

	<p style="text-align: center;"><i>Standard Operating Procedure</i></p> 	Effective Date:	Version:
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SOP_MP_06 Mechanical Properties_ Density of Faecal Sludge			Page #: 1 of 4

Standard Operation Procedure – Density of Faecal Sludge

Introduction

Density is the relationship between the mass (m) and volume (V) of a substance.

Bulk density (D_b) is a measure of mass per unit volume. It is used as a measure of wetness, volumetric water content, and porosity. Factors that influence the measurement include; organic matter content, the porosity, and material structure. The reference mass of the material is taken after oven drying.

Particle density or **solid density (D_p)** represents only the weight of dry material per unit volume of the material solids; the pore space is not included in the volume measurement.

The Porosity (PS) of a material is pore space portion of the material volume occupied by air and water.

1. Scope and Application

- Bulk density is determined by oven-drying a known volume of sample and the mass of the dry sample measured.
- Solid or particle density is determined by one of two methods:
 1. The displacement technique or
 2. The saturation method.
- Once the bulk and particle density values are known, it is a straightforward calculation to determine pore space.

2. Apparatus

- 50ml capacity evaporating porcelain crucibles.
- Desiccator.
- Drying oven.
- Four-place Balance.
- 100ml measuring cylinder.

- Sample holding tube.
- 7.5ml measuring spoon.

3. Reagents

- Nil.

4. Safety Precautions

- Always use safety goggles, gloves and laboratory coat while working in laboratory.
- Wear gloves suitable for withstanding high temperatures when removing crucibles from the oven.
- After the analysis clean bottles and beakers with clear water keep it for drying.
- Dispose the used gloves after completion of analysis.
- Clean the hands using antiseptic soap.
- Disinfect hands after washing with soap.
- Avoid spillage and contact with skin. In the latter case use copious washings with cold water and call for medical attention.

5. Calibration

- Check the temperature throughout the oven area by placing a calibrated thermometer on each shelf, after 30 minutes, check temperature at each level against oven setting.
- Adjust oven setting if necessary.
- If temperatures are uneven on the shelves, check insulation.

6. Sampling Preparation

Prepare Crucible

- Heat a porcelain crucible in an oven for 2 hours at 103-105°C.
- Cool for 15 minutes in a desiccator and weigh.....W1g.

7. Procedure

Sample Analysis

- Measure out appropriate volume of 7.5ml sample. Transfer into the crucible and weigh (crucible + sample).....W2g.
- Place in hot oven at 103-105°C overnight.
- Remove the next day and cool for 15 minutes and weigh.....W3g.
- Suspend a sample holding tube into a water in the 100ml measuring cylinder and record the volume of water.....V1ml.

- Carefully transfer the dry sample into a holding tube, suspend the tube with sample in the water and record the volume.....V2ml (displacement technique).

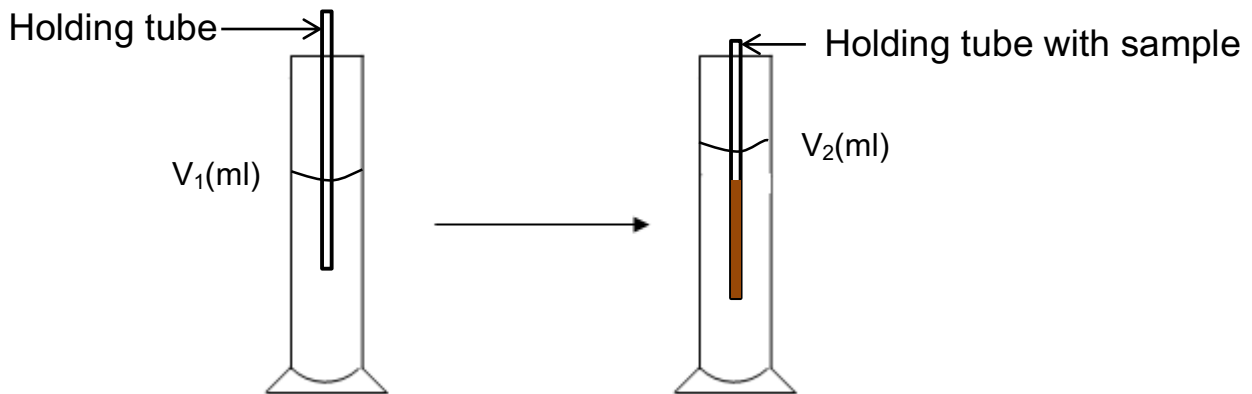


Figure 1: Experimental set-up (displacement technique)

8. Calculation

$$Db_{wet} (g/ml) = \frac{W2 - W1}{V_t}$$

Where:

W2-W1 = Wet mass of sample.

V_t = Total volume of sample (7.5ml).

$$Db_{dry} (g/ml) = \frac{W_s}{V_t}$$

Where:

W_s = Oven dry mass of the sample = W3-W1 (g).

V_t = Total volume of the sample, pore volume + solid volume (7.5ml).

Particle Density, D_p

- Particle density values represents only the weight of dry sample per unit volume of the sample solids; the pore space is not included in the volume measurement.

$$D_p(g/ml) = \frac{W_s}{V_s}$$

Where:

W_s = Oven dry mass of the sample (g)

V_s = Volume of the solids (ONLY) = $V_2 - V_1$ (ml).

$$PS = \frac{1 \quad Db_{dry}}{D_p}$$

APPROVAL OF STANDARD OPERATING PROCEDURE

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