen; |
| Half life (sec) | Time taken from maximum expansion to half this volume. |