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SEDIMENTATION ANALYSIS AT MORNI HILLS

Aditi Gupta[1], Arvind Dewangan[2]

1 Aditi Gupta, Civil Engineering Department, Haryana College of Technology & Management, Kaithal, India, er.aditi@hotmail.com

2 Arvind Dewangan, Civil Engineering Department, Haryana College of Technology & Management, Kaithal, India, arvinddewangan237@gmail.com

ABSTRACT

In a given soil, the percentage of different soil particles upto 75microns is determined by sieve analysis but the percentage of various soil particles finer than 75 microns is determined by hydrometer analysis. Hence, the hydrometer analysis is useful for knowing the percentage of silt in clay. In this paper, hydrometer analysis of fine sand sample from Morni Hills(Haryana, India) have been performed and the results presented. **Morni Hills** are an offshoot of Shivalik range, which run in two parallel ranges. The village of Morni (Bhoj Jabial) lies on the mountainside, at 1220 meters or 3600 feet above sea level.

Keywords: 1) Sedimentation, 2) Analysis, 3) Soil, 4) Moisture
Sub Area: Geotechnology
Broad Area: Civil Engineering

PROCEDURE

The test consists of three parts:

- Sieve analysis to determine the percentage of soil sample passing 75μ sieves
- Calibration of hydrometer
- Hydrometer analysis

Sieve Analysis

Wet sieve analysis was performed on this soil as the percentage of fines was more than 5%. 500g of the soil was taken and was sieved through 75μ sieve. The portion of the soil retained on the sieve was thoroughly washed with water until the water passing through the sieve was clean. This water is collected in a container. The fraction of material retained on sieve was tipped in a tray and dried in the oven. It was weighed again. The loss in mass gave the percentage passing

75μ sieve. Coarse sieve analysis was performed on this fraction of soil. The results have been tabulated.

Sieve Size	Mass of Soil Retained (g)	Cummulative mass of Soil Retained(g)	Cumulative %age of Soil Retained	%age finer
2mm	50	50	10	90
710μ	33	83	16.6	83.4
600μ	2	85	17	83
425μ	10.5	95.5	19.1	80.9
300μ	13.5	109	21.8	78.2
150μ	10.5	119.5	23.9	76.1
75μ	12	131.5	26.3	73.7
PAN	368.5	500	100	0

Therefore, percentage of soil passing 75μ sieve = 73.7%

Calibration of hydrometer

The readings on the hydrometer stem give the density of the soil suspension situated at the center of the bulb at any time. The hydrometer readings were recorded after subtracting 1 and multiplying the remaining digits by 1000. This reduced reading is designated as R_H. The depth H (height in cm between any hydrometer reading R_H and the neck of the hydrometer) can be converted to effective depth by using the following formula:

$h_e = H + K$ Where,

h_e = Effective Depth

H = Height in cm between any hydrometer reading R_H and the neck.

$K = 0.5(h-V_h/A)$

V_h = Volume of the hydrometer

The following observations were made during the hydrometer analysis:

H = 9.555cm

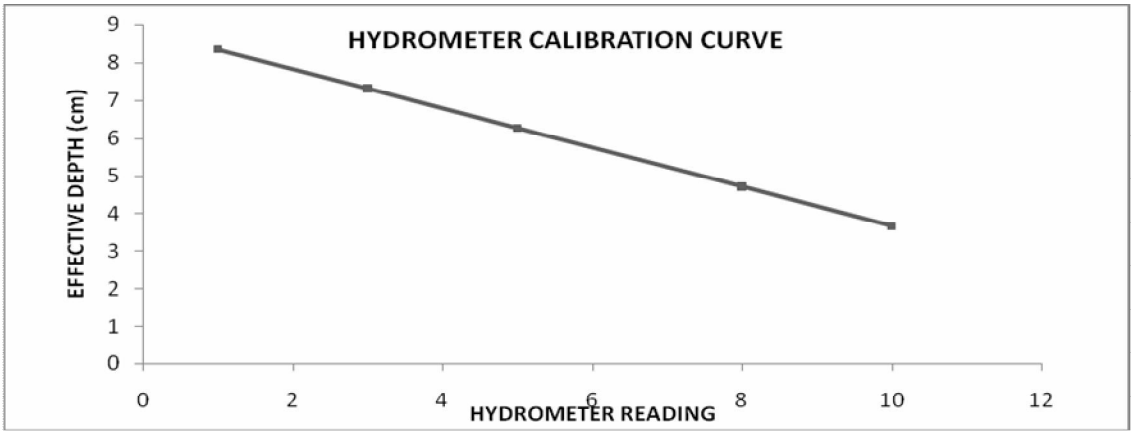
$A = 40.8cm^2$

V_h = 90ml

Therefore, the value of K works out to 3.675cm

Hydrometer Reading, R_H	H(cm)	$h_e = H + K$
1	4.68	8.355
3	3.64	7.315
5	2.6	6.275
8	1.04	4.715
10	0	3.675

The effective depth versus hydrometer readings graph was plotted for calibration of the hydrometer.



Hydrometer Analysis

A dispersing agent solution was prepared by dissolving 33g of sodium hexameta-phosphate and 7g of sodium carbonate in distilled water to make 1 litre of solution. 25g of oven dried soil passing from 75micron sieve was placed in an evaporating dish and covered with 100cc of dispersing solution. This was warmed gently for about 10minutes. Then this solution was transferred to a 1000cc graduated cylinder and stirred using distilled water until the cylinder was three fourth full and stirring was done for about 10minutes. The hydrometer was kept clean in a 1000cc jar filled with distilled water and 100cc dispersing solution. The graduated jar containing the sample was filled with water upto 1000cc mark and a thorough mixing was done. The jar was placed on the table and the hydrometer was inserted in it immediately. The stop watch was started simultaneously. The first reading in the hydrometer was observed after 2min 33seconds. Further readings were taken and recorded in the table as shown.

Corrections

Meniscus Corection (MC)

This correction is incorporated to compensate for the lesser reading of the hydrometer observed due to opacity of soil suspension. The hydrometer was inserted in a cylinder containing about 1000cc of water. The readings of the hydrometer at the top and at the bottom of the meniscus were noted. The difference between the readings is taken as the meniscus correction, which is constant for a hydrometer. In this case, the value of this correction was 0.5. Since soil suspension is opaque, the readings should be taken at the bottom of this meniscus but the opacity of the suspension prevents this. The readings are perforce taken at the top meniscus. Thus, the observed readings are always less than the actual ones. Therefore, this correction is positive in nature and is additive.

Composite Correction (CC)

This correction is adopted to take care of the dispersing agent used during the test. 100cc of the dispersing agent solutionwas taken in a 1000cc jar and was made to 1000cc by adding water to it.

The hydrometer is inserted in this cylinder and readings of top meniscus are noted. The negative of the hydrometer readings so obtained is the composite correction. These readings were taken after each hydrometer reading was taken in the test cylinder. The value of this correction was taken as -1.

The values of the hydrometer reading were then corrected by incorporating these corrections and used in further calculations. If 'R' is the observed hydrometer reading, then the corrected reading is equal to (R+MC-CC)

OBSERVATIONS AND CALCULATIONS

Basic Parameters:

a) Percentage of soil passingμ sieve = 73.7
b) Mass of dry soil taken (passing 75μ sieve), W_D = 25g
c) Specific Gravity of the soil, G_S = 2.88
d) Factor $N = \frac{G_S}{G_S-1} X \frac{100}{W_D} = 6.13$

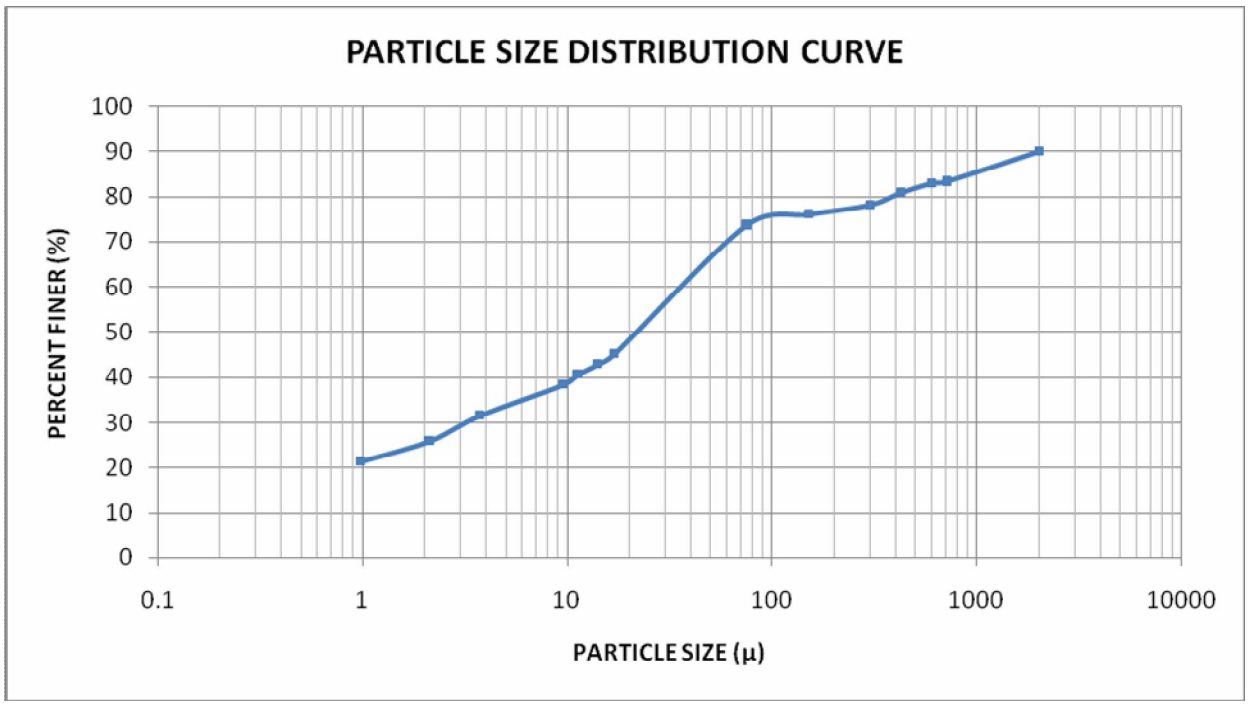
Table below shows the various readings of the test done on the soil sample:

Elapsed Time (t min)	Hydrometer Reading, (R_H)	Temp (T°C)	Eff. Depth, (h_e cm)	√h/t	Viscosity, η (g/cm/cm^2) X 10^{-6}	Factor M*10^{-4}	Particle Size (C mm)	% finer w.r.t. wt. WD (F)	% finer w.r.t. total mass
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) = (5) X (7)	(9) = (2) X N	(10) = (9) X (a)
2.33	10	35	3.675	1.51	7.21	1.073	1.695 X 10^{-2}	61.3	45.178
3	9.5	35	3.935	1.31	7.21	1.073	1.405 X 10^{-2}	58.235	42.91
4	9	35	4.195	1.05	7.21	1.073	1.126 X 10^{-2}	55.17	40.66
5	8.5	35	4.455	0.89	7.21	1.073	9.546 X 10^{-3}	52.105	38.4
15	7	35	5.235	0.35	7.21	1.073	3.754 X 10^{-3}	42.91	31.62
30	5.75	34	5.885	0.196	7.36	1.083	2.124 X 10^{-3}	35.25	25.97
60	4.75	33	5.365	0.09	7.51	1.095	9.85 X 10^{-4}	29.12	21.46
120	3.3	33	7.159	0.06	7.51	1.095	6.57 X 10^{-4}	20.23	14.9
180	3	33	7.315	0.04	7.51	1.095	4.38 X 10^{-4}	18.39	13.53
1320	1.5	32	8.095	0.006	7.67	1.106	6.6 X 10^{-5}	9.195	6.77
1440	1.5	32	8.095	0.0056	7.67	1.106	6.2 X 10^{-5}	9.2	6.78

RESULTS

The mechanical sieve analysis and hydrometer and hydrometer analysis results are combined to obtain a sieve size and percentage finer table

SIEVE SIZE (μ)	%AGE FINER
2000	90
710	83.4
600	83
425	80.9
300	78.2
150	76.1
75	73.7
16.95	45.178
14.05	42.91
11.26	40.66
9.546	38.4
3.754	31.62
2.124	25.97
0.985	21.46



CONCLUSION:

For coarse grained soils, particle size is indicative of physical properties and is significant in the assessment of drainage, frost heave, permeability etc. This paper reveals that the soil consisting of grains of non-uniform size which may have the uneven permeability as a graded soil of great range. Hence, because of plasticity property of soil, it undergoes deformation without breaking.

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