Field Sand Sieve Analysis

Preparation

To be able carry out a sieve analysis, the following materials are needed:

- 3-cycle logarithm paper – an example is annexed to this document;
- Set of sieves for sand analysis. A plastic set is available from www.geosupplies.co.uk. This set does not have larger mesh sizes, but is useful for field trips due to their weight;
- Electronic scales with the ability to weigh 200 grams accurately to within 0.1 gram;
- At least 200 grams of very dry sand.

Instructions

1. Stack the sieves with the coarsest at the top and the finest at the bottom.
2. Place a small container on the scales that will receive the sand (e.g. cut off the bottom of a plastic water bottle), and then zero the scales.
3. Mix the sand and then measure out approximately 200 grams into the top sieve.
4. Put the lid on and shake the sieve column. Theoretically you should shake for 10 minutes, but several minutes should suffice.
5. Weigh the sand retained by each sieve to the nearest 0.1 gram. This is done in a cumulative way – this means that you add what is remaining on the coarsest sieve on top to the container on the scales, and measure the weight. Following this, you add the material from the second sieve down, and again note the combined weight of both samples. Continue in this way for the whole set. When finished, check that the final weight corresponds to the initial weight of the sample.
6. Clean each sieve as it is emptied and return the sand to the stock.
7. Enter the results in Table 1. From this, you can calculate the percentage retained on each sieve, and correspondingly, the percentage passing. Note that to gain more accuracy, it might be worth doing 2 or 3 analyses of the same sand and then take the average reading.
8. Plot the results on 3 cycle logarithm graph paper.

For a worked example, see the table and graph on the next pages.

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16/04/2012

Worked example: recording results in the table

Source of sample: Shallow aquifer 4m depth

Description of sample: Medium well-sorted sand

Initial weight: 200 grams

Final weight: 198.2 grams

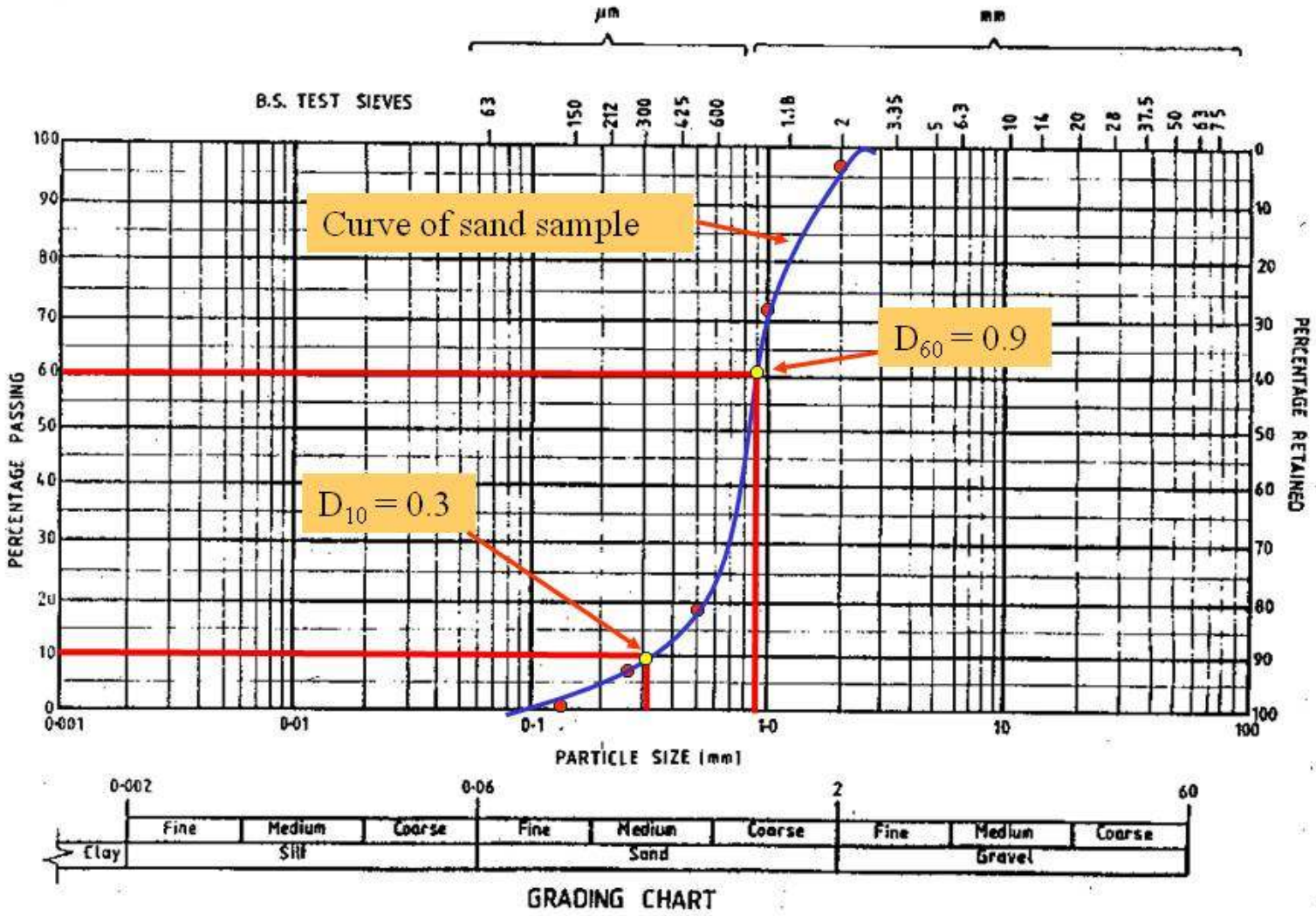
Sieve size (mm)	Weight retained (grams)	% Retained	% Passing
2	4.6	2.3	97.7
1	55.2	27.9	72.1
0.5	159	80.2	19.8
0.25	185.2	93.4	6.6
0.125	197.2	99.5	0.5
0.063	198.2	100.0	0.0
<0.063	198.2	100.0	0.0

Explanation of calculations in the table above:

- Final weight is often not the same as initial weight, because some grains often get lost when you decant the sand, or remain stuck in the sieve. However it is the final weight that should be used for the % calculations.
- Using the yellow highlighted row as an example: for sieve size 0.25 mm, a cumulative total of 185.2 grams were retained (which included the material from sieves 2 mm, 1 mm and 0.5 mm). This represented 93.4% of the total sample (185.2/198.2 x 100). The percentage passing was therefore 6.6% of the total sample (100 – 93.4).

Now use logarithmic paper to plot the data from the % passing data against sieve size – see graph on next page.

Worked example: plotting the grading curve



Worked example: analysing the grading curve

Explanation of plots in the graph above:

- To find the effective size:
  - This is simply the size at which 10% of the sample will pass through (referred to as D_{10}). Reading off the sand curve, we can see that in this case the D_{10} is 0.3mm, which is within the range of 0.15 – 0.35mm recommended for slow sand filtration.
- To find the uniformity coefficient:
  - Read off the sizes at which 10% (D_{10}) and 60% (D_{60}) of the sample will pass through. In this case, the D_{10} is 0.3mm and D_{60} is 0.9mm.
  - The D_{60} / D_{10} will indicate the slope of the line, which itself indicates the amount of grading in your sample (i.e. whether you have a whole range of grain sizes = gives a flatter curve, or whether you have more of a few grain sizes = gives a steeper curve) – this is the uniformity coefficient. In this case, it is 0.9 / 0.6 which gives 1.5, which is within the accepted range of 1.5 – 3 recommended for slow sand filtration.
- Having found both effective size and uniformity coefficient from our sample, we now know that this sand type would probably be suitable for a slow sand filter.

Sieve analysis data sheet

Source of sample: ----------

Description of sample: ----------

Initial weight: ---------- grams

Final weight: ---------- grams

Sieve size (mm)	Weight retained (grams)	% Retained	% Passing

Analysis carried out by: ----------

Date: ----------

Example of 3-cycle logarithm paper