

## UT GeoMechanics Lab

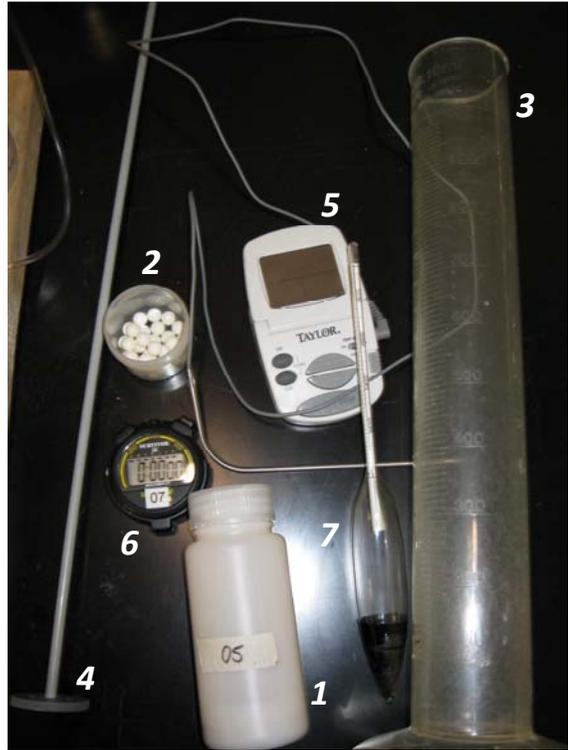
### Grain Size Analysis Procedure (in accordance to ASTM D0422-63R07)

*Note: Italic numbers refer to items in Figures 1, 2.*

#### Set up

1. Weigh out about 50g of air-dried sample (or less if 50g is not available).
2. Transfer sample into white shaking bottle (*1*).
3. Add 5g Sodium Hexametaphosphate.
4. Add de-ionized water until bottle is about 3/4 full.
5. Add 5 ceramic balls (*2*).
6. Shake well (Make sure sediment is not stuck to the bottom of the shaking bottle).
7. Allow material to temper for at least 16 hours.

*Figure 1: Materials needed for grain size analysis. (1) shaking bottle (2) ceramic balls (3) 1000mL cylinder (4) plunging rod (5) thermometer (6) stop watch and (7) hydrometer.*



#### Grain Size Analysis

1. Fill one 1000mL cylinder (*3*) with 1000mL de-ionized water.
2. Add 5g Sodium Hexametaphosphate.
3. Mix well with plunging rod (*4*) (until salt particles are dissolved).
4. Allow to sit and reach room temperature.
5. Place thermometer (*5*) in cylinder (*3*).
6. Fill another 1000mL cylinder (*3*) with about 900mL de-ionized water (Rinse Tube).
7. Shake white bottle (*1*) well again.
8. Remove ceramic balls (*2*) from suspension in shaking bottle (*1*).
9. Pour suspension into malt mixer (*8*).



*Figure 2: More materials needed for grain size analysis. (8) malt mixer (9) 63 micron sieve (10) red funnel (11) squirt bottle (12) evaporating dish.*

10. Remove remaining material in bottle (**1**) with de-ionized water and add to malt mixer (**8**) (try not to lose too much material during this process).
11. Fill mixer (**8**) up to ½ volume with de-ionized water.
12. Mix for 1 minute.
13. IF USING SIEVE:
  - a. Weigh 63 µm dry sieve (**9**).
  - b. Place large Red funnel (**10**) in a third 1000mL cylinder (**3**).
  - c. Place 63 µm sieve (**9**) on top of funnel (**10**).
  - d. Pour mixture through sieve (**9**).
  - e. Use de-ionized water in squirt bottle (**11**) to push as much sediment through as possible.
  - f. Place sieve (**9**) in oven until particles left are dry.
  - g. Fill cylinder (**3**) to 1000mL with de-ionized water.
  - h. Eliminate any air bubbles that are on the inside of the cylinder (**3**) with the plunging rod (**4**) (afterwards clean plunging rod off with de-ionized water above the suspension so that no sediment gets lost).
  - i. Allow to reach room temperature.
  - j. Weigh dry sieve (**9**) with sediment, record mass of dry sieve with sediment and of calculated dry mass only.
- IF NOT USING SIEVE:
  - k. Transfer suspension to a third 1000mL cylinder (**3**).
  - l. Fill cylinder (**3**) with de-ionized water to 1000mL.
  - m. Eliminate any air bubbles that are on the inside of the cylinder (**3**) with the plunging rod (**4**) (afterwards clean plunging rod off with de-ionized water above the suspension so that no sediment gets lost).
  - n. Allow to reach room temperature.
14. Mix suspension thoroughly with plunging rod (**4**) for one minute, starting with short strokes at the bottom and increasingly longer strokes towards the surface so that the entire suspension column is well mixed (do not accidentally pull plunging rod out of suspension which could result in material splashing around and incorporating air bubbles into the suspension).
15. Removal of plunging rod (**4**) marks beginning of sedimentation process (begin stop watch (**6**)).
16. Immediately place hydrometer (**7**) carefully in cylinder (**3**) without it bouncing up and down and take readings at 15s, 30s, 1 minute, 1:30 minute, and 2 minutes. Keep hydrometer in cylinder during these readings.
17. Take temperature reading of the de-ionized water and salt.
18. Remove hydrometer (**7**) and place in rinse tube (**3**) with a spin motion to remove sediment from hydrometer.
19. Stop the stop watch (**6**).

20. Remove hydrometer (7) from rinse tube (3) and dry off.
21. Remix suspension with plunging rod (4) for second set of readings.
22. Removal of plunging rod (4) marks beginning of sedimentation process (begin stop watch (6)).
23. Immediately place hydrometer (7) carefully in cylinder (3) without it bounding up and down and take readings at 15s, 30s, 1 minute, 1:30 minute, and 2 minutes. Keep hydrometer in cylinder during these readings.
24. Remove hydrometer (7) and place with a spin motion in rinse tube (3), another 1000mL cylinder filled with de-ionized water, to remove sediment from hydrometer.
25. Remove hydrometer (7) from rinse tube and dry off.
26. Insert the hydrometer (7) and take readings again at 4, 8, 16, 32 min, ect. until silt/clay boundary (2 micron) has been passed. Insert hydrometer about 20 seconds before reading is due to stabilize the hydrometer. Record exact time of readings if varied from default times. Cover cylinder with plastic wrap or glas petri dish between measurements to prevent evaporation and contamination.
27. After each reading, place hydrometer (7) in rinse tube (3) to collect the amount of sediment that was removed from the suspension via the hydrometer and dry it off before each reading.
28. Take temperature reading after each reading of sediment.
29. At the end of the experiment, get the mass of two evaporating dishes (12).
30. Pour slurry into one evaporating dish (12) making sure no sediment remains in cylinder (3).
31. Pour the rinse tube (3) into a separate evaporating dish (12).
32. Dry both in oven until no water remains (usually about 2 days).
33. Obtain final dry masses of evaporating dish (12) and sediment which includes the dispersing agent.

You can perform several hydrometer analyses at the same time (Figure 3). Prepare all samples first. Then start the hydrometer analysis one at a time. Wait till the 15 or 30



minute reading of the second run before you start another hydrometer analysis.

*Figure 3: Several hydrometer analyses performed at the same time. Image is from set up at Penn State showing malt mixer, sieve, hydrometer, thermometer and materials on right hand side.*

Last updated: October 12, 2010

Data Files are located on the server at:

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GeoMechanics\_Lab\GSD\Data