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Bituminious Mix Testing

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DETERMINATION OF BINDER CONTENT TEST

STANDARD: IS 19008: 2023

This Standard Covers the extraction of bituminous component from paving mixture using trichloroethylene solvent. Then the bitumen content is calculated by difference from mass of extracted aggregate, moisture content and mineral matter in the extract and expressed as mass percent of moisture-free mixture.

APPARATUS:

1. Oven
2. Flat Pan
3. Balance
4. Hot Plate
5. Small-mouth graduate
6. Ignition dish
7. Desiccator
8. Filter paper
9. Extraction apparatus

Reagent:

❖ Trichloroethylene

PREPARATION OF TEST SPECIMEN

❖ If the mixture is not sufficiently soft or separate with a spatula or trowel, place it in a large, flat pan and warm (110 ± 5) °C only until it can be handled or mixed.

❖ Spilt or quarter the material until the mass of material required for test is obtained.

❖ The size of the test sample shall be governed by the nominal maximum aggregate size of the mixture and shall conform to the mass requirement shown in table.

TABLE 1 Size of Sample

Nominal Maximum Aggregate Size Standard, mm	Minimum Mass of Sample, kg
4.75	0.5
9.5	1
12.5	1.5
19	2
25	3
37.5	4

PROCEDURE:

❖ Place a 650 g to 2500 g test portion (W_1) into a bowl.

❖ Determine the moisture content of the sample from the test specimen taken separately and known as weight W_1. A weighed amount of sample dried in an oven at (110 ± 5) °C to constant mass and is known as W_D.

❖ Based on the two weights W_1 and W_D, its moisture content is determined using (W_1-W_D) which known as W_2.

❖ After that cover the sample with trichloroethylene. Let the mixture stand for about 15–20 minutes, but not more than one hour for the solvent to disintegrate the test portion.

❖ Place the bowl containing the test portion and the solvent in the extraction apparatus.

❖ Weigh the dried filter ring and then fit it around the edge of the bowl. Clamp the cover of the bowl tightly.

❖ Place a beaker under the drain to collect the extract.

❖ Start the centrifuge revolving slowly and then gradually the speed is increased to a maximum of 3600 rpm. The speed is maintained till the solvent ceases to flow from the drain.

❖ The machine is allowed to stop, 200 ml of solvent is added and the above procedure is repeated. Use sufficient 200 ml solvent additions (not less than three) are used till the extract is clear and not darker than a light straw color.

❖ Remove the fitter ring from the bowl, dry it first in the air and then in the oven at 110 ± 5°C to a constant weight, and weigh it.

❖ The mass of extracted aggregate, W_3, is equal to the mass of the aggregate in the pan plus the increase in mass of the filter rings.

❖ Record the volume of the total extract liquid in the graduate.

❖ Determine the mass of an ignition dish. Agitate the extract thoroughly and immediately measure approximately 100 ml into the ignition dish.

❖ Evaporate to dryness on a hot plate.

❖ Ash residue at a dull red heat (500 to 600) °C, cool, and 5 ml of saturated ammonium carbonate solution per gram of ash.

- ❖ Digest at room temperature for 1 h. dry in an oven at 100 °C to constant mass, cool in a desiccator, and determine the mass (G).

- ❖ Calculate the mass of mineral matter in the total volume of extract liquid, W_4 as follows

$$W_4 = G \times [\, V_1 / (V_1 - V_2)]$$

Where, W_4 = mass, in g, of mineral matter in the total volume of extract

G = ash, in g, in aliquot

V_1 = total volume, in ml, of liquid extract

V_2 = volume, in ml, after removing aliquot

CALCULATION

Calculate the percentage of binder in the bituminous mix sample as follows:

$$\text{Percentage of Binder} = \frac{[(W_1 - W_2) - (W_3 - W_4)]}{(W_1 - W_2)} \times 100$$

Where, W_1 = mass in g, of test portion taken,

W_2 = mass in g, of water in the test portion

W_3 = mass in g, of extracted aggregate

W_4 = mass in g, of the mineral matter in the total volume of extract.

UTILITY

- ❖ This is a Quality Control Check Test. The Value Obtained shall be Compared with the Designed Value of Binder Content.

-- End of SOP –

DETERMINATION OF MARSHALL STABILITY & FLOW TEST

STANDARD: IS 17127:2019

- ❖ This standard prescribes the method of test for determination of stability, flow and bulk density of bituminous mixes, prepared with bitumen binder and aggregates of nominal maximum sizes 25.4 mm (1.0 in, Method A) and 37.5 mm (1.5 in, Method B).

APPARATUS

1. Specimen Mould Assembly	2. Specimen Extractor
3. Compaction Hammers	4. Compaction Pedestal
5. Specimen Mould Holder	6. Ovens, Heating Pots and Hot Plates
7. Mixing Apparatus	8. Breaking Head
9. Compression Loading Machine	10. Load Measuring Device
11. Flow Meter	12. Water Bath
13. Thermometer	14. Balance

PROCEDURE

PREPARATION OF TEST SPECIMEN

- ❖ A minimum of three specimens of a given mixture shall be prepared and tested.

- ❖ The specimens should have the same aggregate type, quality, and grading; the same mineral filler type and quantity; and the same binder source, grade and amount.

- ❖ In addition, the specimens should have the same preparation, that is, temperatures, cooling, and compaction.

PREPARATION OF AGGREGATE

- ❖ Dry the aggregates to constant weight.

- ❖ Oven drying should be done at 105 to 110 °C

- ❖ After cooling, separate the aggregate by dry sieving into the desired size fractions.

PREPARATION OF BITUMINOUS MIX SPECIMENS

The coarse aggregates, fine aggregates and the filler material should be proportioned and mixed in such a way that final mix after blending has the gradation within the specified range.

- ❖ The aggregates and filler are mixed together in the desired proportion as per design requirements and fulfilling the specified gradation. The required quantity of the mix is

taken as to produce a compacted bituminous mix specimen of thickness 63.5 mm + 2.5 mm approximately.

❖ Approximately 1200 gm of aggregate and filler are taken and heated to a temperature of 175ºC to 190ºC. The compaction mould assembly and rammer kept pre – heated to a temperature of 100 ºC to 145ºC. The bitumen is heated to temp. of 121 to 138 ºC and the required quantity of first trial percentage of bitumen (say 3.5% by weight of mineral agg.) is added to the heated aggregate and thoroughly mixed using a mechanical mixer or by hand mixing with trowel.

❖ The mixing temp. for 80/110 grade bitumen may be around 154 ºC and that for 60/70 grade about 160ºC. The mix is placed in a mould and compacted by rammer, with 75 blows on either side. The compacting temp may be about 138ºC for 80/100 grade bitumen and 149 ºC for 60/70 grade.

❖ The compacted specimen should have a thickness of 63.5 mm. The weight of the aggregate taken may by suitably altered to obtain a thickness of 63.5±3.0 mm. At least two specimens, but preferably three or four specimens should be prepared at each trial bitumen content which may be varied at 0.5 percent increments up to about 7.5 or 8.0 percent.

TEST

Marshall Stability and Flow Values

❖ The specimen to be tested are kept immersed under water in a thermostatically controlled water bath maintained at 60 ºC ± 1 ºC for 30 to 40 minutes.

❖ The sp. Are taken out one by one, placed Marshall test head and the Marshall St. values (max. load carried in kg, before failure) and the flow value (the deformation the specimen under goes during loading in 0.25 mm units) are noted.

❖ The corrected Marshall St. values of each sp. Is determined by applying the appropriate correction factor, if the average height of the sp. is not exactly 63.5 mm.

-- End of SOP --

DETERMINATION OF DENSITY TEST

STANDARD: ASTM D 2726:2021

- ❖ This standard covers the determination of Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.

APPARATUS

2. Weight Balance
3. Fish Line or Wire

PROCEDURE

- ❖ Only specimen that are known to be thoroughly dry are tested in accordance.
- ❖ All other has assumed to contain moisture or solvent and are to be tested in accordance
- ❖ Completely submerge the specimen in the water bath at 25° C for 3 to 5 min.
- ❖ Determine the Mass by Weighing in Water. Designate this mass as C.
- ❖ If the temperature of the water bath by more than 2° C, the specimen shall be immersed in the water bath for 10 to 15 min. instead of 3 to 5 min.
- ❖ Measure the temperature of the water and if different from 25 ± 1° C a correction to the bulk specific gravity to 25°C must be made in accordance.
- ❖ Surface dry the specimen by blotting quickly with a damp cloth towel.
- ❖ Then determine the mass by weighing in air.
- ❖ After determining the mass in water and in a saturated surface by condition, thoroughly dry the specimen to a constant mass at 110 ± 5° C.
- ❖ Determine the constant mass must be sufficient to ensure that all moisture and solvent has been removed.

CALCULATION: -

- ❖ Bulk Specific gravity of the specimen:

$$\boxed{\textbf{Bulk sp gr = A / (B − C)}}$$

Where,

    A: - Mass of the dry specimen in air, g.

    (B – C): -Mass of the volume of water for the volume of specimen at 25°C

    B: -Mass of the saturated surface dry specimen in air g

    C: -Mass of the specimen in water, g

- ❖ The bulk specific gravity of the specimen at 25 deg C can be calculated from bulk specific gravity of the specimen measured at any other temperature as follows.

-- End of SOP --