T 255

TOTAL EVAPORABLE MOISTURE CONTENT OF AGGREGATE BY DRYING

FOP FOR AASHTO T 255

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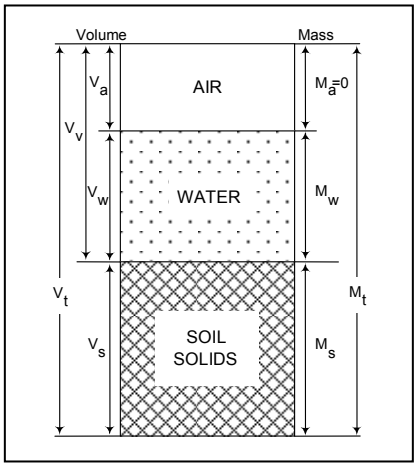

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Phase diagram

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Apparatus

Significance

The amount of water contained in many materials influences design and construction practices. Road bases are difficult to compact if they are too dry or too wet. If too dry, water must be added, and the amount to be added depends on how much is already present.

Portland cement concrete (PCC) mix design must be adjusted to account for moisture present in aggregate. Careful determination of water content is crucial to many construction materials.

Scope

This procedure covers the determination of moisture content of aggregate in accordance with AASHTO T 255. It may also be used for other construction materials.

Apparatus

- Balance or scale: Capacity sufficient for the principle sample mass, accurate to 0.1 percent of sample mass or readable to 0.1 g. Meeting the requirements of AASHTO M 231
- Containers, capable of being sealed
- Microwave safe containers
- Thermometer reading to 400 ±10°F
- Heat source, controlled
    - Forced draft oven
    - Ventilated or Convection oven
- Heat source, uncontrolled
    - Microwave oven (600 watts minimum)
    - Infrared heater, hot plate, fry pan, or any other device/method that will dry the sample without altering the material being dried
- Hot pads or gloves
- Utensils, such as spoons

Sample Preparation

Select the proper sample size based on Table 1 or other information that may be specified by the agency. Obtain the sample in accordance with the
05 FOP for AASHTO T 2. Immediately seal or cover samples to prevent any change in moisture content.

06 **TABLE 1**
Sample Sizes for Moisture Content of Aggregate

Nominal Maximum Size* (in.)	Minimum Sample Mass grams	(lb)
No. 4	500	(1.1)
3/8	1500	(3.3)
1/2	2000	(4)
3/4	3000	(7)
1	4000	(9)
1½	6000	(13)
2	8000	(18)
2½	10,000	(22)
3	13,000	(29)
3½	16,000	(35)
4	25,000	(55)
6	50,000	(110)

* One sieve larger than the first sieve to retain more than 10 percent of the material using an agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieve(s) may be inserted to determine nominal maximum.

Procedure

07 Determine and record all masses to the nearest 0.1 percent of sample mass or to the nearest 0.1 g.

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1. Determine and record the mass of the container.
2. Place the wet sample in the container, and record the total mass of the container and wet sample.
3. Determine the wet mass of the sample by subtracting the mass in Step 1 from the mass in Step 2.
4. Dry the sample to a constant mass in accordance with the directions given under “Directions for Drying”. Measures will be taken to protect the scale from excessive heat

while determining constant mass.

09 5. Allow the sample to cool and record the total mass of the container and dry sample.

6. Determine the dry mass of the sample by subtracting the mass in Step 1 from the mass in Step 5.

Forced draft oven

Directions for Drying

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- **Controlled:** Forced Draft, Ventilated or Convection Oven
  1. Spread sample in the container.
  2. Dry to constant mass at 230 ±9°F. Constant mass has been reached when there is less than a 0.10 percent change after an additional 30 minutes of drying.
- **Uncontrolled**

11 Where close control of temperature is not required (such as with aggregate not altered by higher temperatures, or with aggregate that will not be used in further tests, or where precise information is not required), higher temperatures or other suitable heat sources may be used. Other heat sources may include microwaves, hot plates, or heat lamps.

– Microwave Oven

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1. Heap sample in pile in the center of the container, and install cover. This cover must allow moisture to escape.
2. Dry to constant mass. Constant mass has been reached when there is less than a 0.10 percent change after at least an additional 10 minutes of drying.

Caution: Some minerals in the sample may cause the aggregate to overheat and explode altering the aggregate gradation.

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– Hot plates, heat lamps, etc.

1. Spread sample in container.
2. Stir the sample frequently to avoid localized overheating and aggregate fracturing.
3. Dry to a constant mass. Constant mass has been reached when there is less than a 0.10 percent change after at least an additional 20 minutes of drying.

Calculation

Constant Mass:

Calculate constant mass using the following formula: 14

$$\frac{M_p - M_n}{M_p} \times 100 = \%\text{Change}$$

Where:

M_p = previous mass measurement

M_n = new mass measurement

Example:

Mass of container: 1232.1 g 15

Mass of container after first drying cycle: 2637.2 g

Mass, M_p, of possibly dry sample: 2637.2 g – 1232.1 g = 1405.1 g

Mass of container and dry sample after second drying cycle: 2634.1 g

Mass, M_n, of dry sample: 2634.1 g – 1232.1 g = 1402.0 g

$$\frac{1405.1 - 1402.0}{1405.1} \times 100 = 0.22\%$$

0.22% is not less than 0.10% so continue drying

Mass of container and dry sample after third drying cycle: 2633.0 g 16

Mass, M_n, of dry sample: 2633.0 g – 1232.1 g = 1400.9 g

$$\frac{1402.0 - 1400.9}{1402.0} \times 100 = 0.08\%$$

0.08% is less than 0.10% constant mass has been reached

Allow sample to cool to room temperature before determining final dry mass.

Moisture Content:

Calculate the moisture content, as a percent, using the following formula:

$$w = \frac{M_w - M_D}{M_D} \times 100$$ 17

where: M_w = wet mass

M_D = dry mass

Example: 18

Mass of container: 1232.1 g

Mass of container and wet sample: 2764.7 g

Mass, M_w, of wet sample: 2764.7 g – 1232.1 g = 1532.6 g

Mass of container and dry sample (COOLED): 2633.1 g

Mass, M_D, of dry sample: 2633.1 g – 1232.1 g = 1401.0 g

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$$w = \frac{1532.6\,g - 1401.0\,g}{1401.0\,g} \times 100 = \frac{131.6\,g}{1401.0\,g} \times 100 = 9.39\% \text{ rounded to } 9.4\%$$

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Report

- Results shall be reported on standard forms approved for use by the agency. Include:
- M_w, wet mass
- M_D, dry mass
- w, moisture content to nearest 0.1 percent

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Tips!

- Let sample cool before determining final dry mass.
- Divide by M_D, not M_W.

REVIEW QUESTIONS

1. What extra care should be taken when using a microwave to dry aggregates?

2. What are the maximum temperatures that a sample should be allowed to attain when using the various types of ovens?

3. How is “constant mass” defined according to this FOP?

4. What is the maximum weight loss, in grams, that would still constitute constant mass for a 2180 g sample?

PERFORMANCE EXAM CHECKLIST

TOTAL MOISTURE CONTENT OF AGGREGATE BY DRYING FOP FOR AASHTO T 255

Participant Name _____ Exam Date _____

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Procedure Element	Trial 1	Trial 2
1. Representative sample of appropriate mass obtained?	_____	_____
2. Mass of container determined to 0.1 percent or 0.1 g?	_____	_____
3. Sample placed in container and wet mass determined to 0.1 percent or 0.1 g?	_____	_____
4. Test sample mass conforms to the required mass?	_____	_____
5. Wet mass of sample determined to 0.1 percent or 0.1 g?	_____	_____
6. Loss of moisture avoided prior to mass determination?	_____	_____
7. Sample dried by a suitable heat source?	_____	_____
8. If aggregate heated by means other than a controlled oven, is sample stirred to avoid localized overheating?	_____	_____
9. Is aggregate heated for the additional, specified time (forced draft – 30 minutes; ventilated – 30 minutes; microwave – 10 minutes; other – 20 minutes) and then mass determined and compared to previous mass – showing less than 0.10 percent loss?	_____	_____
10. Sample cooled prior to dry mass determination to 0.1 percent or 0.1 g?	_____	_____
11. Calculations performed properly and results reported to the nearest 0.1 percent?	_____	_____

Comments: First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

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Examiner Signature _____ WAQTC #:_____