Group report: Sieve Analysis

NAMES	ID NUMBER	TASK
ABUBAKAR YASIN	21513651	INDRUCTION CHAPTER 1
KAINE JOSEPH	21579158	CONCLOSION
Alejandro patino	21557102	METHOOLGY 2ND INTRO CHAPTER 2
Marcus Daniel	21548768	DISCUSION
Thomas gill	21588758	Aims & Objectives:
Abdalnaser Gonbos	21539796	RESULTS GRAPH

Chapter 1: Introduction to sieve analysis

What is Sieve analysis?

Sieve analysis and grading is an important technique used in the field of geology, construction, and agriculture to evaluate the particle size distribution of a sample of material. The process involves passing the sample through a series of sieves with progressively smaller openings and determining the percentage of the sample that is retained on each sieve. This information can be used to determine the gradation, or distribution, of particle sizes within the sample. In this report, we will explore the principles of sieve analysis and grading and the equipment and procedures used in the process. We will also discuss some of the limitations and potential sources of error in sieve analysis and grading and provide recommendations for how to minimize these issues. The purpose of this report is to provide a comprehensive overview of sieve analysis and grading, and to serve as a valuable resource for anyone looking to gain a deeper understanding of this technique. [1]

Chapter 2: results and analysis

Introduction:

Sieve analysis and grading is an essential tool in a wide range of industries, as it provides valuable information about the particle size distribution of a sample. This information can be used to ensure that a product meets certain specifications, or to evaluate the quality of a material. The results of sieve analysis and grading can also be used to make informed decisions about how a material should be used or processed.

Sieve analysis and grading also plays a critical role in quality control and quality assurance, ensuring that products meet specified standards and are suitable for their intended use. It is also a crucial part in research and development, where researchers use the results of sieve analysis and grading to optimize the properties of a material or develop new products. [2]

Aims and objectives:

1. Determining the particle size distribution of a sample: The primary aim of sieve analysis is to determine the percentage of the sample that is retained on each sieve. This information can be used to create a particle size distribution curve, which can be used to evaluate the gradation of the sample.
2. Evaluating the quality of a material: By analysing the particle size distribution of a sample, it's possible to determine if it meets certain specifications or if it is suitable for a particular application.
3. Understanding the behaviour of granular materials: By relating the particle size distribution to the probability of the normal distribution, it is possible to understand the behaviour of granular materials. This helps in the field of material science and engineering.
4. Optimizing the properties of a material: The particle size distribution of a material can be used to optimize its properties. Researchers can use the results of sieve analysis to develop new products or to improve existing ones.
5. To evaluate the consistency of the material production: Repeatability and reproducibility of the test are important part of sieve analysis. It can be used as a part of quality control to check the consistency of the production.
6. To provide data for theoretical modelling: The data from sieve analysis can be used to verify theoretical models and to improve understanding of the behaviour of particulate systems.

Methodology:

The main method we followed for the sieve analysis experiment is as follows:

1. Sample preparation: The sample was prepared by mixing sand and gravel, and the initial weight were taken (1200g). The scale, which was calibrated beforehand, tells us the starting weight of our sample which we will refer to throughout our experiment. [3]


2. Sieving: The sample was then passed through a series of sieves with progressively smaller openings going from 10mm to 0.063mm. This sieve was made from stainless steel, but they could also be made from brass, and they are stacked in order of decreasing mesh size. This is to be able to evaluate the sizes of the different particles within the mix.

-
- In our experiment we began with 1200g of the mix, we proceed to put 600g and then we put the other half to improve accuracy. The sample was then shaken and vibrated for a specific period, about 3 to 4 minutes, to ensure that the particles had a chance to pass through the mesh.
-

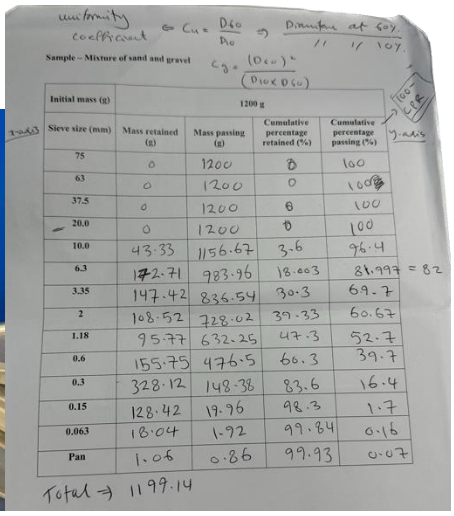
-

3. Weighing: After sieving, each sieve was weighed to determine the mass of the material that has been retained on it, it is recommended to use a brush to make sure all particles are included and avoid accuracy problems Shouldn’t lose more than 2% (in this case 24g)

-

4. Calculation: The percentage of the sample that is retained on each sieve was then calculated by dividing the mass of the material retained on the sieve by the total mass of the sample.

-



uniformity coefficient ⇐ $C_u = \frac{D_{60}}{D_{10}}$ ⇒ $\frac{\text{Diameter at } 60\%}{\text{〃 〃 } 10\%}$

Sample – Mixture of sand and gravel

$C_g = \frac{(D_{30})^2}{(D_{10} \times D_{60})}$

100 − CPR

x-axis

y-axis

Initial mass (g)	1200 g			
Sieve size (mm)	Mass retained (g)	Mass passing (g)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
75	0	1200	0	100
63	0	1200	0	100
37.5	0	1200	0	100
20.0	0	1200	0	100
10.0	43.33	1156.67	3.6	96.4
6.3	172.71	983.96	18.003	81.997 = 82
3.35	147.42	836.54	30.3	69.7
2	108.52	728.02	39.33	60.67
1.18	95.77	632.25	47.3	52.7
0.6	155.75	476.5	60.3	39.7
0.3	328.12	148.38	83.6	16.4
0.15	128.42	19.96	98.3	1.7
0.063	18.04	1.92	99.84	0.16
Pan	1.06	0.86	99.93	0.07

Total ⇒ 1199.14

5. Plotting: A particle size distribution curve is plotted by plotting the percentage of the sample retained on each sieve against the mesh size of the sieve. This curve was used to evaluate the gradation of the sample.
6. Analysis: The data was analysed to find the values of Cumulative % retained and Cumulative % passing for each sieve size and also allow to determine the Cu (D60/ D10)
7. Repeatability and reproducibility: Although in our experiment we did not test using multiple samples, it is commonplace to repeat the test using another sample of the same material. This is used to compare the results and check for repeatability and reproducibility.

It is important to keep in mind that the actual procedure may differ depending on the specific application or industry. However, this general method provides a good overview of the steps involved in a sieve analysis experiment.

Results:

The results shown have been gathered using our methodology listed above.
The results have been neatly recorded in the table below.

- The mass passing is recorded in grams. We found how much mass had passed by subtracting the mass retained by the initial mass. We express this as Bn=Bo-Ac where "Ac" is the cumulative mass retained.
- The cumulative retention of the sample is shown as a percentage. We were able to find this value using the following formula [C=1200-bn/1200 x100] To break this down; To be able to find C (cumulative retention) take the initial mass, 1200 and subtract Bn. The result is then divided by 1200 and multiplied by 100 to get a value out of 100%.
- The cumulative passing is also shown as a percentage. We were able to find this value using a simple formula. Since we know the percentage retained is out of 100% we simply apply 100- C to give us the percentage passed.

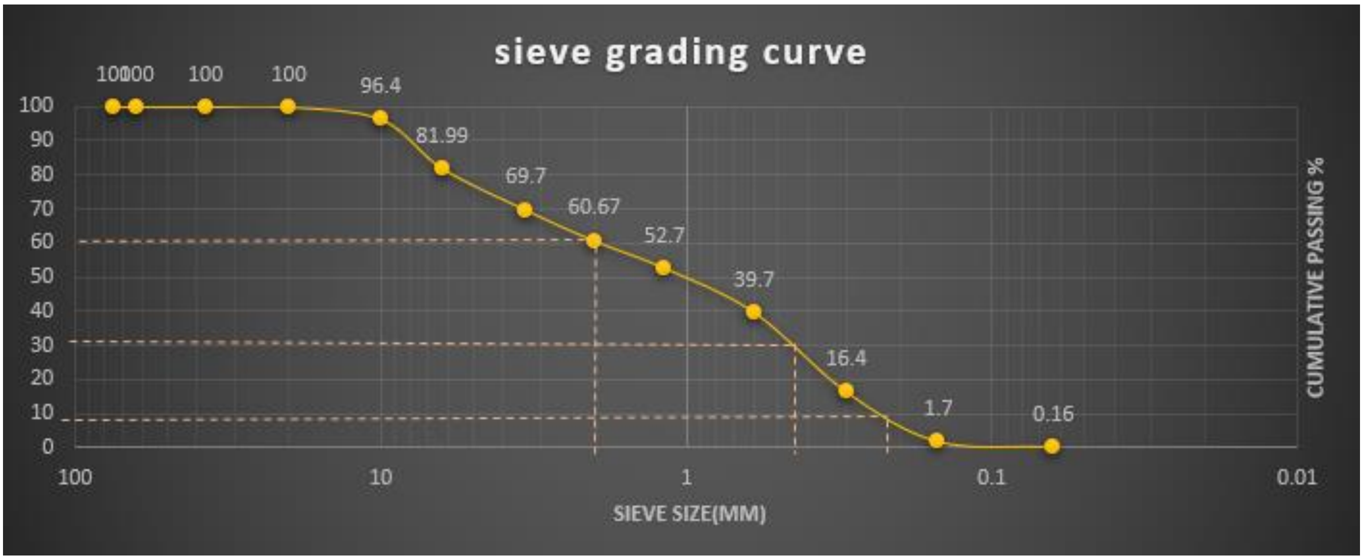
sieve grading curve				
Initial Mass (g), Bo= 1200g				
-		$C = 1200\text{-Bn } /1200 \text{ x}100$		
Sieve size(mm)	Mass retained (g)	**Mass passing (g) Bn=Bo-Ac**	**Cumulative % retained= C**	**Cumulative % passing** 100 - C
75	**0**	**1200**	**0**	**100**
63	**0**	**1200**	**0**	**100**
37.5	**0**	**1200**	**0**	**100**
20	**0**	**1200**	**0**	**100**
10	**43.33**	**1156.67**	**3.6**	**96.4**
6.3	**172.71**	**983.96**	**18.003**	**81.99**
3.35	**147.42**	**836.54**	**30.3**	**69.7**
2	**108.52**	**728.02**	**39.33**	**60.67**
1.18	**95.77**	**632.25**	**47.3**	**52.7**
0.6	**155.75**	**476.5**	**60.3**	**39.7**
0.3	**328.12**	**148.38**	**83.6**	**16.4**
0.15	**128.12**	**19.96**	**98.3**	**1.7**
0.063	**18.04**	**1.92**	**99.84**	**0.16**
Pan	**1.06**	**0.86**	**99.93**	**0.07**
$\boldsymbol{Ac\ is\ the\ cumulative\ mass\ retained}$				

Grading curve

This Results are be represented by the sieve grading curve shown below.
The results of the sieve grading curve can provide us with lots of information regarding the granular makeup of the sample.

1. Particle size distribution; The graph shows us the proportion of the material which is made up of a particular size at each interval. This information can be used to determine whether a material is well-graded (meaning it has an even distribution of particle sizes) or poorly graded (meaning it has a skewed distribution of particle sizes). In this case our graph shows our sample to be poorly graded due to the influx of material being disproportionally collected within the middle section.
2. The maximum particle size; The curve can show the largest particle size present in the material. This is important to know because it can help to determine the suitability of the material for certain applications.
3. The effective size, D10, is a measure of the particle size distribution of the sample. It specifies the point where 10% of the sample material is finer than it and the remaining 90% to be coarser than it. Our results show D10 representing a value of 0.25
4. The uniform coefficient is a good indicator of the uniformity of the particle sizes in a sample. It is used alongside coefficient graduation and other parameters to help determine the particle size distribution of a sample. We represent this value as Cu, to calculate Cu; Cu= D60/D10 2/0.25=8
5. The coefficient graduation, as stated, helps to describe the particle size distribution of a sample. The value we get from calculating the Coefficient graduation will help us to determine if our sample has a well graded distribution compared to similar materials. We represent this value as Cc, to calculate Cc; Cc= D30^(2)/D60xD10
   0.48^(2)/2x0.25=0.4608

The soil is well graded if $1 \leq \boldsymbol{Cg} \leq 3$ and $\boldsymbol{Cu} > 4$ ($\boldsymbol{for\ Gravels}$) $\boldsymbol{or} > 6$ ($\boldsymbol{for\ sands}$) If it does not meet the above, then we say the soil is poorly graded.



uniformity coefficient $\Leftarrow C_u = \frac{D_{60}}{D_{10}} \Rightarrow \frac{\text{Diameter at } 60\%}{\text{" " } 10\%}$

Sample – Mixture of sand and gravel

$C_g = \frac{(D_{60})^2}{(D_{10} \times D_{60})}$

Initial mass (g)	1200 g			
Sieve size (mm) x-axis	Mass retained (g)	Mass passing (g)	Cumulative percentage retained (%)	Cumulative percentage passing (%) y-axis 100-CPR
75	0	1200	0	100
63	0	1200	0	100
37.5	0	1200	0	100
20.0	0	1200	0	100
10.0	43.33	1156.67	3.6	96.4
6.3	172.71	983.96	18.003	81.997 = 82
3.35	147.42	836.54	30.3	69.7
2	108.52	728.02	39.33	60.67
1.18	95.77	632.25	47.3	52.7
0.6	155.75	476.5	60.3	39.7
0.3	328.12	148.38	83.6	16.4
0.15	128.42	19.96	98.3	1.7
0.063	18.04	1.92	99.84	0.16
Pan	1.06	0.86	99.93	0.07

Total $\Rightarrow$ 1199.14

Chapter 3: Discussion and conclusions

In this section we are going to discuss the conclusions we have reached after our report in order of most to least important, this will be done by comparing our results and find out if they are consistent. Furthermore, we will describe some limitations and challenges we have faced to show the readers we have considered some weakness of our analysis. Finally, we will discuss what our result mean and how we used them to determine our final conclusion

-

In order to have an accurate/meaningful Sieve test you must ensure that there is a representative part-sample that is identical to the material being sampled/tested. In this case we have a mixture of 1200 grams consisting of sand and gravel.

In the sieve analysis experiment, what we find is that our results indicate poor grading due to the amount of material that was collected in the middle sieves, giving us a uniform coefficient of D60/D10, with a coefficient gradation of 8. This indicates that the sample was made up of 60% fine material and 40% coarse material. From this we understand that this material is not suitable for construction purposes.

In the future several steps can be taken to improve the accuracy of results and decrease potential sources of error. For one Cleaning the scale with a brush to rid its surface of any particles to have more accurate weight readings. Secondly, cleaning each individual sieve for leftover dust and particles will also help in producing much more accurate results.

Inconclusion, we can see by using sieve analysis and grading technique we are able to identify the particle size distribution of a sample and through that it has led us to evaluate the overall quality of the material. Moreover, through using this technique it has further helped us to gain the knowledge of how the quality control is needed in the project. Also because of the low investment cost and we can do it more than once repeatedly as that enable us to gain specific results letting us conclude that the test is indeed very accurate. With the results we gain by doing the test we ended with nearly 100% the cumulative mass retained at 99.93% and the cumulative results passing 0.07 % conveying that the test was accurate and what we were aiming for from the start was achieved.

References:

You need to use references for all sources which have been used from the literature. You need to follow Harvard referencing

[1] Gupta, A. *et al.* (2021) *Sieve analysis, Properties and Behaviour of Soil Online Lab Manual*. Mavs Open Press. Available at: **https://uta.pressbooks.pub/soilmechanics/chapter/sieve-analysis/** (Accessed: January 12, 2023).

[2] Clyde, W. (2019) *How to perform a test sieve analysis (preparation, steps, & tips + video), W.S. Tyler Blog*. Available at: **https://blog.wstyler.com/particle-analysis/how-to-perform-a-test-sieve-analysis** (Accessed: January 12, 2023).

[3] Sponsored by RETSCH GmbHAug 11 2017 (2019) *Different sieving methods for varying applications, AZoM.com*. Available at: **https://www.azom.com/article.aspx?ArticleID=14339** (Accessed: January 12, 2023).