Highway Engineering Laboratory

ASTM D70

Density of Semi-Solid Bituminous Materials (Pycnometer Method) |
اختبار الوزن النوعي للمواد الإسفلتية

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Specific Gravity

3. Terminology

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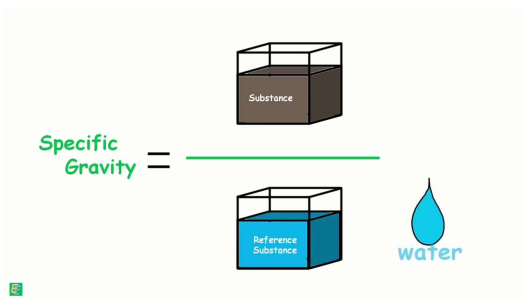
3. Terminology

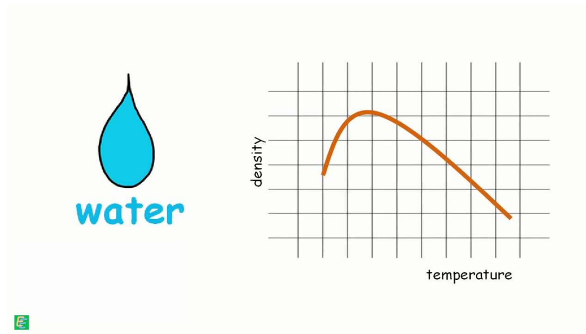
3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *density*—the mass per unit volume of a material.

3.1.2 *relative density*—the ratio of the mass of a given volume of a material to the mass of the same volume of water at the same temperature (see Note 2).

Note 2—Relative density is also described as specific gravity.





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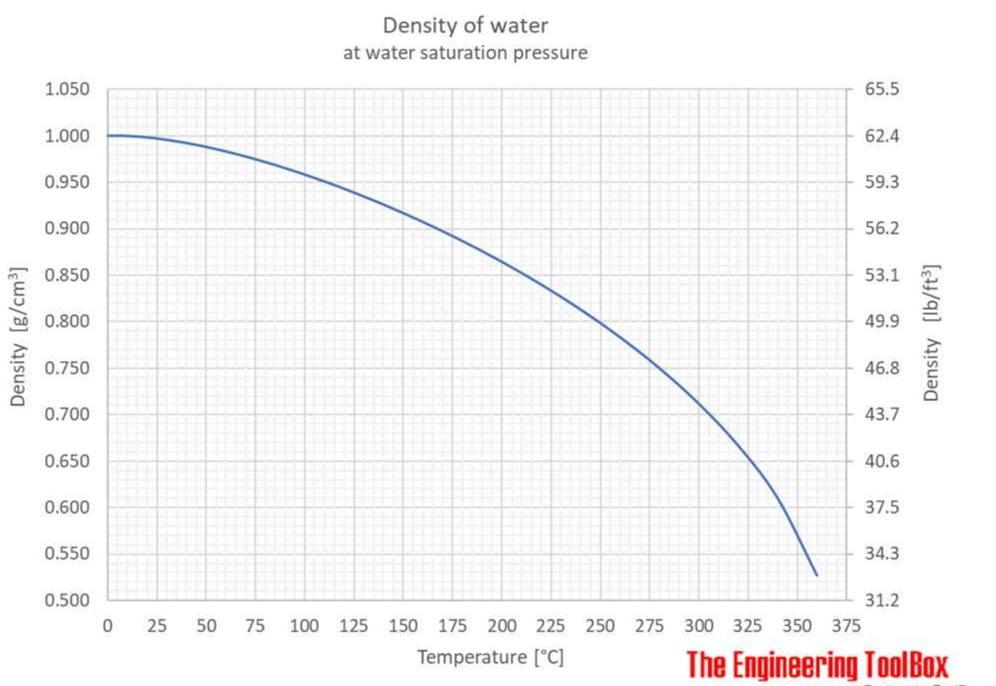

https://www.engineeringtoolbox.com/docs/documents/595/water_density_C.jpg

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Specific Gravity

Scope

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1. Scope

1.1 This test method covers the determination of the specific gravity and density of semi-solid bituminous materials, asphalt cements, and soft tar pitches by use of a pycnometer.

NOTE 1—An alternate method for determining the density of semi-solid and solid bituminous materials is Test Method D 3289. For materials which are too fluid for use of this test method, use Test Method D 3142.

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Specific Gravity

Referenced Documents

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2. Referenced Documents

2.1 *ASTM Standards:*

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

D 140 Practice for Sampling Bituminous Materials[3]

D 3142 Test Method for Density of Liquid Asphalts (Hydrometer Method)[3]

D 3289 Test Method for Density of Semi-Solid and Solid Bituminous Materials (Nickel Crucible Method)[3]

D 4311 Practice for Determining Asphalt Volume Correction to a Base Temperature[3]

E 1 Specification for ASTM Thermometers[4]

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Specific Gravity

Significance and Use

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5. Significance and Use

5.1 Values of density are used for converting volumes to units of mass, and for correcting measured volumes from the temperature of measurement to a standard temperature using Practice D 4311.

Designation: D4311/D4311M – 15

Standard Practice for Determining Asphalt Volume Correction to a Base Temperature[1]

This standard is issued under the fixed designation D4311/D4311M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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Specific Gravity

4. Summary of Test Method

4. Summary of Test Method

4.1 The sample is placed in a calibrated pycnometer. The pycnometer and sample are weighed, then the remaining volume is filled with water. The filled pycnometer is brought to the test temperature, and weighed. The density of the sample is calculated from its mass and the mass of water displaced by the sample in the filled pycnometer.

Specific Gravity

Apparatus

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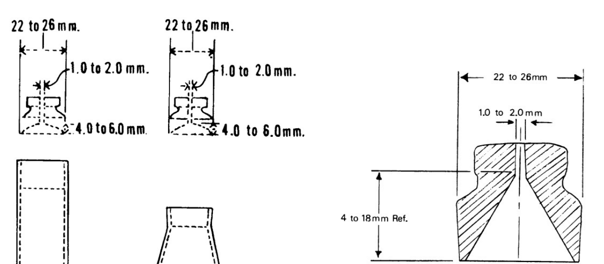
6.1 *Pycnometer*, glass, consisting of a cylindrical or conical vessel carefully ground to receive an accurately fitting glass stopper 22 to 26 mm in diameter. The stopper shall be provided with a hole 1.0 to 2.0 mm in diameter, centrally located in reference to the vertical axis. The top surface of the stopper shall be smooth and substantially plane, and the lower surface shall be concave to allow all air to escape through the bore. The height of the concave section shall be 4.0 to 18.0 mm at the center. The stoppered pycnometer shall have a capacity of 24 to 30 mL and shall weigh not more than 40 g. Suitable pycnometers are illustrated in Fig. 1.



(b) Stopper

(a) Pycnometers

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6.2 *Water Bath*, constant-temperature, capable of maintaining the temperature within 0.1°C of the test temperature.

6.3 *Thermometers*, calibrated liquid in glass, total immersion type, of suitable range with graduations at least every 0.1°C and a maximum scale error of 0.1°C as prescribed in Specification E 1. Thermometer commonly used is ASTM 63°C. Older ASTM 63F thermometers may be used until supplies are exhausted. Any other thermometer device of equal accuracy may be used.

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Specific Gravity

Materials

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7.1 *Water*—Freshly boiled and cooled distilled or deionized water.

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Specific Gravity

8. Sampling

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8. Sampling

8.1 Take samples in accordance with Practice D 140. The sample shall be free of foreign substances.

8.2 Thoroughly mix the sample before removing a representative portion for testing.

TERNATIONAL

Designation: D 140 – 01

Standard Practice for Sampling Bituminous Materials[1]

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Specific Gravity

9. Preparation of Apparatus

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9. Preparation of Apparatus

9.1 Partially fill a 600-mL Griffin low-form beaker with freshly boiled and cooled distilled or deionized water to a level that will allow the top of the pycnometer to be immersed to a depth of not less than 40 mm.

9.2 Partially immerse the beaker in the water bath to a depth sufficient to allow the bottom of the beaker to be immersed to a depth of not less than 100 mm, while the top of the beaker is above the water level of the bath. Clamp the beaker in place.

9.3 Maintain the temperature of the water bath within 0.1°C of the test temperature.

Specific Gravity

10. Calibration of Pycnometer

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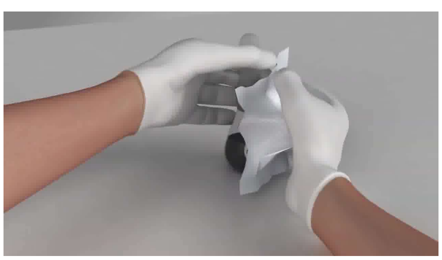
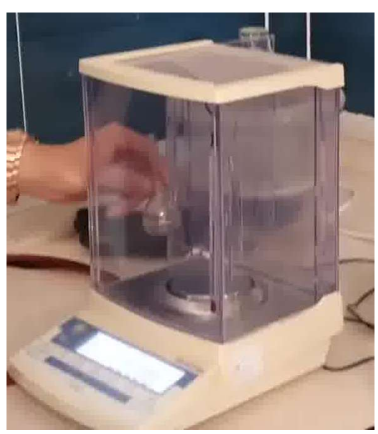
10.1 Thoroughly clean, dry, and weigh the pycnometer to the nearest 1 mg. Designate this mass as *A*.





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10.2 Remove the beaker from the water bath. Fill the pycnometer with freshly boiled distilled or deionized water, placing the stopper loosely in the pycnometer. Place the pycnometer in the beaker and press the stopper firmly in place. Return the beaker to the water bath.

NOTE 3—Calibration must be done at the test temperature. A pycnometer calibrated at one temperature cannot be used at a different temperature without recalibration at that temperature.

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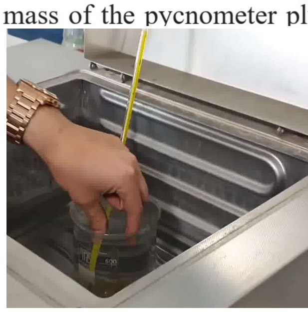
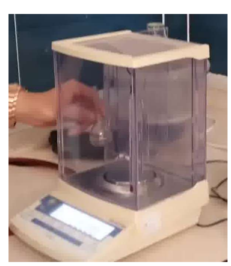
10.3 Allow the pycnometer to remain in the water for a period of not less than 30 min. Remove the pycnometer, immediately dry the top of the stopper with one stroke of a dry towel (Note 4), then quickly dry the remaining outside area of the pycnometer and weigh to the nearest 1 mg. Designate the mass of the pycnometer plus water as *B*.





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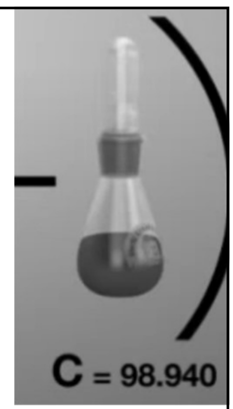
NOTE 4—Do not redry the top of the stopper even even if a small droplet of water forms as a result of expansion. If the top is dried at the instant of removing the pycnometer from the water, the proper mass of the contents at the test temperature will be recorded. If moisture condenses on the pycnometer during weighing, quickly redry the outside of the pycnometer (excluding the top) before recording the mass.

Specific Gravity

11. Procedure

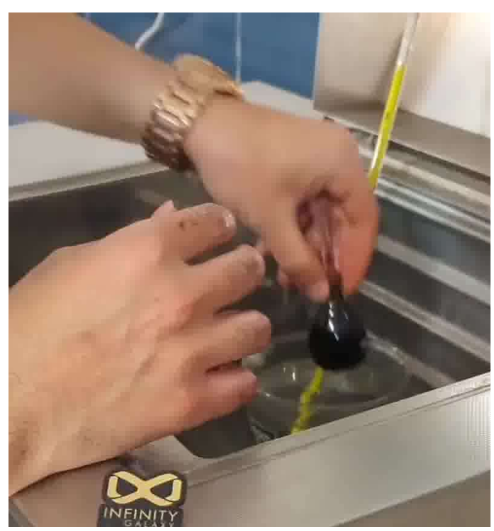
11.1 *Preparation of Sample*—Heat the sample with care, stirring to prevent local overheating, until the sample has become sufficiently fluid to pour. In no case should the temperature be raised to more than 55°C above the expected softening point for tar, or to more than 110°C above the expected softening point for asphalt. Do not heat for more than 60 min, and avoid incorporating air bubbles into the sample.

11.2 Pour enough sample into the clean, dry, warmed pycnometer to fill it about three fourths of its capacity. Take precautions to keep the material from touching the sides of the pycnometer above the final level and prevent the inclusion of air bubbles (Note 5). Allow the pycnometer and its contents to cool to ambient temperature for a period of not less than 40 min and weigh with the stopper to the nearest 1 mg. Designate the mass of the pycnometer plus sample as *C*.



NOTE 5—If any air bubbles are inadvertently occluded, remove by brushing the surface of the asphalt in the pycnometer with a high "soft" flame of a bunsen burner. To avoid overheating, do not allow the flame to remain in contact with the asphalt more than a few seconds at any one time.

11.3 Remove the beaker from the water bath. Fill the pycnometer containing the asphalt with freshly boiled distilled or deionized water, placing the stopper loosely in the pycnometer. Do not allow any air bubbles to remain in the pycnometer. Place the pycnometer in the beaker and press the stopper firmly in place. Return the beaker to the water bath.



11.4 Allow the pycnometer to remain in the water bath for a period of not less than 30 min. Remove the pycnometer from the bath. Dry and weigh using the same technique and timing as that employed in 10.3. Designate this mass of pycnometer plus sample plus water as *D*.

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11.4 Allow the pycnometer to remain in the water bath for a period of not less than 30 min. Remove the pycnometer from the bath. Dry and weigh using the same technique and timing as that employed in 10.3. Designate this mass of pycnometer plus sample plus water as *D*.

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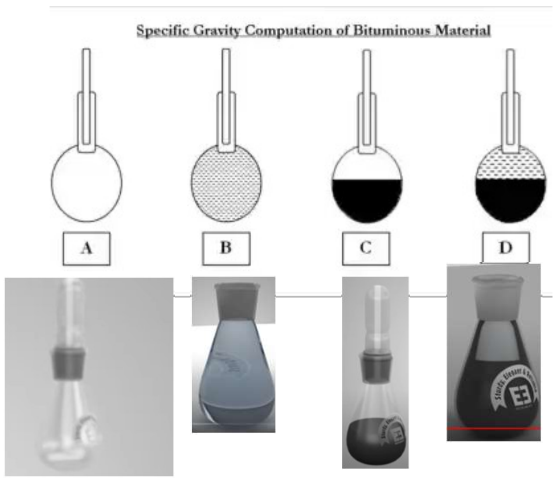
Specific Gravity (S.G)

ASTM D70



Specific Gravity Test of Bitumen - 2 Methods [+Video] - Infinity Galaxy

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Specific Gravity

12. Calculation

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Specific Gravity (S.G)

ASTM D70

- 12.1 Calculate the S.G. as indicated in the following equ:
  - $S.G = \frac{(C-A)}{[(B-A) - (D-C)]}$
    - Where
      - A = mass of pycnometer (plus stopper),
      - B = mass of pycnometer filled with water,
      - C = mass of pycnometer partially filled with asphalt
      - D = mass of pycnometer plus asphalt plus water.

Specific Gravity Test of Bitumen - 2 Methods [+Video] - Infinity Galaxy

Specific Gravity (S.G)

ASTM D70

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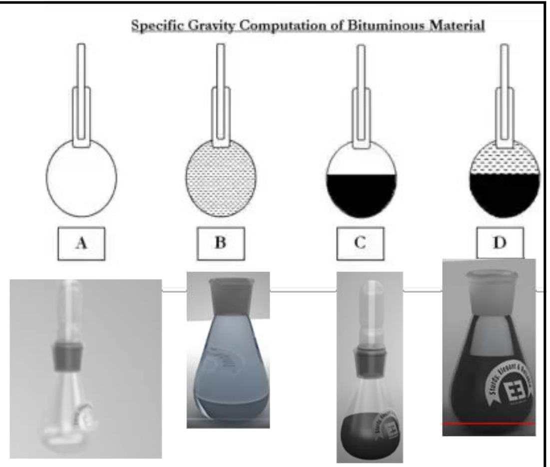
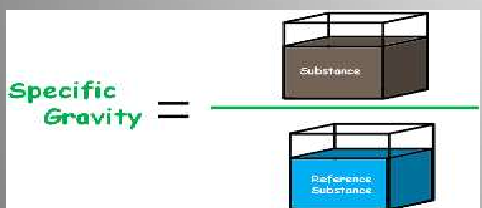


Specific Gravity Test of Bitumen - 2 Methods [+Video] - Infinity Galaxy

CALCULATION

- Specific gravity is defined as
  - *The ratio of the mass of the material at a given temperature to the mass of an equal volume of water at the same temperature.*

$$\text{Specific gravity of bitumen} = \frac{\text{Weight of bituminous material}}{\text{Weight of equal volume of water.}}$$



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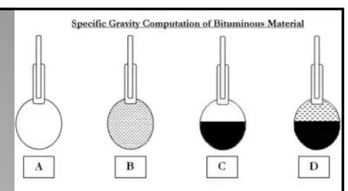
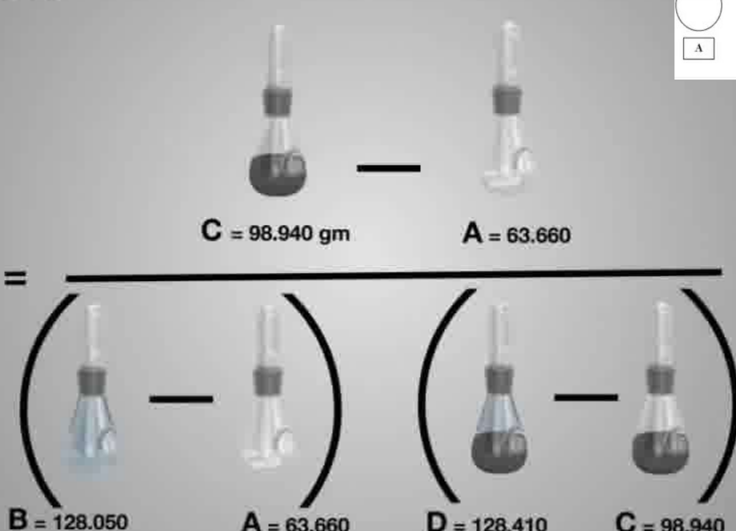
CALCULATION



Specific gravity of bitumen =



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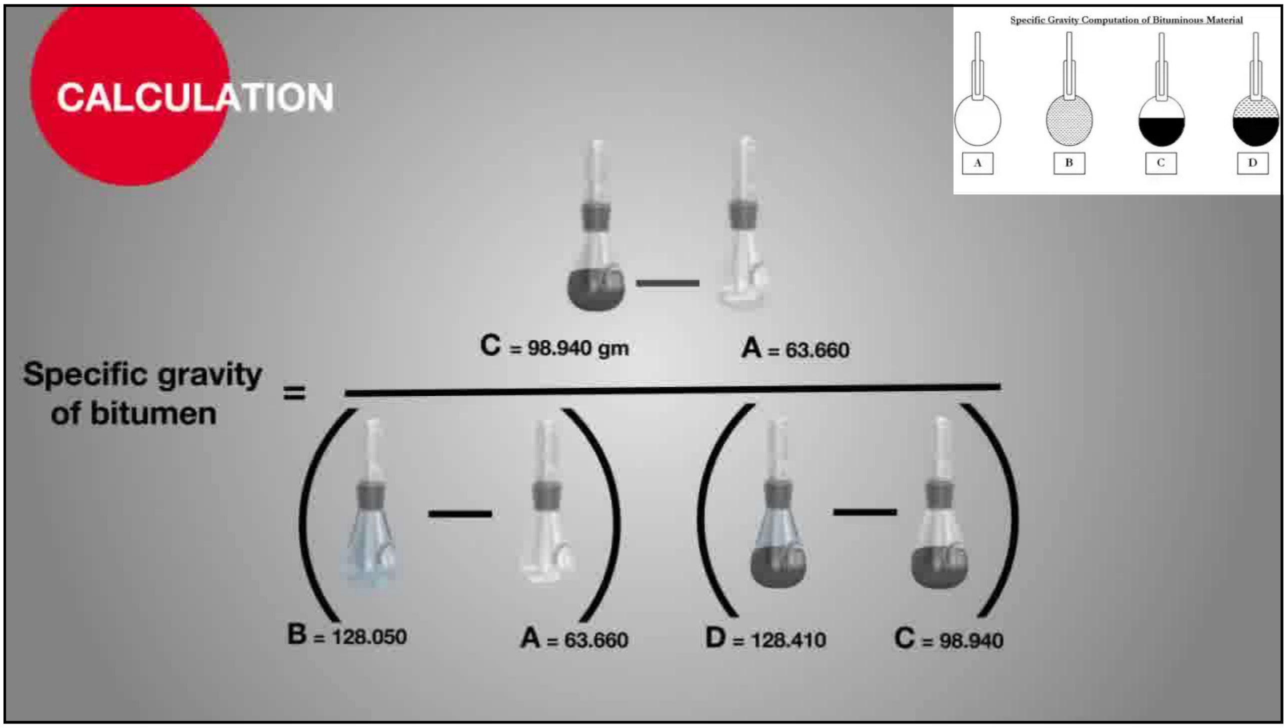
CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
C = 98.940 gm
A = 63.660
Specific gravity of bitumen =
B = 128.050
A = 63.660
D = 128.410
C = 98.940

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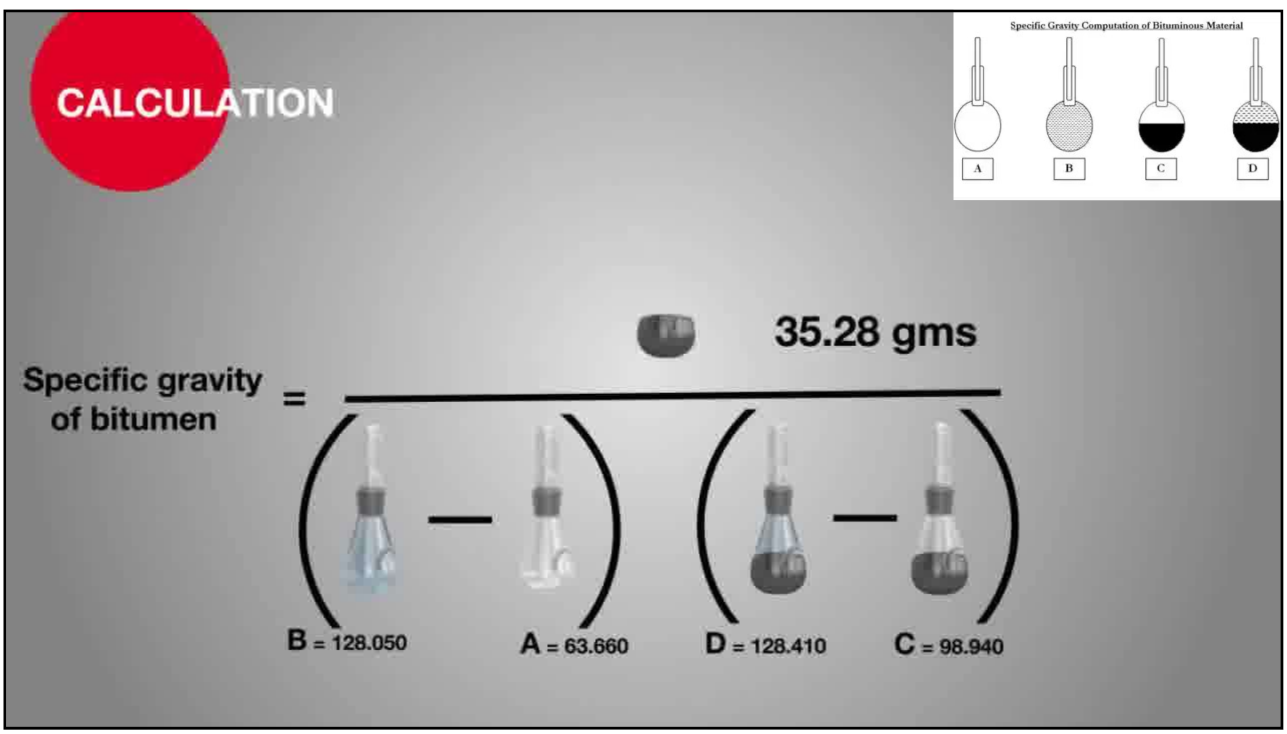
CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
35.28 gms
Specific gravity of bitumen =
B = 128.050
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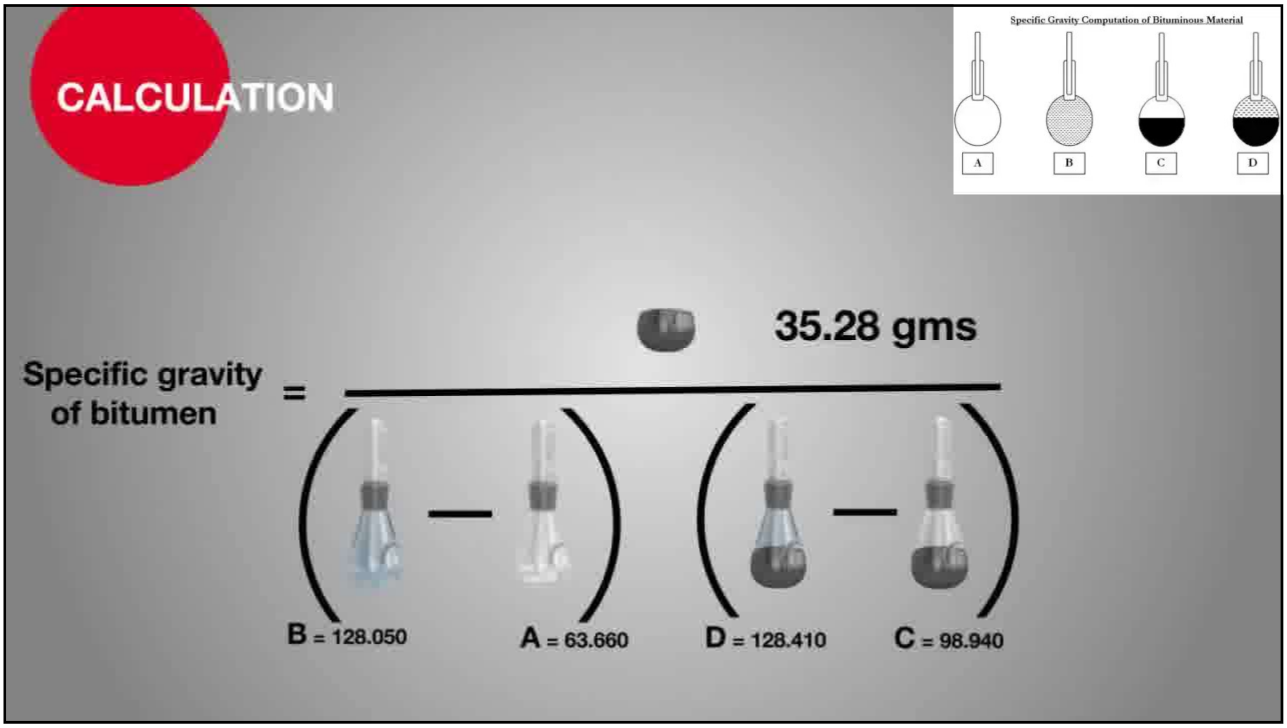
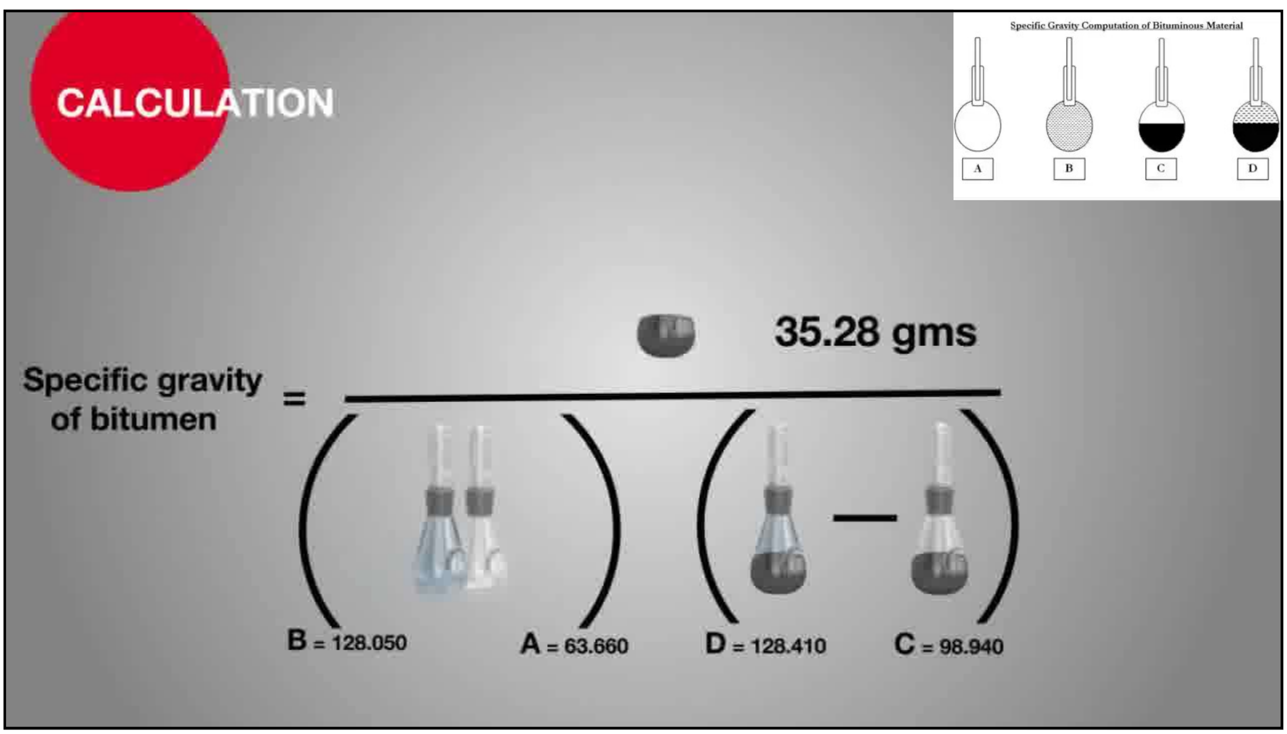
D = 128.410
C = 98.940

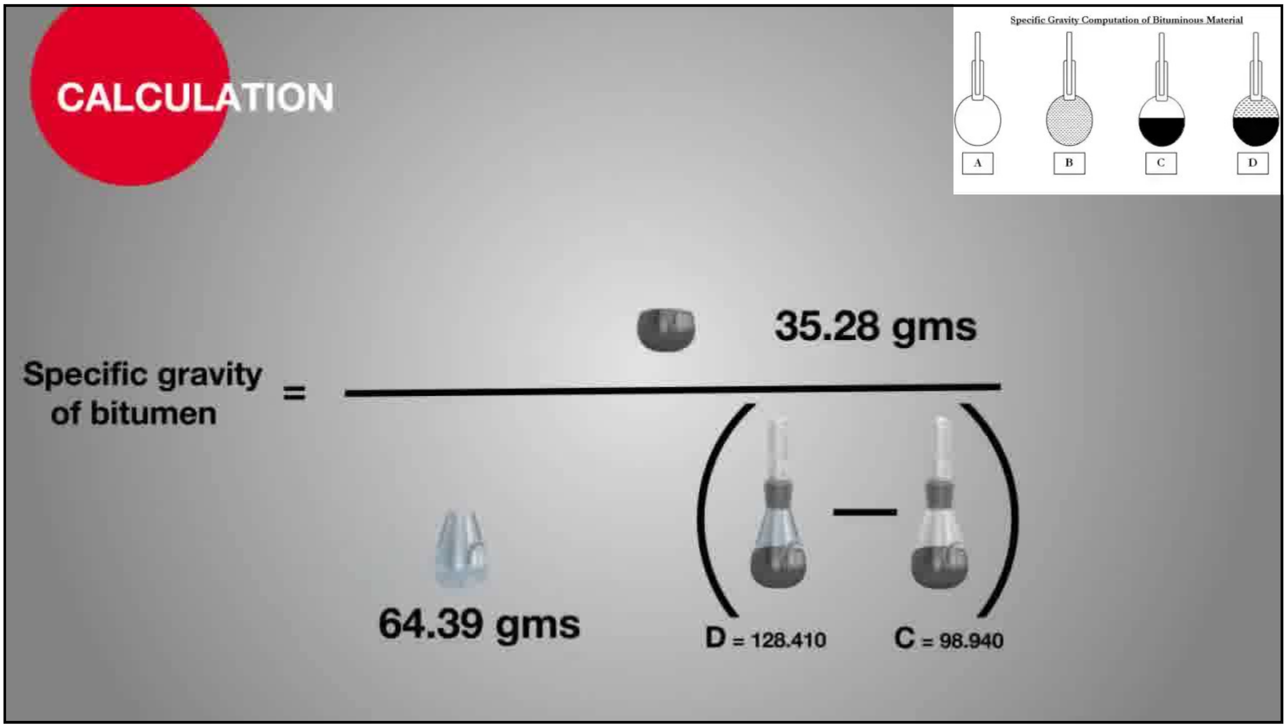
42


CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
35.28 gms
Specific gravity of bitumen =
B = 128.050
A = 63.660
D = 128.410
C = 98.940

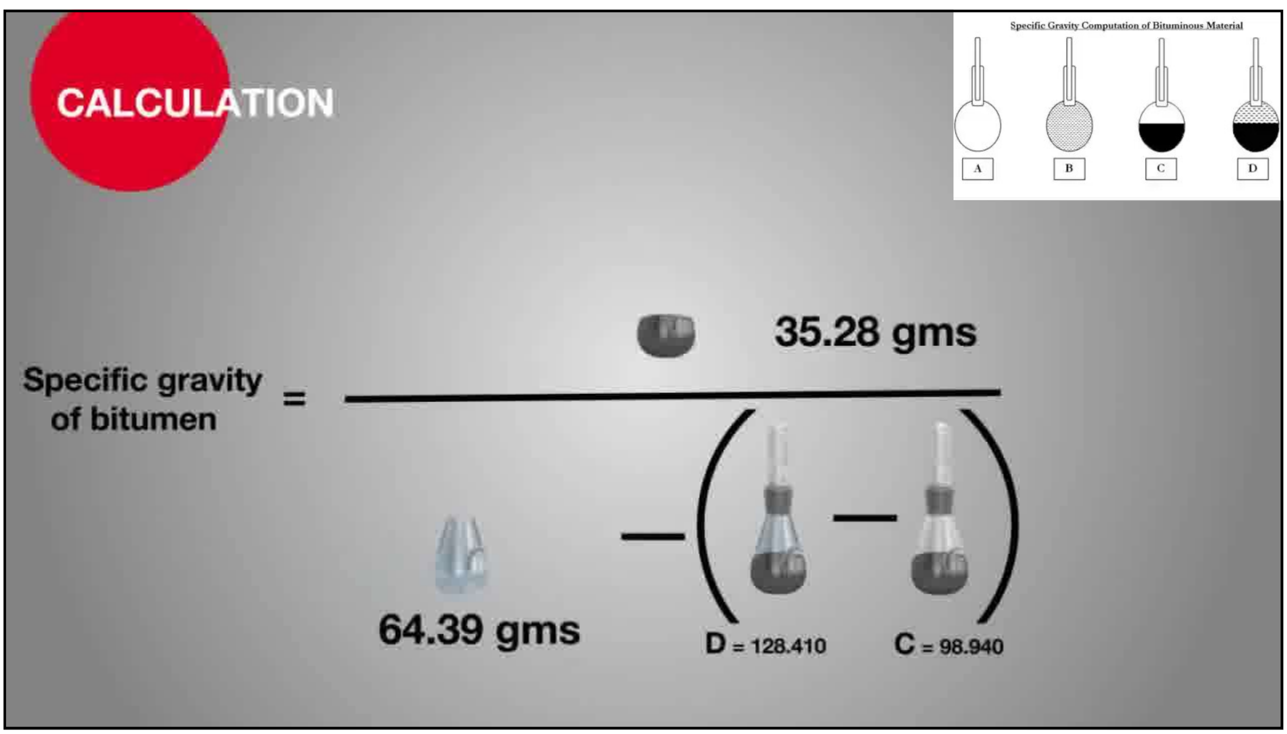
43


CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
35.28 gms
Specific gravity of bitumen =
B = 128.050
A = 63.660
D = 128.410
C = 98.940

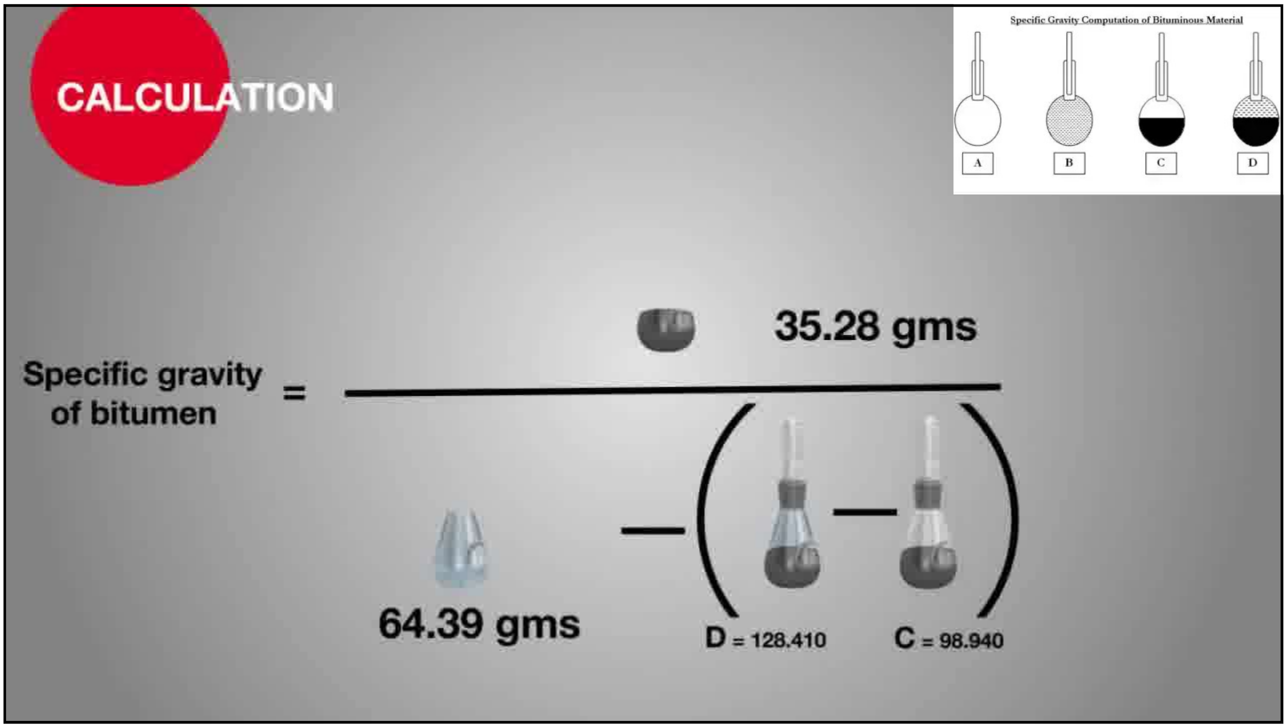
44


CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
Specific gravity of bitumen =
35.28 gms
64.39 gms
D = 128.410
C = 98.940

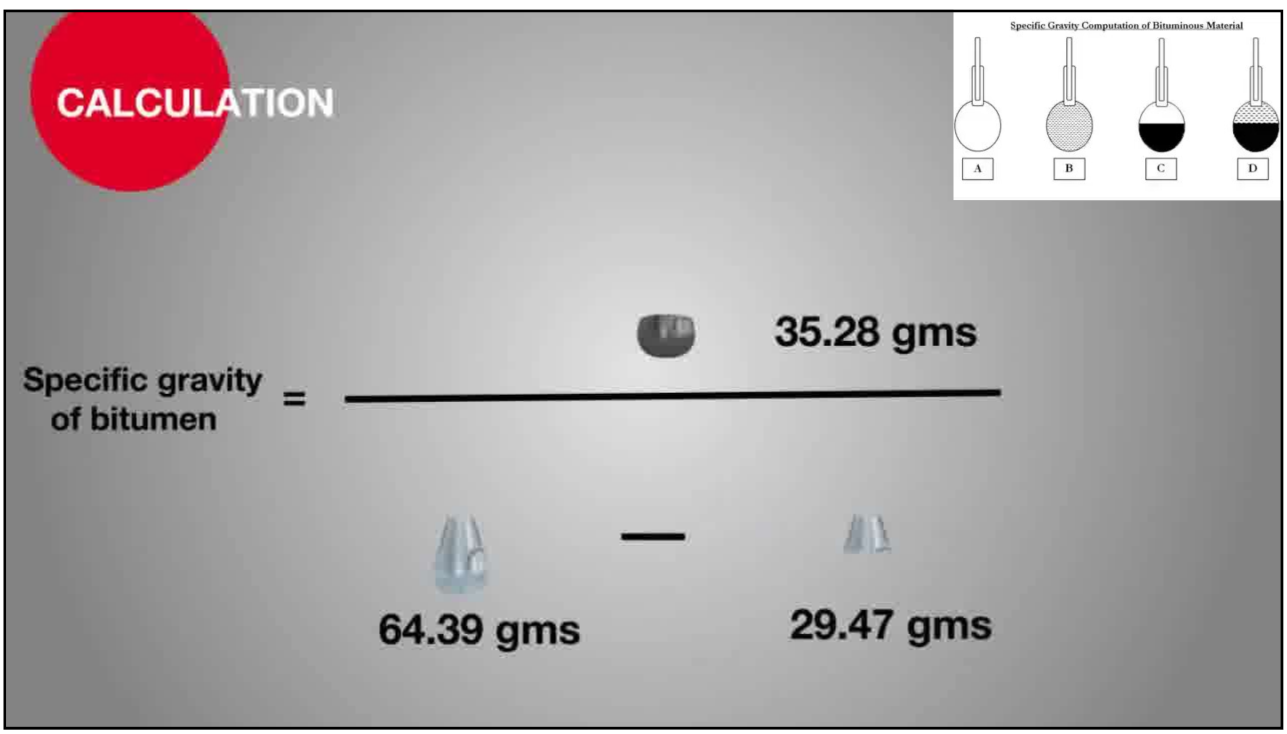
45


CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
Specific gravity of bitumen =
35.28 gms
64.39 gms
D = 128.410
C = 98.940

46


CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
Specific gravity of bitumen =
35.28 gms
64.39 gms
D = 128.410
C = 98.940

47


CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
Specific gravity of bitumen =
35.28 gms
64.39 gms
29.47 gms

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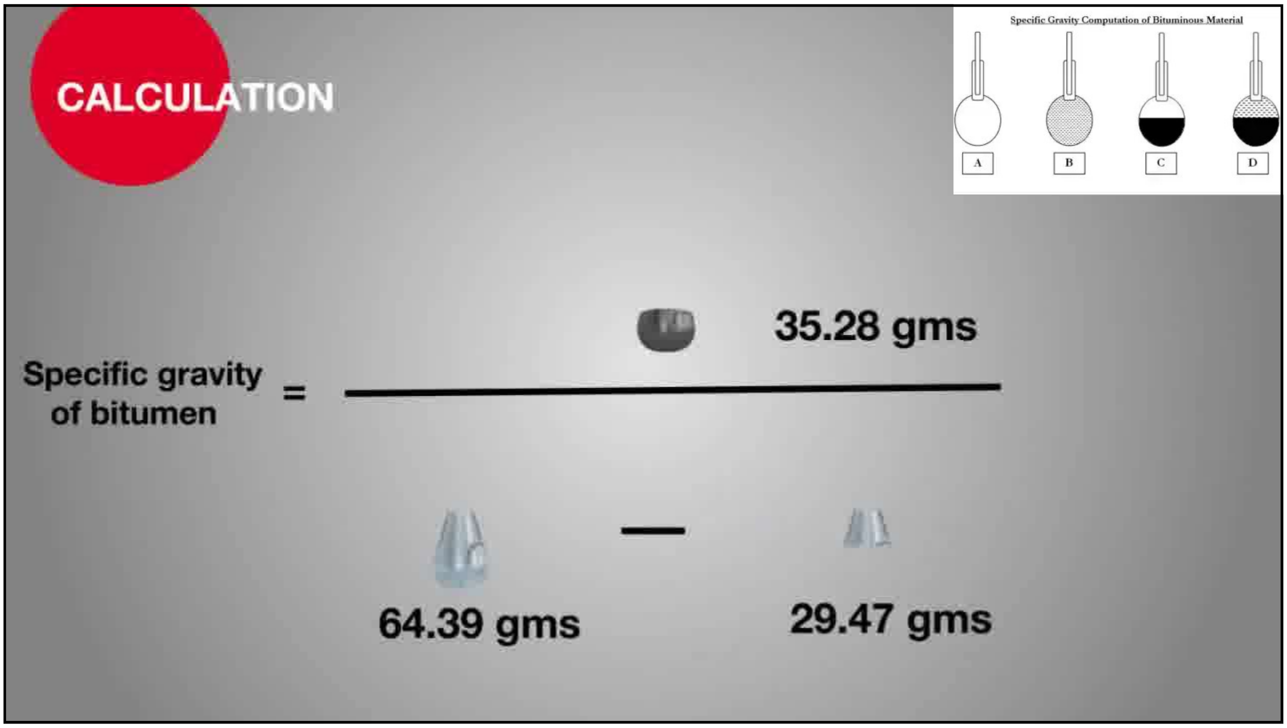
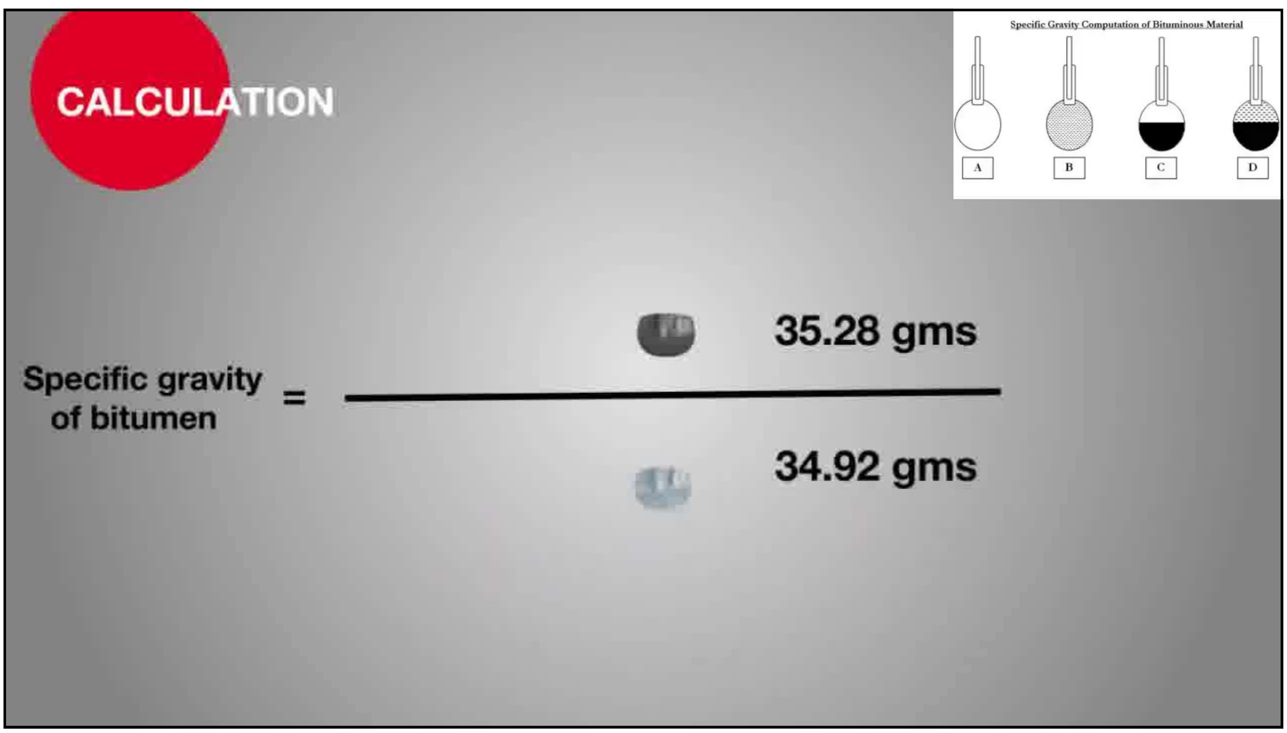

CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
Specific gravity of bitumen =
35.28 gms
64.39 gms
29.47 gms

49


CALCULATION
Specific Gravity Computation of Bituminous Material
A
B
C
D
Specific gravity of bitumen =
35.28 gms
34.92 gms

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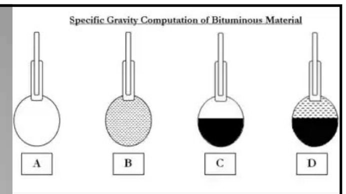
CALCULATION



Specific gravity of bitumen = **1.010 gms/cm3** (at 27° C)

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Specific Gravity (S.G)

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- ❑ 12.2 $Density = S.G \times \gamma_w$, Where
  - ❖ γ_w = density of water at the test temperature

NOTE 6—Density of water from CRC Handbook of Chemistry Physics:

Temperature, °C	Density of Water, kg/m^3
15.0	999.1
25.0	997.0

Specific Gravity Test of Bitumen - 2 Methods [+Video] - Infinity Galaxy

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Specific Gravity

Report

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13. Report

13.1 Report density to the nearest 1 kg/m^3 and the test temperature.

- The specific gravity of pure bitumen is in the range of 0.97 to 1.03.

Penetration grade bitumen	Specific gravity @ 25°C	
	min	max
30/40	1.01	1.05
40/50	1.01	1.05
60/70	1.01	1.06
85/100	1.01	1.05
100/120	1.01	1.04

Specific Gravity Test of Bitumen - 2 Methods (+Video) - Infinity Galaxy

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Specific Gravity

Lab demonstration

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Specific Gravity (S.G)

https://www.youtube.com/watch?v=Mf4ds_7SFTw

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Specific Gravity (S.G)