

Lab Exercise 5 - Soil Moisture

PART 1 - Water Movement

The table below has been filled in with the amount of water which percolated through each soil in ½ hour. Calculate the amount for 1 full hour.

Soil Sample	mls/30 minutes	mls/60 minutes
Soil A - Loam	72	
Soil B – Loamy sand	47	
Soil C – Clay loam	56	

PART 2 - Field Capacity

The table below has been partly filled in with the data obtained from the experiment using the same soils as for Part 1. Please fill in the remaining blanks in the table. See your lab handout for a reminder of what the terms in the table mean.

	Soil A	Soil B	Soil C
Dry soil (g)	20	20	20
Wet soil (g)	34	28	37
H ₂ O wt (g)			
MC _{wet} at FC			
MC _{dry} at FC			

Use your knowledge of pore space and particle size as it relates to texture, and the observations you made from watching the video, to answer the following QUESTIONS. Review your lab exercise handout and the video. The answers to any questions you have will more than likely be found there!

1. The rates of water conductivity for Soils A, B and C were different. Were the results as you expected them to be given the soil textures of

each of the samples? Explain. What might explain the differences in rates, other than texture?

2. Calculate the pore space (f) for each of the soils. (See DATA IN TABLE BELOW) Why are the porosity values different? Be specific. Would you expect the pore space for each of the soils to be different in their natural environment? What might account for differences in pore space between soils of similar textures?

3. Calculate the volumetric moisture content (θ) of each of the soils at field capacity and express your answer in % and in cm^3/cm^3 . (PUT DATA IN TABLE BELOW)

4. Discuss the significance of the different field capacities of the soils from the perspective of agriculture and landscape management (lawn, golf course, environmental plantings, etc). Focus on irrigation management.

	Bulk density (g/cm^3)	Pore space (f) (%)	Volumetric moisture content (θ) (%)	Volumetric moisture content (θ) (cm^3/cm^3)
Soil A – Loam	1.5			
Soil B – Loamy sand	1.6			
Soil C – Clay loam	1.4			

NOTES ON SOIL MOISTURE CALCULATIONS

There are three straightforward ways of expressing soil moisture content, two methods involve using Gravimetric expressions and the third method uses a Volumetric expression. All three methods are explained below with sample calculations shown.

The process of drying a wet soil provides 3 numbers

Mass of wet soil (W_w) (For our example let's assume 54 grams)

Mass of dry soil (W_d) (For our example let's assume 38 grams)

Mass of water originally in the soil (W_{water} or $W_w - W_d$)

(From our example, subtracting 38 from 54 leaves us with 16 grams of water originally in the soil, 1 gram of water is the same as 1 ml of water which is the same as 1 cm³ of water, therefore we have 16 grams or mls or cm³ of water in this particular sample)

GRAVIMETRIC EXPRESSIONS

- **Based on mass of water per unit mass of soil (gramswater/gramsoil)**
- **Measured by comparing masses of wet and dried soils**

Gravimetric moisture contents can be expressed as the mass of water per mass of wet soil (wet basis) or mass of water per mass of dry soil (dry basis)

VOLUMETRIC MOISTURE CONTENT ($\emptyset$)

- **Based on volume of water per volume of soil (cm³water/cm³soil)**
- **Usually calculated or determined indirectly**

- Related to gravimetric moisture by bulk density
- No wet or dry bases unless soil solids expand when wet
- Can be expressed as a percentage
- Units can be reduced to cm/cm (or equivalent) to give quantity of water per depth of soil

Relationship of volumetric moisture content ($\emptyset$), gravimetric moisture content and bulk density (D_b)

$$\emptyset = (D_b) \times (MC_{dry})$$

Using our numbers from above and a given bulk density of 1.50 g/cm³ we get the following result:

$$\emptyset = (1.5 \text{ g/cm}^3) \times (.421 \text{ g}) = 0.63 \text{ cm}^3$$

Notice how the grams were cancelled out leaving us only with cm³. This result indicates that for each cm³ of soil we have 0.63 cm³ (or 63%) of it filled with water.

Relationship between particle density (D_p), pore space (f) and bulk density (D_b)

$$f = 1 - (D_b/D_p)$$

For all calculations, you may assume that 1 ml of water = 20 drops, and that water has a density of 1 g/ml or 1 g/cm³ and particle density is 2.65 g/cm³.

Moisture content (wet basis)

$$\text{MC}_{\text{wet}} = \text{Mass}_{\text{water}} / \text{Mass}_{\text{wet soil}}$$

Moisture content (dry basis)

$$\text{MC}_{\text{dry}} = \text{Mass}_{\text{water}} / \text{Mass}_{\text{dry soil}}$$