

TEST METHOD T609

BITUMEN CONTENT AND AGGREGATE GRADING OF BITUMINOUS MIXES ROTAREX METHOD

1. SCOPE

This method sets out the procedure for determining by centrifugal extraction the bitumen content of bituminous mixes containing residual bitumen and subsequently the particle size and distribution of the aggregate by sieve analysis. This method is commonly referred to as the “Rotarex Method”.

2. SAFETY NOTES

Heat resisting gloves or tongs should be used when handling hot bituminous materials. Loosen or puncture lids before heating containers. Solvents such as toluene should be used within a fume cupboard. M.S.D.S. should be consulted before handling any materials.

3. APPARATUS

- (a) Flask, one litre Erlenmeyer type, with approximately 40 mm diameter neck and an additional stopper for sealing the flask during weighing.
- (b) Bitumen extraction machine - Rotarex or similar.
- (c) A heating device, such as a hot plate with adjustable temperature control, and covered with a mat of appropriate material to diffuse the heat evenly.
- (d) Balances, one of not less than 3.5 kg capacity, accurate and readable to 0.1 g and another of 250 g capacity, accurate and readable to 0.2 mg.
- (e) Small metal containers with flat press-over lids, about 60 mL capacity.
- (f) Centrifuge to accommodate tubes of 25 mL capacity.
- (g) Laboratory tongs.
- (h) Australian Standard sieves as required.
- (i) Metal dishes and sieve brush.
- (j) Filter pipe suitable for use with “Rotarex” bowl.
- (k) Spatula
- (l) Toluene, commercial grade.

4. TEST SAMPLE

- (a) Warm the sample just sufficiently, by heating on the hotplate, to loosen the mass of material.
- (b) Reduce the size of the sample by quartering to obtain the following minimum amounts.

Nominal Size of Mix mm	Minimum Mass of Test Sample g
Under 10	600
10 to 20	800
Over 20	1000

DETERMINATION OF BITUMEN CONTENT

5. PROCEDURE

- (a) Determine the mass of the flask with stopper to nearest 0.1 g. Designate as M_1 .
- (b) Dry the sample, if necessary, by standing in a current of air at a temperature between 18°C and 25°C. Determine the mass of the mix to the nearest 0.5 g and transfer it to a “Rotarex” filter bowl. Designate mass of mix as A.
- (c) Add sufficient toluene to cover the test sample to a depth of about 10 mm.
- (d) Allow the test sample to soak for about 5 minutes covered by filter bowl cover plate.
- (e) Lift the filter bowl cover plate and insert filter paper beneath. Secure the whole assembly by screwing down tightly by hand, the hollow flanged fitting to the filter bowl.
- (f) Secure the outer bowl lid to the outer bowl.
- (g) Place the one litre flask at the discharge spout of the outer bowl.
- (h) Adjust revolutions of filter bowl to ensure a steady and constant discharge of toluene bitumen solution. When the discharge has ceased, stop the machine and introduce about 150 mL of toluene to the filter bowl through the hollow flanged fitting.
- (i) Proceed as before until the discharge liquid is clear.
- (j) Remove the one litre flask containing the solution, replace the stopper and determine its mass, designate as M_2 .

- (k) Shake the flask and contents, allow to stand for about one minute and pour a portion of the solvent extract into the two balanced centrifuge tubes and centrifuge to separate out any fine suspended matter.
- (l) Without disturbing the suspended mineral matter, pour the free liquid from the tubes into a small metal container, whose mass M_3 has previously been obtained to the nearest 1 mg. Fit the lid and determine the mass. Designate the mass at M_4 .
- (m) Carefully evaporate the solvent from the container by placing it in its own lid on an insulated wire gauze on the hotplate so that evaporation takes place without boiling.
- (n) When most of the solvent has been evaporated (as evidenced by the formation of an immobile bitumen film), remove the container from its lid and place it on the hotplate proper. Continue the evaporation until the bitumen just begins to fume. During this last stage, manipulate the container with tongs to control the heating and to distribute the bitumen. Allow a faint degree of fuming to continue for 30 seconds.
- (o) Remove the container from the hotplate, fit the lid, allow the container to cool to room temperature and determine the mass to the nearest 1 mg. Designate this mass at M_5 .

6. CALCULATIONS

(a) $B = \text{Total mass of bitumen in test sample} = \frac{(M_2 - M_1) \times (M_5 - M_3)}{(M_4 - M_3)}$

(b) $A = \text{Total mass of test sample} \quad \text{See Procedure (b)}$

(c) $\text{Bitumen content per 100 parts of mix} = \frac{B}{A} \times 100$

7. REPORTING

Report to the nearest 0.1% the bitumen content based on the total mass of the mix.

8. TECHNIQUES

- (a) The time and speed of centrifuging is best determined by experiment. Excessive degree of centrifuging should be avoided, i.e. choose conditions to ensure that the liquid above the suspended material is virtually ash-free. In decanting off the supernatant liquid from the tube it is advisable not to drain off the entire liquid from the residue.
- (b) As the “filler” content, i.e. material passing the 75 μm AS sieve, is obtained by the difference in mass of the theoretical amount of aggregate (A - B) and the mass of aggregate actually retained on the 75 μm AS sieve, care must be taken in the sieving operation to avoid loss of material in the process.
- (c) The actual mass taken for sieving should be noted and accounted for within practical limits, when the masses of fractions are summed.

- (d) A control test should be conducted on a solution in toluene of bitumen of similar grade to that used in the bituminous mix, as a check on technique adopted in *Procedure (m) and (n)*. The result of the control test should agree with the theoretical amount of bitumen within a difference of 1 percent.
- (e) To ensure that an appropriate order of accuracy is obtained in the final result, the portion of solvent extract taken as per *Procedure (k)* should be enough to obtain at least 1 g of bitumen after evaporation of the toluene.
- (f) Two equal volumes should be evaporated to check whether the final evaporation stage is done correctly.

DETERMINATION OF AGGREGATE GRADING

9. PROCEDURE

- (a) Remove the outer bowl lid, unscrew the hollow flanged securing bolt and the filter bowl cover plate.
- (b) Place the bowl containing the extracted material and the covering filter paper on a hot plate in a drying oven.
- (c) Carefully remove any adhering material from the filter paper by brushing it back into filter bowl. Material adhering to the wall of the filter bowl may be eased away by a spatula to accelerate drying.
- (d) Allow the solvent to be thoroughly evaporated.
- (e) Sieve the material on the appropriate size sieves down to the 75 μ m AS Sieve according to the procedure given in Test Method T201, Clause 4.

10. CALCULATIONS

Calculate the cumulative percentage passing successive sieves based on the total mass of aggregate (A-B) in *Determination of Bitumen Content*.

11. REPORTING

Report the cumulative percentage passing each sieve to the nearest whole number excepting for the percentage passing the 75 μ m AS Sieve, which is given to the nearest 0.1 percent.

12. TECHNIQUES

Toluene is highly flammable and toxic. Conduct all operations involving toluene in a well ventilated fume cupboard away from naked flame. Avoid absorption by inhalation, or by skin contact or by splashing in the eyes.

