DETERMINATION OF THE DENSITY OF THIN POLYTHENE PLASTIC FILM

1 SCOPE

This method describes procedures for determining the density of thin polythene plastic film used in plastic bags for test method WA 733.2.

2 SAFETY

This method does not attempt to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of the method to establish appropriate occupational health and safety practices that meet statutory regulations.

3 REFERENCED METHODS

Main Roads Western Australia

WA 733.2: Bulk Density and Void Content of Asphalt – Vacuum Sealing Method

4 APPARATUS

(a) Pycnometer to determine the density of plastic, total fill type made of glass having a known volume of approximately 100 mL, with a stopper and capillary.

(b) Pycnometer to determine the density of test fluid, total fill type made of glass having a known volume of no less than 25 mL, with a stopper and capillary.

(c) Thermometer readable to 0.1°C with an uncertainty of measurement not exceeding 0.03°C.

(d) Balance readable to 0.0001g with limit of performance less than or equal to ± 0.0005g.

(e) Water bath capable of maintaining a temperature of 25 ± 0.1°C.

(f) Test fluid with a density less than 0.9 kg/L (Note) known to 0.001 kg/L.

NOTE*: The density of the test fluid must be lower than the density of the plastic film to ensure that the film does not float. Kerosene has been found to be suitable.*

(g) Glass beaker 600 mL capacity.

(h) Timer.

(i) Gloves.

(j) Cutting device with sharp edges.

NOTE*: Dress making scissors have been found to be suitable.*

(k) Tweezers.

(l) De-ionized water that has been boiled.

5 ENVIROMENTAL CONDITIONS

The room temperature shall not exceed 23°C during testing.

6 CALIBRATION

This describes procedures for determining the volume of the 100 mL pycnometer and the density of the test fluid. Pycnometers shall not be handled with bare hands**.**

6.1 Volume of 100 mL Pycnometer

(a) Determine and record the mass (m_1), to the nearest 0.0001g of the clean dry pycnometer and stopper.

(b) Immerse the pycnometer into a 600 mL beaker containing de-ionised water with at least 5 mm of water above the top of the pyconometer. Place the stopper beside the pyconometer in the 600 mL beaker.

(c) Place the 600 mL beaker into a temperature controlled water bath.

(d) Place the probe of a thermometer within the water in the pyconometer and bring the water to 25 ± 0.1°C. Maintain the test temperature for at least 10 minutes.

(e) Remove the thermometer from the pycnometer and place the stoper in the pyconometer and press the stopper down to expel excess water until the stopper forms a tight seal. The pycnometer shall be kept under water during this procedure.

(f) Remove the pycnometer with stopper from the water and immediately wipe dry, using absorbent cloth or a tissue, with one single quick stroke over the hole in the stopper. Dry the remaining surfaces of the pyconometer without touching the pyconometer with bare hands.

NOTE: *Placing the pyconometer on a cloth or paper towelling whilst the surfaces are wiped dry has been found to be a suitable technique*

(g) Determine and record the mass (m_2), of the pycnometer, stopper and water to the nearest 0.0001g.

(h) Calculate the volume of the pycnometer, to the nearest 0.001 mL, using the formula:

$$V_p = \frac{m_2 - m_1}{\rho_w}$$

Where:

Vp = Volume of pycnometer at 25°C in mL

m_1 = Mass of pycnometer in grams

m_2 = Mass of pycnometer and water in grams

p_w = Density of water at 25°C in kg/L (sufficiently correct to use 0.997 kg/L)

(i) Repeat calibration Procedure 6.1(b) to 6.1(g). If the difference between the two results exceeds 0.05 mL repeat the calibration commencing at Procedure 6.1(a).

(j) Calculate and record the average volume of the pycnometer to the nearest 0.001 kg/L.

6.2 Density of Test Fluid

(a) Determine and record the mass (m_3), to the nearest 0.0001g of the clean dry pycnometer and stopper.

(b) Immerse the pycnometer into a 600 mL beaker containing the test fluid with at least 5 mm of test fluid above the top of the pyconometer. Place the stopper beside the pyconometer in the 600 mL beaker.

(c) Place the 600 mL beaker into a temperature controlled water bath.

(d) Place the probe of a thermometer within the test fluid in the pyconometer and bring the temperature to 25 ± 0.1°C. Maintain the test temperature for a minimum of ten minutes.

(e) Remove the thermometer from the pycnometer and place the stoper in the pyconometer and press the stopper down to expel excess water until the stopper forms a tight seal. The pycnometer shall be kept under the test fluid during this procedure

(f) Remove the pycnometer with stopper from the test fluid and immediately wipe dry, using absorbent cloth or a tissue, with one single quick stroke over the hole in the stopper. Dry the remaining surfaces of the pyconometer without touching the pyconometer with bare hands.

NOTE: *Placing the pyconometer on a cloth or paper towelling whilst the surfaces are wiped dry has been found to be a suitable technique*

(g) Determine and record the mass of the (m_4), of the pyconometer, stopper and the test fluid to the nearest 0.0001 g.

(h) Calculate the density of the test fluid, to the nearest 0.001 mL, using the formula:

$$\rho_{TF} = \frac{m_4 - m_3}{V_p}$$

Where:

ρ_{TF} = Density of test fluid in kg/L

m_3 = Mass of pycnometer in grams

m_4 = Mass of pycnometer and test fluid in grams

Vp = Volume of pycnometer at 25°C in mL

(i) Repeat calibration Procedure 6.2(b) to 6.2(g). If the difference between the two results exceeds 0.005 kg/L repeat the calibration commencing at Procedure 6.2(a).

(j) Calculate and record the average density of the test fluid to the nearest 0.001 kg/L.

7 PROCEDURE

DENSITY OF THIN POLYTHENE FILM

Plastic samples and pycnometers shall not be handled with bare hands.

(a) Select from the relevant batch of bags the sample to be tested. Record the batch number and the date the sample was taken.

(b) Inspect and discard any samples that show contamination or defects within the plastics, and if required select another sample from the same batch.

(c) Trim the sample to remove all perforated edges and any features that may entrap air.

(d) Cut the sample into pieces of approximately 2 cm x 4 cm to provide enough pieces to occupy approximately 75% of the volume of the 100 mL pycnometer .

(e) Determine and record the mass of a clean dry pycnometer (m_5) to the nearest 0.0001 g.

(f) Immerse the pycnometer into a 600 mL beaker containing test fluid with at least 5 mm of test fluid above the top of the pycnometer. Place the stopper beside the pycnometer in the 600 mL beaker.

(g) Determine and record the mass of the sample of pieces of plastic (m_6), to the nearest 0.0001g.

(h) Carefully place, using suitable tweezers, each piece individually in a vertical orientation into the pycnometer.

NOTE: If not practical to place the pieces into the pyconometer whilst it is in the 600 mL beaker this operation may be performed with the pycnometer out of the beaker, but still filled with test fluid.

(i) Place the 600 mL beaker containing the pycnometer, stopper, test fluid and sample into a temperature controlled water bath.

(j) Place the probe of a thermometer within the test fluid in the pycnometer and bring the temperature to 25 ± 0.1°C. Maintain the test temperature for a minimum of ten minutes and then remove the thermometer probe.

(k) Place the stopper on the pycnometer whilst immersed in the test fluid. Press the stopper down to expel excess test fluid until the stopper forms a tight seal.

(l) Remove the pycnometer from the 600 mL beaker and immediately wipe the top of the stopper dry with one single quick stroke over the hole using absorbent cloth or tissue. Dry the pycnometer using minimal handling to prevent transfer of heat.

NOTE*: Placing the pycnometer on cloth or paper towelling whilst the surfaces are wiped dry has been found to be a suitable technique.*

(m) Determine and record the mass (m_8) of the pycnometer, sample and test fluid to the nearest 0.0001 g.

(n) Return the pycnometer, with the stopper removed, sample and test fluid to the 600 mL beaker and repeat Procedures 7(i) to 7(m). The range of two consecutive results shall be less than or equal to 0.005 kg/L. If not repeat Procedures 7(i) to 7 (n) until two consecutive results meet the criteria.

8 CALCULATONS

(a) Calculate the volume of the sample using the formula:

$$V_s = V - \frac{m_8 - (m_5 + m_6)}{\rho_{TF}}$$

Where:

V_s = Volume of sample in mL

V = Volume of pycnometer at 25°C in mL

m_5 = Mass of pycnometer in grams

m_6 = Mass of sample in grams

m_8 = Mass of pycnometer, test fluid and sample in grams

ρ_{TF} = Density of test fluid @ 25°C in kg/L

(b) Calculate the density of the sample using the formula:

$$\rho_s = \frac{m_6}{V_s}$$

Where:

ρ_s = Density of sample in kg/L

m_6 = Mass of sample in grams

V_s = Volume of sample in mL at 25°C

9 REPORTING

a) Report the density of the thin polythene film as the average of the two conforming values to the nearest 0.001 kg/L.
b) Sample Description
c) Batch Number
d) Supplier

10 MEASUREMENT UNCERTAINTY

The expanded measurement uncertainty has been determined in accordance with the ISO/IEC Guide 98-3 (2008) Uncertainty of measurement-Part3: *Guide to the Expression of Uncertainty in Measurement* (GUM 1995), by evaluating the major components that influence the measurand. Some of those components were the volume of the pycnometer, the density of the test fluid and the volume of the sample.

11 ISSUING AUTHORITY

Document Owner
Bituminous Product Consultant

12 REVISION STATUS RECORD

Page No.	Section	Revision Description / Reference
3	9	Add Sample Description, Batch Number and Supplier to Reporting.
4	11	Update Issuing Authority