

Tex-212-F, Determining Moisture Content of Bituminous Mixtures

Overview

Effective date: August 1999 – October 2004.

Part I of this method, a modification of ASTM D 1461, discusses how to determine by direct measurement the moisture content of any type of bituminous paving mixtures.

Part II discusses how to determine the moisture (free and/or absorbed) in aggregates for bituminous mixtures, and in completed bituminous mixtures which have no significant amounts of hydrocarbon volatiles.

Part I, Moisture Content by Distillation

This part discusses how to determine the moisture content of any type of bituminous paving mixtures by direct measurement.

Apparatus

The following apparatus is required:

- ◆ 'Metal Still,' consisting of a vertical cylindrical container, approximately 127 mm (5 in.) in diameter and 152 mm (6 in.) deep with removable lid, heavy fiber gasket or O-ring, and a clamping system. There should be two holes in the lid, each approximately 25 mm (1 in.) in diameter, to provide for entrance of the water trap-condenser assembly and a safety valve
- ◆ moisture trap of 25 mL (0.85 fl. oz.) capacity, graduated in 0.1 mL (0.0034 fl. oz.) divisions and equipped with cork stoppers
- ◆ condenser, Liebig glass-tube type, having a condenser jacket approximately 400 mm (16 in.) long
- ◆ a system of tubing for passing water continuously through condenser
- ◆ loose, clean cotton for plugging the top of the condenser
- ◆ a balance readable to 0.1 g and accurate to 0.5 g
- ◆ hot plate or other satisfactory heating device
- ◆ ring stand with base and clamp
- ◆ pipette with 1 to 10 mL (0.03 to 0.35 fl. oz.) capacity
- ◆ bucket, 4 L (1 gal.), with airtight lid or plastic bag.

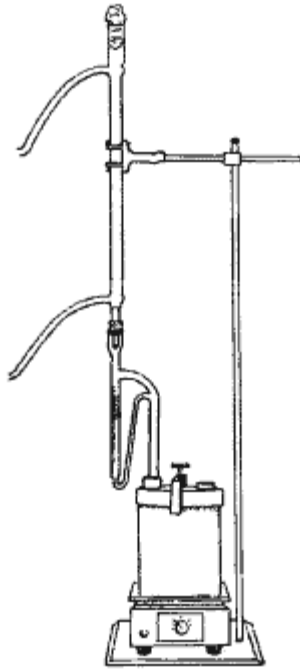


Figure -1. Metal Still.

Materials

The following material is needed:

- ◆ water free gasoline.

Test Record Form

Record test data on Form 9.614, "Moisture and Volatile Worksheet" (9614).

Procedure

The following steps detail determining moisture content of bituminous mixtures.

Determining Moisture Content of Bituminous Mixtures	
Step	Action
1	<ul style="list-style-type: none"> ◆ Obtain a representative sample of the bituminous mixture according to Test Method "Tex-222-F, Sampling Bituminous Mixtures." ◆ Thoroughly mix, breaking up large lumps.
2	Reduce the mixture to laboratory test size by quartering, or by thoroughly blending the material and taking small portions from several places in the pan.
3	Weigh a 500-600 g sample and record to the nearest 0.1 g as X under "Calculations" and on the 'Moisture and Volatile Worksheet' (9614).

Determining Moisture Content of Bituminous Mixtures	
Step	Action
	NOTE: Keep samples in moisture-tight containers at all times.
4	Immediately pour the weighed sample into the still.
5	Add gasoline until the sample is covered to a depth of about 25 mm (1 in.)
6	Place gasket or O-ring on rim of still and firmly fasten the lid with the clamping system.
7	Insert the moisture trap through a rubber stopper in the still lid, making sure the tip extends away from the source of heat, and assemble the condenser as shown in 'Metal Still.'
8	<ul style="list-style-type: none"> ◆ Place a cork or rubber stopper in the other hole as a safety valve. ◆ Minimize evaporation loss by inserting a loose cotton plug in the top of the glass condenser. ◆ Inspect all stoppers regularly to be certain they do not leak.
9	<ul style="list-style-type: none"> ◆ Circulate plenty of cool water continuously through the condenser. ◆ Apply heat at such rate that refluxing will start within 5 to 10 minutes after the heat has been applied and solvent will drip from the condenser at a rate of 85 to 95 drops per minute.
10	Continue distillation until three consecutive readings of the trap at 15 minute intervals show no increase in the amount of water being condensed.
11	<ul style="list-style-type: none"> ◆ If the volume of moisture exceeds the capacity of the trap, stop the distillation, allow the still and trap to cool, record meniscus reading and withdraw 10 or 20 mL (0.35 to 0.7 fl. oz.) of water from the bottom of the trap with pipette. ◆ Check the temperature of the water passing from the condenser and control the flow so that its temperature does not exceed 43 °C (110 °F).
12	Cool the moisture trap and contents to room temperature.
13	Rinse the condenser tube with gasoline to remove any trace of moisture and read the meniscus between the gasoline and water.
14	<ul style="list-style-type: none"> ◆ 'Meniscus' shows an example of a meniscus which reads 10.8 mL (0.365 fl. oz.). ◆ This value, in addition to any water withdrawn from the trap, is the volume of moisture removed from the bituminous mixture.
15	Record the total volume of moisture as V (under 'Calculations'), which is also the weight of the moisture, since the assumption is made that one milliliter of water weighs one gram at room temperature.

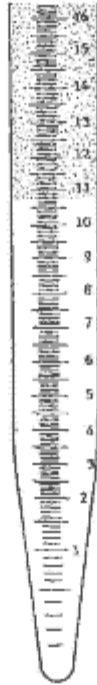


Figure -2. Meniscus.

Calculations

Use the following to calculate percent by weight of moisture in the mixture:

$$\text{Percent Moisture} = \frac{100V}{X}$$

Where:

- ◆ X = Weight (grams) of total sample
- ◆ V = Volume of moisture (milliliters).

Precautions

To maintain a safe working condition:

- ◆ Use care in handling and heating the solvent, and avoid inhaling fumes.
- ◆ Fumes should not escape the still. Escaping fumes indicate a possible fire hazard.
- ◆ Check to see that all connections and the lid on the still are fastened tightly.

Part II, Moisture Content by Oven Drying

This part discusses determining moisture in aggregates for bituminous mixtures and in completed bituminous mixtures which have no significant amounts of hydrocarbon volatiles.

Apparatus

The following apparatus is required:

- ◆ balance readable to 0.1 g and accurate to 0.5 g
- ◆ drying oven, capable of attaining a temperature of 93 °C (200 °F) or more, or suitable microwave oven
- ◆ suitable pans for drying aggregates.

Procedure

Follow these steps to determine moisture content of bituminous mixtures by oven drying.

Determining Moisture Content of Bituminous Mixtures by Oven Drying	
Step	Action
1	Obtain a representative sample of the bituminous mixture according to Test Method "Tex-222-F, Sampling Bituminous Mixtures"
2	Thoroughly mix, breaking up large lumps and reduce to laboratory test size by quartering the material, or thoroughly blending the material and taking small portions from several places from the entire area of the pan. NOTE: Keep samples in moisture-tight containers from the time of sampling to the time of testing.
3	Tare a pan and record weight to the nearest 0.1 g as A under 'Calculations.'
4	<ul style="list-style-type: none"> ◆ Quickly place approximately 2000 g of mix in the tared pan and weigh to the nearest 0.1 g. ◆ Record weight as B under 'Calculations.'
5	<ul style="list-style-type: none"> ◆ Immediately place material in pre-heated oven and allow sample to dry at 93 - 150 °C (200 - 300 °F). ◆ Stir sample periodically to facilitate drying.
6	<ul style="list-style-type: none"> ◆ Remove pan of material at 30 minute intervals and weigh to the nearest 0.1 g. ◆ Record weight.
7	Place pan back in oven immediately and continue drying.
8	<ul style="list-style-type: none"> ◆ Continue the drying and weighing procedure until a constant weight is reached. ◆ Record final weight as C under 'Calculations.'

Calculations

Calculate the percent by weight of moisture in the sample:

- ◆ For Aggregates:

$$\text{Moisture Content} = \frac{B - C}{C - A} \times 100$$

◆ For Bituminous Mixtures

$$\text{Moisture Content} = \frac{B - C}{B - A} \times 100$$

Where:

- A = Tare weight of pan
- B = Original sample weight plus pan
- C = Final sample weight plus pan.

NOTE: Other methods of moisture determination which correlate satisfactorily with 'Part I' or 'Part II' may be used.