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Conceptual Theory and Sieve Analysis of Regular Plaster Sand

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Abstract: *An extensive collection of construction work in structural construction requires construction materials such as plaster sand are required as the performance and quality of the final product is anchored to the particle size and shape of the raw materials and thus involves quality control by particle characterization. This article described and modelled a standard plaster sand with a grain size distribution theory [y= 18.673 ln (x) + 47.981 (R^2=0.9713)]. The extrapolated results announce the coefficient of uniformity [Cu=14.5528] and curvature [Cc=27.5530] as indices of poor gradation with the plaster sand category adopted.*

Keywords: Plaster sand, particle size distribution, structural construction, uniformity coefficient and uniformity curvature.

1.0 INTRODUCTION

In the terrestrial environment, soil represents a stratified system of great complexity. This is not just a connection between other components of the environment, but as well a key bridge between the synthetic and organic agents [1]. The spread by the soil particle size (PSD) is of critical interest for the transportation of soil water systems, soil degradation, and movement of soil solutions. Thus it is recognized as a significant physical parameters of the soil that defined its hydraulics in relationship with other parameters, such as the hydraulic conductivity, curve characteristics of soil water density, porosity, residual water quality, retention of water and relative permeability [1]. Analysis of particle size for sand particles requires the determination of the frequency at which particles exist within the groups or ranges of the specified size [2]. In this model of definition, the challenge is the product of the broad variety of techniques available to obtain and distribute the particle size. The strategies to evaluate the allocations of the sand particle sizes are categorized on the types and nature of particles. The coarse portion granulometry (bigger than the ABNT 200 0.074 mm sieve) is performed by direct estimation with sieving. Sieving describes the methodology for assessing the arrangement of grain size in soils. Such a study quantitatively illustrates the ratios of the different sizes of particles found in the soil by mass. Gravel, sand, silt and clay fractions are accepted in the soil as comprising particles of diminishing magnitude [3]. By using various particle sizes, a grade size distribution curve is investigated: D60, D30 and D10. The graph is the chart drawn on the logarithmic scale between the finer percentages in y-axis to the particle size in x-axis. Based on the findings from sieve analysis carried out on the soil sample, this is plotted. D10 is considered the average size of a particle. That implies that 10% of the sands sample are finer while 90% are coarser than D10 which is the size by weight at 10 per cent finer. Likewise, D60 equals the sand particle size as 60% sand particulates are finer while 40% are coarser. The size of D30 is 30 percent smaller by mass, as the residual 70 percent are coarser than the size of D30 as they are used for assessing the gradation measurements. The grading features of the soil are the coefficients of uniformity (Cu) with curvature (Cc) and the net size (D10). These are the grading curve's numerical characteristics that define a specific type of soil. The uniformity constant (Cu) is express by the D60 to D10 ratio. A Cu value more of 4 or 6 designates the soil as being well graded and as poorly or uniformly rated as Cu is lower to 4. Uniformly graded soils have equivalent particles approximately equal to1 with a Cu value. A factor of 3 to 2 with the coefficient of uniformity defines the sand specimen as poorly graded. The higher Cu value suggests that the mass of the soil is made up of soil particles of various size ranges [4].

$$Cu = \frac{D60}{D10}$$

$$Cc = \frac{(D30)^2}{D60 \times D10}$$

The value of Cc must range within 1 to 3 for the soil to be well graded. The value of both Cu and Cc is1. For every single sized soil mass. In soil classification, the outcomes of grain size analysis are extensively employed I In the design of earth dam filters, the data obtained from grain size distribution curves is used to assess the suitability of soils for highway construction. Plastering sand material is

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regularly applied to produce a safe and attractive surface for brickworks in building projects. It is important to use the right sand for plastering as it must be highly workable and cohesive with strong water retention capabilities in its natural state. The characteristics and consistency of natural covering depend heavily on the materials and proportions of the blend with strong resistance to abrasion impact and adequate strength in the dry state of the coating However, sand characteristics decide whether or not the material can be engaged for plastering. [5].This study decided to mathematically model a theory that will estimate a well graded fractions of soil on the basis of the same poorly distributed soil particles or samples.

2.0 MATERIALS AND METHOD

Analytical balance, Sieves (20 mm IS Sieve, 10 mm IS Sieve, 4.75 mm IS Sieve, 2.00 mm IS Sieve, 1.18 mm IS Sieve, 600 µm IS Sieve, 425 µm IS Sieve, 300 µm IS Sieve, 212 mm IS Sieve, 150 µm IS Sieve, 75 µm IS Sieve and Pan).

2.1 Sieve analysis

The analysis was conducted according to ASTM D6913M standard.

Figure 1. A typical plaster sand

3.0 RESULTS AND DISCUSSION

Table 1. Plaster sand particle size distribution (dry method)

SN	Sieve size (mm)	Mass Retained (g)	Mass Retained (%)	Cumulative mass retained (%)	% Fineness
1	20.00	33.00	3.30	3.30	96.70
2	10.00	49.00	4.90	8.20	91.80
3	4.75	85.00	8.50	16.70	83.30
4	2.00	140.00	14.00	30.70	69.30
5	1.18	160.00	16.00	46.70	53.30
6	600 µm	142.00	14.20	60.90	39.10
7	425 µm	118.00	11.80	72.70	27.30
8	300 µm	82.00	8.20	80.90	19.10
9	212 µm	56.00	5.60	86.50	13.50
10	150 µm	35.00	3.50	90.00	10.00
11	75 µm	23.00	2.30	92.30	7.70
12	Pan	77.00	7.70	100.00	0

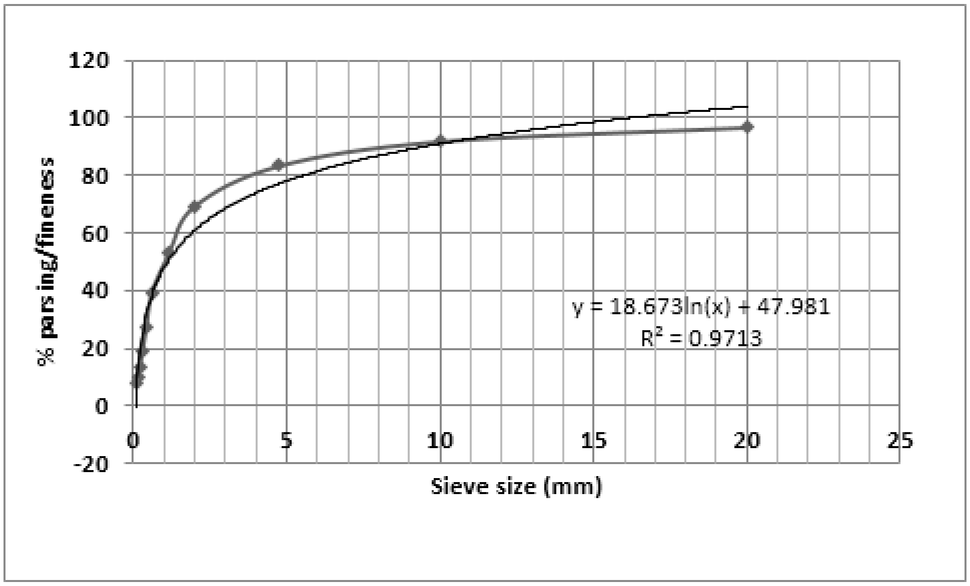

Figure 2. Sieve analysis plot of a typical plaster sand

The equation y= 18.673 In (x) + 47.981 (R^2= 0.9713) was induced from the interactive plot of the percent passing against the sieve sizes of the selected plaster sand.

Table 2. Estimation of the coefficients of uniformity [Cu] and curvature [Cc].

Factor	Model	Logarithm form	Indices form	X (sieve size) mm
D_{10}	$18.673\ln(X_{10}) + 47.981=10$	$Log_eX_{10} = -2.0340$	$e^{-2.0340}$	0.1308
D_{30}	$18.673\ln(X_{30}) + 47.981=30$	$Log_eX_{30} = -0.9629$	$e^{-0.9629}$	2.6193
D_{60}	$18.673\ln(X_{60}) + 47.981=60$	$Log_eX_{60} = 0.6437$	$e^{-0.6437}$	1.9035
	Coefficient of Uniformity [Cu]	Coefficient of curvature [Cc]		
	$D_{60} / D_{10} = \frac{1.9035}{0.1308}$ 14.5528	$(D_{30})^2/ D_{60} \times D_{10} = \frac{(2.6193)^2}{1.9035 \times 0.1308}$ 27.5530		
Remark	Poorly graded	Poorly graded		

Where constant e or Euler's number is: = 2.7183

The logarithmic curve above was determined by the plaster sand particle size analysis on a dry basis with a net mass of 100g according to ASTM standards. The curvature and uniformity coefficients specifically express the gradation of the sand sample to be heterogeneous in nature and categorically weak. The overall sand particle mass of the soil defines the entire distribution of the particle size of the soil, and largely determines the fractal and multifracta specifications of the distribution of the particle size of the soil. However as the size and shape distributions can influence the compaction of suspensions, and thus the compression rate and final strength of a building material, the

impact of oversized particles may basically be breakages due to inhomogeneous materials.

4.0 CONCLUSION

Construction materials vary from natural resources such as rock, clay, sand, and wood to synthetic polymers and various composite combinations with their distribution of particle sizes with different effects on the building materials, such as a large distribution or too many fines decreasing flowability, segregation of size and increased viscosity of irregularly shaped particles. Inconsistent and heterogeneous combinations are maintained in the modelled plaster sand distribution profile, which are expected to improve their aggregation with binders.

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