Hydrometer Analysis
1/27/2010

1. Objective:

To determine the particle sizes in a given soil sample and draw particle size distribution curve.

2. List of Equipment:

- *ASTM 152-H* hydrometer
- Mixer
- Two 1000-cc graduated cylinders
- Deflocculating agent
- Beaker
- Balance
- Plastic squeeze bottle
- Tap water
- No. 12 stopper

3. Procedure:

1. Take 50 g. of oven-dry, well-pulverized soil in a beaker.
2. Prepare a deflocculating agent. Usually a 4% solution of sodium hexametaphosphate (Calgon) is used. This can be prepared by adding 40 g of Calgon in 1000 cc of tap water and mixing it thoroughly.
3. Take 125 cc of the mixture prepared in Step 2 and add it to the soil taken in Step 1. This should be allowed to soak for about 8 to 12 hours.
4. Take a 1000-cc graduated cylinder and add 875 cc of tap water *plus* 125 cc of deflocculating agent in it. Mix the solution well.
5. Put the cylinder (from Step 4) in a constant temperature bath. Record the temperature of the bath, T (in °C).
6. Put the hydrometer in the cylinder (Step 5). Record the reading. (*Note*: The *top of the meniscus* should be read.) This is the zero correction (F_z), which can be +ve or –ve. Also observe the meniscus correction (F_m).
7. Using a spatula, thoroughly mix the soil prepared in Step 3. Pour it into the mixer cup.
   Note: During this process, some soil may stick to the side of the beaker. Using the plastic squeeze bottle filled with tap water, wash all the remaining soil in the beaker into the mixer cup.
8. Add tap water to the cup to make it about two-thirds full. Mix it for about two minutes using the mixer.
9. Pour the mix into the second graduated 1000-cc cylinder. Make sure that all of the solids are washed out of the mixer cup. Fill the graduated cylinder with tap water to bring the water level up to the 1000-cc mark.
10. Secure the No. 12 rubber stopper on the top of the cylinder (Step 9). Mix the soil-water well by turning the soil cylinder upside down several times.
11. Put the cylinder into a constant temperature bath next to the cylinder described in Step 5. Record the time immediately. This is cumulative time

t = 0. Insert the hydrometer into the cylinder containing the soil-water suspension.

12. Take hydrometer readings at cumulative times t = 0.25 min., 1 min., 2 min., and 4 min. Always read the upper level of the meniscus.
13. Take the hydrometer out after two minutes and put it into the cylinder next to it (Step 5).
14. Hydrometer readings are to be taken at time t = 8 min., t = 15 min., t = 30 min., t = 45 min., t = 60 min., t = 180 min., t = 1290 min., t = 1320 min., and t = 1460 min. For each reading, insert the hydrometer into the cylinder containing the soil-water suspension about 30 seconds before the reading is due. After the reading is taken, remove the hydrometer and put it back into the cylinder next to it (Step 5).

4. **Data:**

Description of soil: Silty Clay
Sample No.: 2
Location: Wisner Bridge
G_s: 2.70
Hydrometer type: ASTM 152-H
Dry weight of soil, W_s: 50 g
Temperature of test, T: 26°C
Meniscus correction, F_m: +1
Zero correction, F_s: 5
Temperature correction, F_T: +1.65
Correction for specific gravity, a: 0.99 (for G_s = 2.70) (Table 5-3)

Time (min)	Hydrometer Reading, R	R_{cp}	Percent Finer	R_{cL}	L (cm) (Table 5-1)	A (Table 5-2)	D (mm)
0.25	35	31.65	62.7	36	10.6	0.0125	0.081
1	37	33.65	66.6	38	10.2		0.040
2	35	31.65	62.7	36	10.6		0.029
4	28	24.65	48.8	29	11.7		0.021
8	24	20.65	40.9	25	12.4		0.016
15	20	16.65	33.0	21	13.0		0.012
30	16	12.65	25.0	17	13.7		0.0084
45	14	10.65	21.1	15	14.0		0.007
60	13	9.65	19.1	14	14.2		0.0061
180	12	8.65	17.1	13	14.3		0.0035
1290	10	6.65	13.2	11	14.7		0.0013

1320	10	6.65	13.2	11	14.7		0.0013
1460	9.5	6.15	12.2	10.5	14.75		0.00126

5. Analysis of Data:

1. $\mathbf{F_T} = -4.85 + 0.25T$ *(for T between 15°C and 28°C)*
   Ex: $F_T = -4.85 + 0.25(26°C) = \boxed{1.65}$

2. $\mathbf{R_{cp}} = R + F_T - F_z$
   Ex: $R_{cp} = 35 + 1.65 - 5 = \boxed{31.65}$

3. **Percent finer** $= \dfrac{a * R_{cp}}{W_s}(100)$

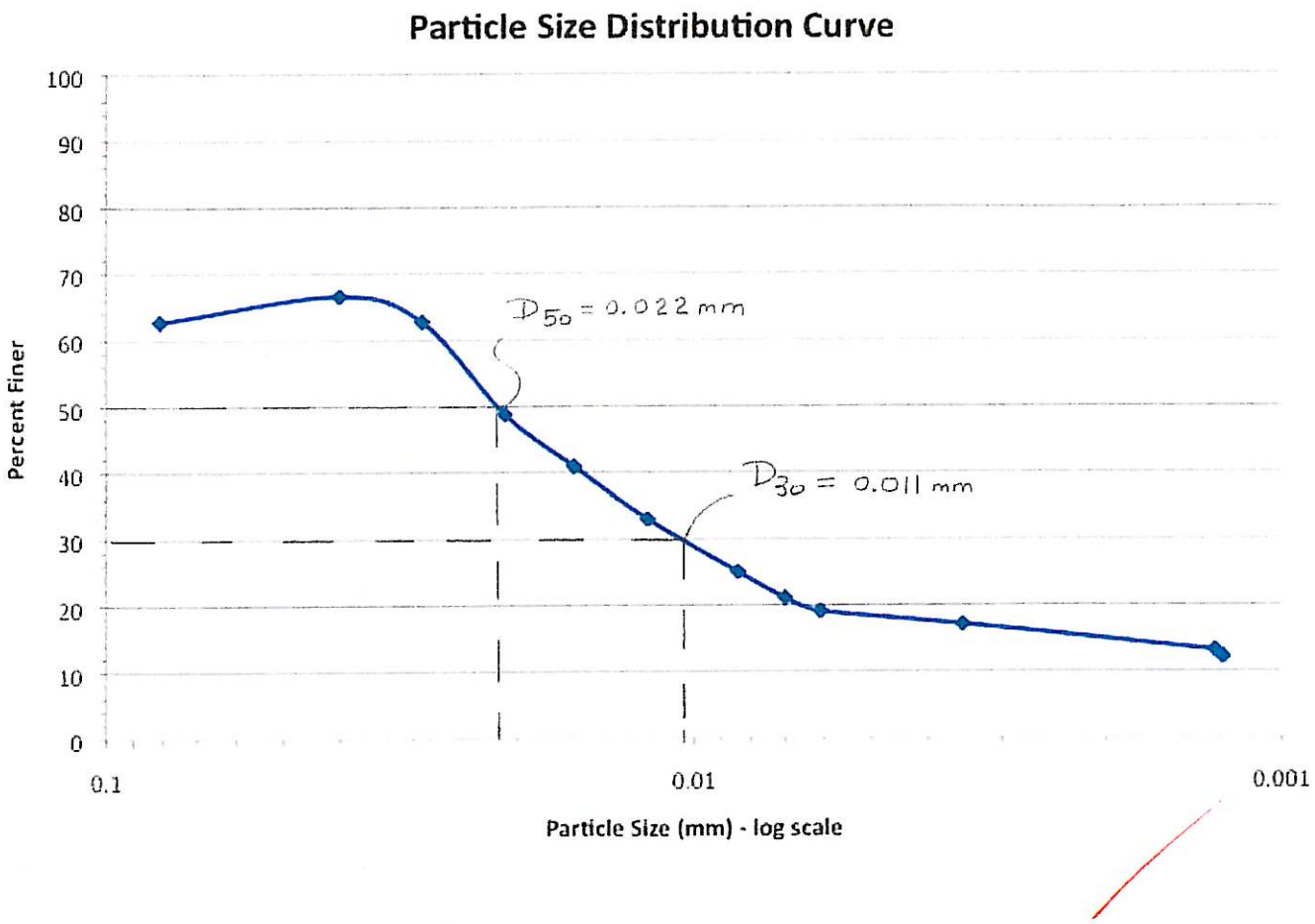
   for reading ... @ ... min

   Ex: Percent finer $= \dfrac{0.99x31.65}{50g}(100) = \boxed{62.7\%}$

4. $\mathbf{R_{cL}} = R + F_m$
   Ex: $R_{cL} = 35 + 1 = \boxed{36}$

5. $\mathbf{D\ (mm)} = A\sqrt{\dfrac{L(cm)}{t(\text{min})}}$

   Ex: $D\ (\text{mm}) = 0.0125\sqrt{\dfrac{10.6cm}{0.25\text{min}}} = \boxed{0.081\ \text{mm}}$



6. Conclusion:

From the results of the hydrometer analysis and my particle size distribution curve, I can conclude that the soil sample tested in this lab experiment is a well graded soil. A well graded soil is a soil whose particle sizes are distributed over a wide range.

Hydrometer Analysis

January 27th, 2010

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Objective:

To determine the particle size distribution of a soil sample for the fraction that is finer than 0.075mm (# 200 Sieve).

Equipment:

ASTM 152-H hydrometer
mixer
1000 cc graduated cylinder (2)
deflocculating agent
beaker
balance
plastic squeeze bottle
distilled water
No. 12 rubber stopper
spatula

Procedure:

1. Place 50 g of oven dry, well pulverized soil in a beaker.
2. Prepare a deflocculating agent. Usually a 4% solution of sodium hexametaphosphate is used. To prepare, add 40 g of sodium hexametaphosphate in 1000 cc of distilled water and mixing thoroughly.
3. Take 125 cc of this mixture and add it to the soil (in step 1).
4. Add 875 cc of distilled water and 125 cc of the deflocculating agent to a 1000 cc graduated cylinder. Thoroughly mix the solution.
5. Put this cylinder in a constant temperature bath and record the temperature, T (in °C).
6. Place the hydrometer in the cylinder (from step 5) and record the reading at the top of the meniscus. This is the zero correction, F_z; also take note of the meniscus correction, F_m.
7. Mix the soil prepared in step 3 using the spatula, and pour it into the mixer cup. Be sure to wash all the remaining soil in the beaker into the mixer cup.
8. Add enough water to the mixer cup to make it about 2/3^{rds} full. Mix the solution for about 2 minutes using the mixer.
9. Pour the mix into the 2nd graduated cylinder, making sure that all the soil solids are washed out of the mixer cup. Fill the cylinder with water to the 1000 cc mark.
10. Secure a No. 12 rubber stopper on the top of the cylinder (step 9). Mix the soil-water well by turning the cylinder upside- down several times.
11. Place the cylinder into the constant temperature bath next to the cylinder from described in step 5. Record the time immediately. This is time t=0. Insert the hydrometer into the cylinder containing the soil-water suspension.
12. Take hydrometer readings (from the top of the meniscus) at cumulative times t=0.25 min., 0.5 min., 1 min., and 2 min.
13. After the 2 min. reading, take the hydrometer out and place it in the cylinder next to it (from step 5).
14. Take hydrometer readings at t=4 min., 8 min., 15 min., 30 min., 1 hr., 2 hr., 4 hr., 8 hr., 24 hr., and 48 hr. Between readings, place the hydrometer into the cylinder prepared in

step 5. About 30 seconds before each reading, place the hydrometer into the soil-water cylinder. This is to prevent buildup of soil particles on the hydrometer, resulting in incorrect readings.

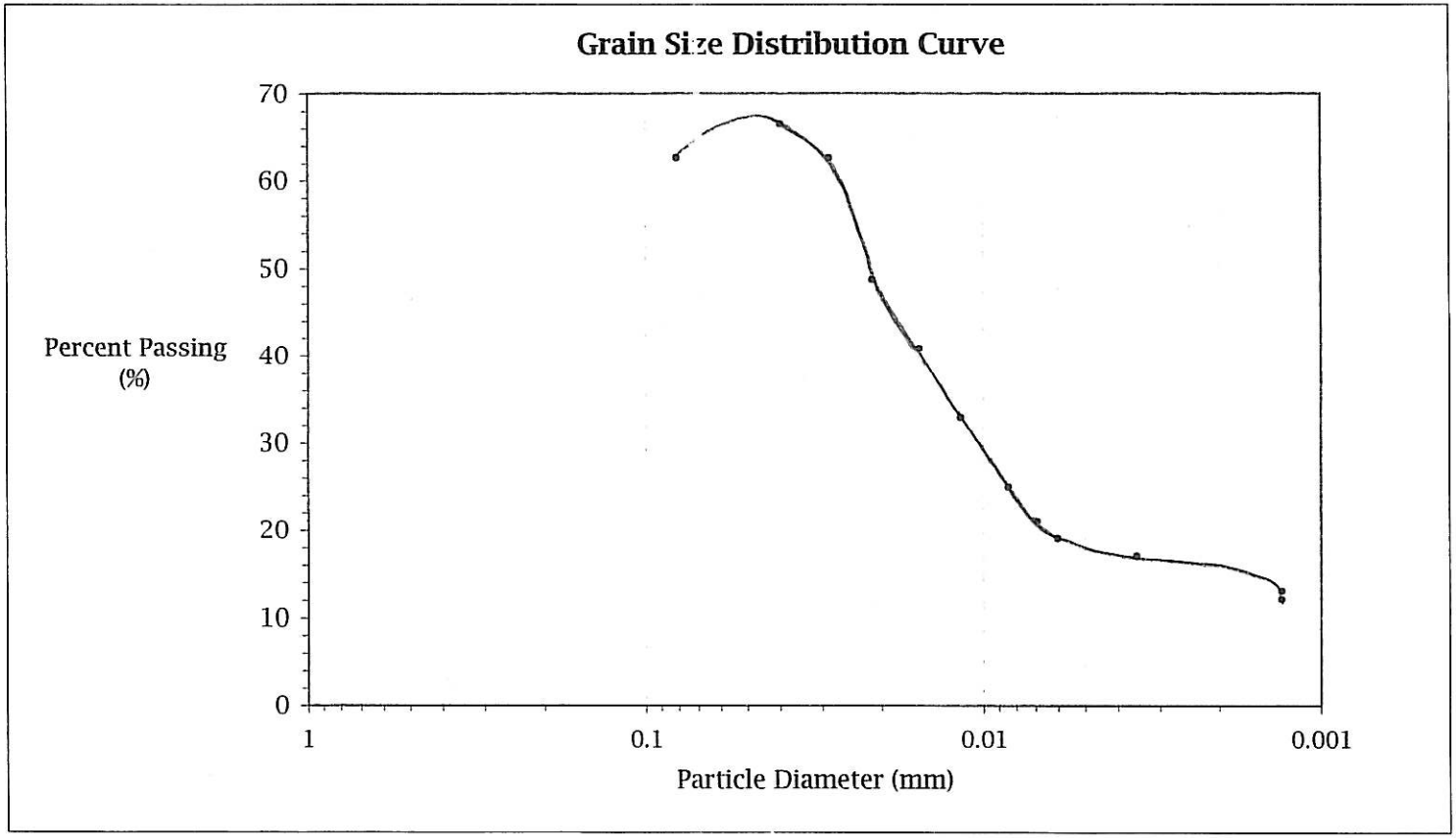
Data:

Time (min)	Hydrometer Readings R	R_{cp}	Percent Finer	R_{cL}	L (cm)	A	D (mm)
0.25	35	31.65	62.7	36	10.4	0.0125	0.0806
1	37	33.65	66.6	38	10.1	0.0125	0.0397
2	35	31.65	62.7	36	10.4	0.0125	0.0285
4	28	24.65	48.8	29	11.5	0.0125	0.0212
8	24	20.65	40.9	25	12.2	0.0125	0.0154
15	20	16.65	33.0	21	12.9	0.0125	0.0116
30	16	12.65	25.0	17	13.5	0.0125	0.0084
45	14	10.65	21.1	15	13.8	0.0125	0.0069
60	13	9.65	19.1	14	14.0	0.0125	0.0060
180	12	8.65	17.1	13	14.2	0.0125	0.0035
1290	10	6.65	13.2	11	14.5	0.0125	0.0013
1320	10	6.65	13.2	11	14.5	0.0125	0.0013
1460	9.5	6.15	12.2	10.5	14.6	0.0125	0.0013

Conclusion:

From the results of the calculations, the majority of the soil sample is comprised of particles less than 0.075 mm (# 200 Sieve). Only the first reading resulted in a diameter size greater than 0.075 mm, probably because the first reading was taken at 0.25 minutes (15 seconds) and there were still larger particles settling after the initial mixture of the solution. From the graph results, the grain size distribution indicates a ~~uniformly~~ WELL graded soil sample.

Sample Calculation?


Grain Size Distribution Curve
Percent Passing (%)
70
60
50
40
30
20
10
0
1
0.1
0.01
0.001
Particle Diameter (mm)