AI-generated AbstractThis document outlines a comprehensive method for conducting sieve analysis on fine and coarse aggregates. It describes various parts of the analysis including weight-based dry and washed sieve methods, as well as volumetric analysis. The paper provides necessary equipment specifications, sample size requirements, and guidelines for executing the tests effectively. When selecting aggregate for commercial use, there are a number of tests the product goes through to evaluate its suitability for a certain application. Among these tests is a sieve analysis. A sieve analysis helps companies to evaluate aggregate for use as a quality product in pathway mixes, architectural and decorative precast concrete, epoxy resin applications, epoxy overlay, and much more. We've put together a quick summary that highlights the significance of sieve analysis and why it matters to the aggregate industry. Evaluating Aggregates for Their Intended Uses The practice of sieve analysis is especially important for the performance of aggregates in their intended uses. Each of these uses will require a specific size or gradation of aggregate, including the percentage of material allowed for each sieve size in the gradation. This can be critical for the strength of the material, compaction of the aggregate, and the visual aesthetic and surface area of the stone.In other words, the process of sieve analysis assists with the gradation of aggregates. What Is Gradation in Sieve Analysis? The gradation of aggregates is the distribution of aggregate particles, by size, within a given sample. The purpose of gradation in this capacity is to enable compatibility of the aggregate with product control requirements, designs, and verification specifications. Gradation via sieve analysis works particularly well for aggregates because of the shapes of the stones and particles. Material that is not somewhat spherical—say, closer to cylindrical—may not lend to successful sieve analysis. Sieve Analysis: Step by Step The procedure of sieve analysis starts with the stacking of sieves, or screens, from the largest to the smallest size. Typically, the mesh of these sizes can range from 1 inch or 25.4 mm to what's known as the "No. 400" or .037 mm of an opening. Then, the bulk aggregate is placed carefully on the top sieve and the material is screened through the various sieves and subsequently become separated by size. Aggregates that couldn't pass through a ⅜" sieve screen, for example, will stay in that sieve while the others pass through until they're caught in the proper sieve. However, simply dumping your aggregate through sieves is not enough for accurate parsing – that's what sifters are for. Sifting Methods Depending on your machinery, sifting can be a relatively painless and time-saving process. Mechanical sieve shakers will shake the stacked sieves, causing each stone and particle to fall to its coinciding sieve screen. Note that there are different methods for sifting, common methods include: Horizontal sifting: where the sieves are sifted in a horizontal motion Throw-action: a sieve method whereby vertical force combined with circular motions is applied Air jet: uses a vacuum or other means of creating an air stream to transport and separate finer particles Tap: circular, horizontal motions with frequent tapping Wet: uses water to support the sieving process, but is a far less common practice than the traditional dry methods Once sifted, each sized aggregate is weighed and noted as a percentage of the overall sample—that is, the percent of aggregate retained per sieve is noted as well as the percentage passed through that size (known as the passing aggregate). These details are then recorded, and the quality aggregate is sent for distribution where it will then await its new home. An Example: How to Read a Sieve Analysis In general, specialty crushed stone products must have consistent sizes and fall within acceptable tolerances. For a real-life example of the sieve test as it relates to Kafka's quality control, we'll unpack the sieve tests as they pertain to our stabilized pathway mix. Kafka Granite's Stabilized Pathway Mix must adhere to specifications as outlined by the binder manufacturer, Organic-Lock. With the gradation specification, there is an acceptable range and distribution of particle sizes that is to exist within the stone sample. While each sample and sieve will vary slightly, it's vital that the samples for stabilized pathway mix fall within this range because a success ensures one of two things: the pathway mix is consistently well-graded, and it will compact properly. Let's take a closer look at the gradation specification for Stabilized Pathway Mix and how it works. First we must understand what U.S. Mesh sizing is. U.S. Mesh Sizing is defined as the number of openings per one square inch of a screen. Therefore, the larger the number, the smaller the screen size. The example below shows each sieve size translated to metric sizing, but you can also use a helpful screen size / sieve conversion chart. The first pass calls for 80-100% passing the #4 mesh screen. In other words, 80-100% of stone particles must fall through a #4 mesh screen. Then, 65-90% of the stone particles should pass through an #8 mesh screen. You can see the rest of the required pass percentages in the below table. Once you reach the bottom of the chart, you'll see that 5-15% of the stone particles should fall through the #200 mesh screen, which is an extremely fine, dust-like material.. If this were a "clean" or "chip" aggregate, there would not be such fine material included in the mix. Sieve Sieve Size (mm) Percent Passing 4 4.75 80%-100% 8 2.36 65%-90% 16 1.18 40%-65% 30 0.6 25%-55% 50 0.3 15%-35% 100 0.15 10%-20% 200 0.075 5%-15% It is important that the pathway mix meets the gradation requirement above; it is vital for the product's functionality. In order for the binder to work properly, the surface to compact, and rain water to drain, the gradation must be consistent and within the defined tolerances. This is, of course, just one of many sieve analyses we run at Kafka to check a product's gradation, and only one of many tests used to analyze quality. Contact us to request a sieve analysis or other product information. Skip to content Understanding ASTM C136 is essential for anyone involved in the construction industry. This standard for sieve analysis judges the particle size distribution of fine and coarse aggregates, critical for maintaining building material standards. Our article breaks down the nuts and bolts of the test method, discusses its pivotal role in quality control, and outlines the necessary tools and steps for implementation. Key Takeaways from ASTM C136 ASTM C136/C136M is a standardized test method critical for grading determination of fine and coarse aggregates in the construction industry, ensuring consistent quality and safety in construction materials. Proper sample preparation, including drying, dividing, and sieving is essential, and equipment such as a mechanical sieve shaker, standard test sieves, and sample preparation tools are required for accurate sieve analysis in accordance with ASTM C136. The limitations of ASTM C136 include regulatory constraints and the need for strict adherence to health and safety practices during the sieve analysis process, emphasizing the importance of wearing protective equipment and maintaining a clean work environment. Understanding ASTM C136 The ASTM C136, also known as C136/C136M, is a product of ASTM International. Its primary purpose is grading determination of materials proposed for use as aggregates or those already in use. The importance and use of this test method lies in its ability to provide a standardized test procedure for grading determination, critical for maintaining the quality and consistency of materials in construction and related industries. Purpose of ASTM C136 The main goal of ASTM C136 in aggregate analysis is to perform a gradation test to determine the grading of materials proposed or currently used as fine aggregate products and mixtures of coarse aggregates in the construction industry. This contributes to materials testing and quality control by offering a standardized test method for sieve analysis of fine and coarse aggregates. ASTM C136 addresses the issue of determining the grading of materials used as aggregates, thereby aiding in ensuring a well-graded mix for a denser, stronger, and more durable final product. This method also impacts materials selection for construction projects by outlining the grading requirements for aggregates. Significance of ASTM C136 In the construction and material testing industries, ASTM C136 is highly significant. It sets a standardized method for grading materials used as aggregates, ensuring uniformity and quality in construction projects through rigorous quality control. This standard test method assesses the quality of concrete, cement, and aggregates, ensuring materials meet necessary standards. Additionally, ASTM C136 enhances construction safety and durability by providing a standardized sieve analysis method for fine and coarse aggregates. Equipment and Materials Required To conduct a sieve analysis, you need the size distribution with applicable following equipment: A series of standard test sieves and sieve frames of various dimensions A mechanical sieve shaker Sample preparation tools, including the Gilson Testing Screen and Gilson Test Master Testing Screen The results obtained from the ASTM C136 sieve analysis test are utilized to determine compliance with applicable specification requirements. Mechanical Sieve Shaker A mechanical sieve shaker is crucial for consistent and thorough sifting of aggregate samples. It determines particle size distribution in fine and coarse aggregates. Available types include mechanical, vibratory, and sonic shakers, each with distinct mechanisms for sieve analysis. These shakers have motorized systems engineered to generate coordinated movements. This effectively agitates the sieve stack, allowing the sample to pass efficiently through the sieve openings. Sieves and Sieve Frames The sieves used in the ASTM C136 test typically consist of sieve cloth mounted on robust frames. The test results in C136 can be influenced by the size of the sieve holes, as it determines the particle size distribution of the fine and coarse aggregates. The various types of sieve frames utilized in the C136 test consist of round sieve frames and nonstandard sieve frames. Sample Preparation Tools The necessary tools for sample preparation according to ASTM C136 include a sieve shaker and other essential equipment for preparing bulk field samples. For coarse aggregates, the tools must be able to retain a sample mass that does not exceed the product of 2.5 × (sieve opening in mm) × (effective sieving area in m2). Sample Preparation Before proceeding with the sieve analysis, sample preparation is a must. This involves air-drying the samples, dividing them into two or more parts, and sieving each part separately. It is important to avoid common errors such as incorrect sample amount and underestimating or overestimating tolerances. Determining Sample Size Choosing the right sample size is crucial for accurate test results and obtaining the necessary data for fine and coarse aggregate. For fine aggregate, use a minimum of 300 g. For coarse aggregate, follow standard guidelines based on the nominal maximum size and square openings. Utilizing samples that exceed the optimal size may result in imprecise test outcomes. Drying the Sample An oven capable of maintaining a consistent temperature of 110°C (230°F) is necessary to dry the aggregate samples. The sample should be dried at this temperature for approximately one to two hours before undergoing testing. Using forced air circulation can be an effective method for reducing humidity levels during the drying process. Splitting the Sample Once the sample is dried, divide it into smaller portions. Split it into two or more pieces, sieve each piece separately, and then combine the masses remaining on each screen. This ensures accurate results through representative analysis of the aggregate. Use a Gilson Testing Screen or a Gilson Test Master Testing Screen for this procedure. When dividing a sample, consider the original size. Ensure each component is sieved separately before consolidating the results. ASTM C136 Test Procedure The ASTM C136, a standard test method, involves specific steps, including: Acquiring roughly 10 pounds (4.5 kilograms) of the sample Using at least 500 grams (4.76 mm) of dry weight for fine aggregates Carrying out the sieving process to ascertain the particle size distribution of fine and coarse aggregates After sieving, the sieves are cleaned for future use. Sieving Process Sieving in ASTM C136 is significant for assessing the grading of materials used as aggregates. After sieving, precisely deposit the material remaining on each sieve onto the balanced scale pan for accurate results. Washing the Sieve After sieving, clean the sieve with a soft brush using gentle, circular motions. Ensure no bristles are left in the mesh. Use mild soap, warm water, or a detergent like Simple Green for washing sieves. Dry the sieve thoroughly before its next use. First, record the results of the ASTM C136 sieve analysis by determining the grading of the materials under examination. Next, compare the grading requirements with the applicable specifications to ensure compliance. For an example of a well-formatted ASTM C136 test report, refer to Lab#5: Sieve Analysis of Coarse Aggregate- C136. This document includes a detailed procedure and report format. Calculations and Reporting Results In ASTM C136, perform a gradation test by sieving the fine and coarse aggregates, including the finer material, to establish particle size distribution. Next, use the results from the C136 sieve analysis test to determine adherence to relevant specification requirements. According to the license agreement, the prescribed reporting format for C136 test results is to report the grading of materials proposed for or currently used as aggregates. Particle Size Distribution Determine particle size distribution by performing a sieve analysis or gradation test. This process evaluates the distribution of aggregate particles by size within a specific sample. Then, use the test results to interpret and evaluate the grading of materials intended for use as aggregates. This offers valuable insight into the suitability of materials for specific construction applications. Compliance with Applicable Specifications To comply with ASTM C136, determine the particle size distribution and compare it with the specified standards. Failure to follow ASTM C136 can result in inaccurate grading of aggregate materials, potentially affecting the quality and integrity of construction projects. Reporting Format A comprehensive ASTM C136 test report should include the grading of materials intended for use as aggregates or currently used as coarse aggregates by sieving. It should specify the minimum dry weight for fine aggregates, typically 500 grams (4.76 mm). Characterize the particle size distribution using percentages in different size fractions. Limitations and Considerations Despite its value in the construction industry, it's important to understand the various limitations prior to use of and considerations of ASTM C136. The regulatory limitations for ASTM C136 sieve analysis primarily revolve around the determination of the grading of materials that are either being considered for use as aggregates or are already in use, along with the necessary health and safety practices. Additionally, health and safety practices need to be observed during the sieve analysis process, including the use of personal protective equipment and maintaining a tidy work environment, in accordance with internationally recognized principles. ASTM C136 Regulatory Limitations One limitation of C136 is the maximum limit of 7 kg/m² of sifting surface area for sieves with openings smaller than 4.75 mm (No. 4). Complying with ASTM C136 requirements can be challenging. It requires precise sampling, maintaining data for equipment calibration, and following specific procedures and guidelines. Consider these limitations before conducting any tests or experiments. Health and Safety Practices During ASTM C136 Health and safety practices to be observed during ASTM C136 sieve analysis include: Utilizing personal protective equipment to ensure safety during the sieve analysis process Maintaining a tidy work environment Employing appropriate lifting methods Wearing ear protection to mitigate noise exposure Adhering to electrical safety protocols Proper disposal of waste materials Compliance with any supplementary safety directives from the laboratory or testing facility. Case Studies and Applications of ASTM C136 The construction industry widely uses the ASTM C136 sieve analysis. In road construction, it evaluates the particle size distribution of water-bound macadam, recycled aggregates, and coarse aggregates. In concrete production, it determines the grading and compliance of fine and coarse aggregates in the concrete mixture. Road Construction In road construction projects, ASTM C136 sieve analysis evaluates aggregate particle size distribution. This influences quality control procedures and ensures suitable material gradation. Proper gradation is crucial for construction quality. Case studies highlight ASTM C136's application in analyzing recycled aggregates for sub-base materials. They also examine various sources of recycled concrete aggregate for road construction. These studies demonstrate the standard's versatility in sustainable construction practices, particularly with recycled concrete aggregate. Concrete Production In the realm of concrete production, C136 sieve analysis contributes to the quality control process by determining the grading and particle size distribution of fine and coarse aggregates used in the concrete mixture. This ensures the quality and consistency of the concrete produced. A decrease in median particle size typically leads to an accelerated hydration rate and enhanced early characteristics, such as higher early strengths. Summary of ASTM C136 In conclusion, the C136 sieve analysis is crucial in the construction industry. It ensures the quality and consistency of materials used in various aggregate projects. This method provides a standardized approach to grading materials, ensuring they comply with relevant specifications. However, it's essential to be aware of the test's limitations and follow health and safety practices during the sieve analysis process. Certified MTP has the largest selection of aggregate testing supplies, showcasing industry-leading brands for Sieve Shaker Machines, test sieves, Classification Devices for Aggregate Testing, Sample Splitters and Dividers, and Specific Gravity Test Equipment. Frequently Asked Questions What is the purpose of ASTM C136? The purpose of ASTM C136 is to set the standard for performing a sieve analysis on fine or coarse aggregates to assess particle size distribution. This is crucial in industries like civil and chemical engineering. What ASTM is sieve analysis? The ASTM designation for sieve analysis is ASTM C136. This standard sets the guidelines for conducting a sieve analysis of fine or coarse aggregates. What is the standard method of sieve analysis? The standard method of sieve analysis involves moving the sample vertically or horizontally. During this process, compare particles with each sieve's apertures. After a set agitation period, measure the weight of material retained on each sieve. This process assesses particle size distribution and is commonly used in civil and chemical engineering. How does ASTM define fine aggregate? ASTM defines fine aggregate as the material that passes the 3/8-inch sieve and is retained on a #200 U.S. sieve. It consists of natural sand, manufactured sand, or a combination, and must be free of harmful organic impurities (ASTM C33). What equipment is required for conducting a sieve analysis? To conduct a sieve analysis, you will need standard test sieves, sieve frames, a mechanical sieve shaker, and sample preparation tools such as the Gilson Testing Screen and Gilson Test Master Testing Screen. View the full line of Aggregate Testing Products and Aggregate Moisture Testing Equipment, especially the popular Aggregate/Sand Moisture Measurement System Related Blogs for ASTM C136 Sieve Analysis: A Guide to Grain Size Distribution Selecting Sieve Sizes: Tips for Soil, Sand, and Aggregate Sieve Size Chart: Understanding Mesh and Particle Sizes ASTM D6913: Soil Particle-Size Distribution Analysis No two pieces of natural stone look alike—even if you're comparing two pieces of granite extracted from the same quarry. This variation of color, pattern, and texture is part of what makes natural stone so unique and so highly prized as a building and landscaping material. If you're on the lookout, you'll notice it in… READ MORE Thin Stone Veneer's Carbon Footprint Depends on the Source Every construction material has its own unique carbon footprint. If you're considering thin stone veneer for your next project, you may be wondering, "What are the environmental impacts of stone construction?" That largely depends on the stone's sourcing and transportation. There are two main types of… READ MORE Stone veneer offers nearly endless potential, introducing depth and drama to a wide range of interior and exterior spaces. If you're considering this product for your next new build or renovation project, you'll have to choose between natural stone veneer versus manufactured stone veneer. But what is the difference between manufactured and natural stone veneer?… READ MORE Sieve analysis of fine aggregates is one of the most important tests performed on-site. Aggregates are inert materials that are mixed with binding materials such as cement or lime for the manufacturing of mortar or concrete. It is also used as fillers in mortar and concrete. Aggregates size varies from several inches to the size of the smallest grain of sand. The Aggregates(fine + coarse) generally occupy 60% to 75% of the concrete volume or 70% to 85% by mass and strongly influence the concrete's freshly mixed and hardened properties, mixture proportions, and economy. All Aggregates pass IS 4.75 mm sieve is classified as fine Aggregates. All aggregate technicians use the sieve analysis (gradation test) to determines the gradation (the particle size distribution, by size, within a given sample) in order to determine compliance with design, production control requirements, and verification specifications. Used in conjunction with other tests, the sieve analysis is very good to control and quality acceptance tool. Gradation meaning the distribution of particle sizes within the total range of size. Gradation can be identified on a graph as well-graded, uniform, or gap graded (sometimes called skip graded) which are described below : Well graded means sizes within the entire range are in approximately equal amounts, although there will be a very small amount of the largest and smallest particles. Uniform gradation means that a large percentage of the particles are of the same size. Gap graded or skip graded means that most of the particles are large in size or small in size with very few particles of an intermediate size. Objectives: The whole procedure of sieve analysis is to determine the particle size distribution of the fine aggregates and determine whether it is suitable to use in concrete mixing. Test Equipment A series of IS sieves 4.75 mm 2.36 mm 1.18 mm 600 mic 300 mic 150 mic 75 mic Fig. Set of IS Sieves A pan and a shovel Fig. Pan and Shovel Balance or scale with an accuracy to measure 0.1 percent of the weight of the sample. Fig.Weighing Balance Mechanical sieve shaker Fig. Mechanical Sieve Shaker 1000 grams of fine aggregates Fig. Sand Sample Experimental Procedure for Sieve Analysis Weighed the sample to exactly 1000g. First of all, we have to clean all the sieves using a wire brush to be clear of aggregates stuck in some gaps. Then we have to prepare the sieves onto the shaking machine from top to bottom, by the size from biggest (4,75mm) to smallest (0.075mm). The sample is sieved by using the set of IS Sieves for 10 minutes. After the sieving is done, the aggregates on each sieve are weighed individually. Cumulative weight passing through each sieve is calculated as a percentage of the total sample weight. The same procedure is followed for two more samples. The formula for calculating the percentage retained and percentage passing: TABLE: DETERMINATION OF PARTICLE SIZE DISTRIBUTION OF FINE AGGREGATES The percentage passing weight so obtained shall than be compared with the permissible values given in the IS 383. The standard table in IS code shows the permissible values of percentage passing for different grading zones i.e., Zone I, Zone II, Zone III, and Zone IV. The zone of the sand thus is determined by comparing the observed percentage passing values with the permissible values given in the IS 383. Data and Calculation for a random sample Determination of Particle Size Distribution of Fine Aggregates: Total Weight of Fine Aggregates = 1000g RESULT : In this case, in comparison with Table 4 IS:383, it can be concluded that the Fine Aggregate corresponds to Grading Zone II. Author: Farhan Khan Posted On: June 11, 2021 Updated On: June 11, 2021 ASTM C 136 Objective Following are the objectives of performing sieve analysis on coarse and fine aggregates: Related Theory Coarse Aggregates: The aggregate particles that retain on sieve #4 are termed as coarse aggregates. These may include gravels, crushed stones, etc. Fine Aggregates: They are the aggregate particles that pass sieve #4 but retain on sieve #200. Fine aggregates include a wide range of particle sizes. Specifically talking about sands, the grain-size distribution further classifies sand into coarse sand, medium sand, and fine sand. Fineness Modulus: It is an empirical number mathematically equal to the ratio of cumulative percentage retained on standard sieve #150 and 100. It is an index value that gives an idea of the coarseness or fineness of an aggregate sample in general. Mathematically, Sieve Analysis: Sieve analysis or mechanical straining is the process of determining the relative proportion of various particle sizes in an aggregate sample by passing the sample through a stack of standard sieves arranged in descending order of their opening sizes. The weights retained on each sieve are noted and the cumulative percentage of sample passing through each sieve is calculated. Finally, a semi-logarithmic graph called gradation curve or 'particle-size distribution curve' is plotted, taking particle size as abscissa and cumulative percentage passing as ordinate. It is to be kept in mind that gradation curves for coarse and fine aggregates are plotted separately and the samples are qualified or fall short of acceptability based on the standard's criteria of gradation. Importance of performing sieve analysis Aggregates when used for construction activities are supposed to meet some gradation requirements imposed by the standard. Therefore, the performance of sieve analysis helps in qualifying an aggregate sample as fit for use. Sieve analysis also helps in determining the fineness modulus of aggregates which proves instrumental in telling whether an aggregate sample is well-graded or not. In addition, the fineness modulus also indicates the surface area of the aggregate particles. However, there exists an inverse relation between aggregate surface area and the fineness modulus. Coefficient of Uniformity: For fine aggregates like sands, the uniformity coefficient can be determined from the gradation curve. It is mathematically given as, Cu = D60/D10 Where D60 and D10 are the particle diameters corresponding to 60% finer and 10% finer, respectively. Coefficient of Curvature: It is also determined by citing the gradation curve. It is expressed mathematically as, Cc=(D30)2 /(D10×D60) Apparatus Standard set of sieves Mechanical sieve shaker Coarse aggregate sample Fine aggregate sample Test Procedure The test size of the sample is specified by the standard and for coarse aggregates, the sample size to be taken is given in the following table. However, for fine aggregates, the standard suggests that a minimum of 300g of dried aggregate sample is ample for performing the test. Source: ASTM C 136 Oven-dry the aggregate sample at a temperature of 110 ± 5 °C and let the sample cool before performing the test. Arrange the standard set of sieves by stacking them on top of each other in descending order of their opening sizes. Place a pan at the bottom of the last sieve. It is to be remembered that the standard sieve set is different for coarse and fine aggregates and therefore, separate tests are to be conducted on them. Place the stacked sieves in the mechanical sieve shaker and start shaking the sieve set. Pour a portion of the aggregate sample on the top-most sieve cautiously, ensuring that the sieve does not get overloaded with the material. In no case should any particle be made to pass a particular sieve forcefully. Continue sieving for a duration till no particle originally retaining on a sieve slips through it into the sieve present just underneath. Once the sieving operation is completed, remove the sieve stack and weigh the material retained on each sieve. Calculate the percentage weight retained on each sieve as Determine the cumulative percentage weight retained on each sieve. Determine the cumulative percentage passing also called cumulative percentage finer for each sieve as Plot the gradation curve between the particle sizes and cumulative percentage passing on a semi-logarithmic graph. From the graph, determine the requisite parameters related to aggregate particles. In order to verify whether an aggregate sample conforms with the standard, plot the limiting gradation curves and check whether the sample gradation curve lies between the two limiting curves. If it does so, the standard qualifies the sample, else the deficient particle sizes can be determined and added to the sample prior to using it for construction work. For limiting gradation curves, consult ASTM C33. Observations and Calculations For Coarse Aggregates Weight of aggregate sample = gm. Sieve No. in. (mm) Weight Retained (gm) Percentage Weight Retained Cumulative % Weight Retained Cumulative % Passing 3 75 1 1/2 37.5 3/4 19 3/8 9.5 3/16 4.75 3/32 2.36 Pan Pan Graph Plot the gradation curve taking the size of particles on the x-axis and cumulative percentage passing on the logarithmic y-axis. Plot the limiting gradation curves to qualify the sample as per the standard. For Fine Aggregates Weight of aggregate sample = gm. Sieve No. (mm) Weight Retained (gm) Percentage Weight Retained Cumulative % Weight Retained Cumulative % Passing #4 4.75 #8 2.36 #16 1.18 #30 0.6 #50 0.3 #100 0.15 #200 0.075 Pan Pan Graph Plot the gradation curve taking the size of particles on the x-axis and cumulative percentage passing on the logarithmic y-axis. Plot the limiting gradation curves to qualify the sample as per the standard. Note: For a sand sample, the sieve analysis data can further aid in categorizing the sand sample. % Sand=%age passing Sieve #4 and retaining on Sieve #200 % Coarse-Grained Sand = % passing #4 and retaining on #10 % Medium Coarse Sand = % passing #10 and retaining on #40 % Fine Grained Sand = % passing #40 and retaining on #200 Coefficient of Uniformity = Coefficient of Curvature = Results Fineness Modulus of Coarse Aggregates = Fineness Modulus of Fine Aggregates = Coarse Aggregate Sample qualification as per standard = Fine Aggregate Sample qualification as per standard = Test Precautions Particles that get stuck in the sieve mesh should not be forced through either way. This is because forcing the particles can either distort them or damage the mesh. In either case, the grain size results would be misleading. Care should be exercised while removing a sieve from the stack after the sieving operation. In case a sieve shaker is not used, the sieving operation is to be carried out manually for which horizontal motion of sieves instead of vertical motion. The sieves must be shaken for a minimum period of 10 minutes. Discussion Aggregates qualified as per standard are used in manufacturing concrete for construction operations. This is because the overall concrete strength and durability hinge on the gradation of aggregates used. A well-graded aggregate sample that conforms to the standard not only guarantees the longevity of concrete but also its reduced porosity and high early strength. A flatter gradation curve that is smooth and concave in shape is indicative of a well-graded sample. A sharp decline in the slope of the curve shows poor gradation i.e., it signifies the fact that the sample is either short of some grain sizes or is deficient in the same. Grading refers to the distribution of different particle sizes in an aggregate. The grading is determined as per American standards, ASTM C 136, "Sieve or Screen Analysis of Fine and Coarse Aggregates." The process is called sieve analysis. Fineness modulus (FM) is a numerical index used to determine the extent of fineness of aggregates.Sieve Analysis of Aggregates - Grading Aggregates & Fineness ModulusIn the grading process or sieve analysis, sample of aggregate is shaken through a series of wire-cloth sieves with square openings, that is nested one over the other in the decreasing order of sieve size. Largest sieve size is placed top and at bottom the sieve with small size and pan at bottom to receive particles that pass through the smallest sieve.The commonly used sieve sizes for concrete aggregates are given in Table-1 below for both coarse sieves and fine sieves.Grading Coarse and Fine AggregatesCoarse and fine aggregates are sieved separately. That portion of aggregates that pass through a 4.75 mm sieve (From Table-1, No: 4 Sieve) and that retains on the 75 µm sieve (No.200 sieve) is called as fine aggregates.Aggregates larger than 4.75 mm sieve size are coarse aggregates. Coarse aggregates are available in several different size groups like 19 to 4.75 mm (3/4 in. to No. 4), or 37.5 to 19 mm (1-1/2 to 3/4 in.).The number and size of sieves that is selected for conducting sieve analysis is dependent on the particle size present in the sample and type of grading required. Sieve Analysis of Coarse-Grained SoilsAfter sieving the sample of aggregates through the select series of sieves, the mass of material retained on each sieve and the last pan is measured using a balance that is accurate to 0.1%.The results are recorded in a tabular form (Fig.2) that shows the:Quantity of aggregates retained on each sievegoog_583263229Individual percentage of aggregates retained (Wr) and passing (Wp) through the sieve. Individual percent retained is the percentage of material contained between successive sieves, recorded to the nearest whole percent. It is calculated by dividing the mass retained on each sieve (and passing the sieve above) by the sum of the masses retained on each sieve and the pan and multiplying by 100. W = (X + Wt) x 100; W = Individual percent retained, X is the weight of the oven dry aggregate retained on the individual sieve or pan, and Wt is the total mass of dry sample (Sum of mass retained on sieves and the pan). For eg, in the figure-2 below, considering the sieve 4.75 mm No.4 , The mass retained on 4.75 mm sieve = X =9.2 g; The total weight of sample = 508.5; Then, W1 (Individual percent retained in sieve No.4) = (X/Wt)x100 = (9.2/508.5)x 100 = 2 %Total percent of retained cumulative (cumulative of retained is taken - i.e. 2, (2+13=15), (15+20 =35), (35 +20 =55) so on.)Total percent of the whole sample passing or retaining through each sieve. The total percent passing is calculated by subtracting the total (cumulative) percent retained from 100. In the table below, for sieve 4.75 mm, total percent passing is 100-2 =98, for 2.36 mm sieve it is 100 - 15 =85, so on.Results of Sieve Analysis Presented in a Tabular FormImportant Points To Remember:The total mass retained may differ from the original, as sieving process may result in loss or gain of aggregate particle or due to round-off errors.As each mass is measured within 0.1% of the total mass, maximum difference must not exceed 0.1% times the number of mass determinations. For example, in the above test result, 7 mass determinations were made, so the difference should not exceed 0.7 %.In the above example, the mass of original sample was 510.5 g. From the figure-2, the total mass retained after test was 508.5g, which give a difference from original sample by 2 g, i.e. 0.4% difference, which is less than 0.7 % mentioned before, which is accepted.If the difference is too large, a check would have been made for possible errors in mass determination, calculation, accidental loss due to spillage, or material stuck in the sieve openings.Normally, the sieve analysis calculations are done to the nearest 0.1% and then reported to the nearest 1%, except for the percent passing the No. 200 sieve, which is reported to the nearest 0.1%.The total mass of the material after sieving should check closely with the original mass of the sample placed on the sieves. If the amounts differ by more than 0.3%, based on the original dry sample mass, the results should not be used for acceptance purposes.To measure the accurate quantity of aggregate material finer than 75 µm, the specimen is washed as per ASTM C 117. This is performed before sieving or on another sample.Grading charts are used to represent the results obtained after the sieve analysis graphically. In the vertical axis or Y-Axis, the percent passing through the sieve is plottedIn the X-Axis, the sieve sizes adopted for the test are plottedThe upper and lower limits that is specified for allowable percentage of material passing through the sieve may also be included in grading chart.Typical grading chart. Dashed lines indicate limits specified in ASTM C 33 for fine aggregates and for 25.0 mm (1 in.) coarse aggregate. To evaluate consistency of grading the individual size fractions of a coarse aggregate and fine aggregate, the grading charts are plotted separately, so that any gaps or excess amounts of particle sizes can be analyzed.Fineness Modulus of Coarse AggregatesThe fineness modulus (FM) is a numerical index obtained from the sieve analysis test result. The FM is the sum of the total percentages coarser than each of a specified series of sieves, divided by 100. In the figure-3, the sum of total cumulative percentage retained divided by 100 gives the fineness modulus.Calculation of Fineness Modulus of AggregatesAlthough the FM is most commonly computed for fine aggregates, the FM of coarse aggregate is needed for some proportioning methods. It is calculated in the same manner, while taking care to exclude sieves that are not specified in the definition (for example, 25.0 and 12.5 mm [l and 1/2 in.] sieves) and to include all of the specified finer sieves.Important Points To Remember:The coarser the aggregate, the higher is the fineness modulus.FM generally ranges between 2.3 to 3.1 for fine aggregates used in concrete as per ASTM C 33.Read More On: How to Choose Good Quality Aggregates for Construction? AI-generated AbstractThis document outlines a comprehensive method for conducting sieve analysis on fine and coarse aggregates. It describes various parts of the analysis including weight-based dry and washed sieve methods, as well as volumetric analysis. The paper provides necessary equipment specifications, sample size requirements, and guidelines for executing the tests effectively. Originating from hand-sieving techniques, test sieve analysis is a particle size analysis method that has been practiced for centuries. From the coffee grounds that give us a boost throughout the day to the fertilizers we use to make our yards pop, test sieve analysis is responsible for ensuring the products we use work as intended. Regardless of how you carry out your test sieve analysis process, the most integral tool in your lab are your test sieves. In fact, your sieve analysis test results are only as accurate as your test sieves. As the creator of the Tyler Standard Scale Sieve Series, W.S. Tyler has been a leader of innovation in the particle size analysis industry for over 150 years. We strive to share the experiences we've had over the years so you are better equipped to navigate the market and refine the way you test material. For that reason, the following article was written to shed light on what a test sieve is and its role in the world of particle size analysis. You will learn: How test sieves are defined in the world of particle size analysis How test sieves work The type of test sieve used today What components make up a test sieve How much test sieves cost The test sieve standards that may affect your test sieve analysis process What test sieve certification is What Is a Test Sieve? A test sieve is a scientific screening instrument, that utilizes wire sieve cloth mounted on a rigid frame to help generate a reliable particle size distribution curve. Sieves with variating mesh openings are typically stacked on top of each other, working to separate the particles of a material sample based on their size. Now, the parameters surrounding test sieve analysis vary from industry to industry. That said, how you construct your test sieve stack will be reflected in your industry standards. What Is a Test Sieve Used For? When someone asks "what is a sieve used for?", its best to refer to panning for gold as a simplified example. Imagine someone shaking a pan full of dirt and water looking for pieces of gold. As they shake the pan up and down and from side to side, the small pieces of dirt and water fall through the openings in the screen. The bigger pieces of rocks don't go through the holes, and they can search through what's left in the pan for gold. At a very basic level, this is a test sieve. Test sieves are used in all kinds of industries to perform particle analysis. Sometimes the particles are super fine, like in the food or pharmaceutical industry. Sometimes the particles can be larger, like in the agricultural and mining industry. A sieve shaker, such as the W.S. Tyler RO-TAP Sieve Shaker, is a machine that uses some type of agitation to separate the particles down through a stack of sieves. This gives the user a different size sample in each sieve. Nonetheless, test sieves can be used individually or several can be stacked on top of each other in a sieve shaker. Types of Test Sieves There are two predominant types of test sieves used to conduct test sieve analysis. Depending on your sample material, you will either use dry test sieves or wet wash test sieves. Dry test sieves are used when the particles are free-flowing and can pass through openings with just a shaking or tapping motion. Wet Wash Test Sieves are used when water needs to be added to the sample to get the particles to pass through the sieve. Wet wash sieving is often used in the aggregate industry. Clay and silt stick to the outside of the rocks, making them larger than they really are. By adding water to their sieving process, the dirt and silt are cleaned off the outside of the rocks allowing them to be measured properly. To learn more about wet and dry test sieve analysis, take a moment and review our article: Wet & Dry Sieve Analysis (Alloys, Certification & Sizes). Components of a Test Sieve Standard wire cloth sieves typically consist of three components. These components are the wire mesh screen, the frame, and the skirt. Wire Mesh Screen The wire mesh screen, often referred to as sieve cloth, is the most technical part of a test sieve. The most commonly used type of mesh is stainless steel woven wire mesh. This comes in opening sizes 4" (100mm) to 635 mesh (20um). For a more in-depth explanation, refer to our article: How to Pick the Right Woven Wire Mesh (Mesh Count, Wire Diameter, and Micron Rating). Frame The frame is the round metal circle that holds the mesh in place. The standard frame sizes in the U.S. are 3-inch, 8-inch, and 12-inch. Internationally, 100mm, 200mm, and 300mm are the standard sizes. Sieve frames can be made of stainless steel or brass. Skirt The main function of the skirt is to allow the sieves to be stacked without toppling over. How Much Does a Test Sieve Cost? There are hundreds of sieve specifications you can buy. Factors such as the frame height, alloy, and specifications of the sieve cloth all contribute to the overall cost of a test sieve Typically, A sieve can cost anywhere from $75 to $930.We wrote an entire article on what a test sieve costs and all the factors and choices that go into that cost. You can read all about it in our article: How Much Does A Test Sieve Cost? Soil usually consists of particles of different sizes. These particle sizes and their distribution in the soil affects the engineering properties of the soil. Therefore, to find out the particle size distribution of a soil, Mechanical analysis, or Grain size analysis or Particle size, sieve analysis of aggregates is done.The result of the mechanical analysis is used broadly in soil classification, soil stabilization, soil compaction, filter design for Earth dams and many others.This method consists of two parts, Sieve analysis for gravel and sand (Coarse-grained soil) and sedimentation analysis or wet analysis for silt and clay (Fine-grained soil) by using Stokes' law.Today we are going to talk about Sieve Analysis.Sieve analysis is a method of determining the particle size distribution of coarse-grained soils (particle size greater than 75 microns).In this method, the soil is sieved through a set of sieves. Sieves are generally made up of spun brass and stainless steel.As mentioned above, the sieve analysis is done for coarse-grained soils. The coarse-grained soils can further be divided into gravel (size > 4.75 mm) and sand (size from 75µ – 4.75 mm), where µ represents micron.A set of sieves, consisting of the sieves of size 4.75mm, 3.35mm, 2mm, 1mm, 600 µ, 300 µ,150 µ, 75 µ, and the pan is used for sand fraction whereas a set of sieves, consisting of size 100mm, 63mm, 20mm, 10mm, 4.75mm, and the pan is used for gravel fraction.The selection of the number of sieves is done to obtain a good particle size distribution curve. The sieves are stacked one over other, with decreasing size from top to bottom.A pan is placed at the bottom of the smallest sieve which has no opening and the sieve with the largest opening is kept at the top and covered with the help of a lid.Particle size distribution helps to classify the soils. As particle size determines how fast or slow water or other fluids moves through the soil, particle size distribution assists engineering and agriculture purpose. It also helps to maintain the quality of concrete produced.How to perform Sieve analysis of aggregates?IS sieves (4.75mm, 3.35mm, 2mm, 1mm, 600 µ, 300 µ,150 µ, 75 µ, and pan)Weighing machineMetal traysMechanical sieve shakerThermostatically controlled ovenTrowelStopwatchA sample of soil is collected from the site.The soil sample is then dried in the oven.The quantity of soil samples for the test depends upon the maximum size of material present in substantial quantities. For example, if a particle of size 75mm is present then 60 kg of the sample should be taken and if the particle of size 4.75 mm is present then 500 gm of the sample should be taken.Based on the percentage of silt and clay particles present in the soil sample, the analysis should be done by either dry sieving or wet sieving method.500 gm of a dry soil sample is taken.It is then kept in IS sieves arranged in the order as shown in Table 1.Mass of each sieve is weighed and noted before placing the soil sample in them.The set of sieves were then placed in the mechanical sieve shaker and sieved for 10 minutes. The time is recorded.After 10 minutes the weight of soil retained in each sieve is recorded. The soil sample retained in 4.75 mm sieve represents the gravel fraction.The retained soil mass is checked whether it matches with the original mass or not.Finally, % finer than the sieve sizes are calculated and used in the analysis.Mass of soil sample taken = 500 gmTable – 1 Now, the semi-log graph is plotted with % finer in Y-axis and sieve size in X-axis as shown below:Figure 1: Semi-log graphNow, the Coefficient of uniformity (Cu) and Coefficient of curvature (Cc) is determined with the help of the semi-log graph and formula listed below:At last, the soil is classified as per the following rules:If Cu < 2: uniform graded soilIf Cu > 4 and Cc is in between 1 and 3: well-graded gravel else poorly graded or gap graded gravelIf Cu > 6 and Cc is in between 1 and 3: well-graded sand else poorly graded sand.The sum of the retained mass should be equal to the original soil sample. If it is not obtained, then the fraction retained on different sieves should be adjusted proportionately.The electric connection of mechanical sieve shaker should be checked before starting the test.The sieves should be cleaned properly so that no particles are stuck in them.I hope this post remains helpful for you.Happy Learning – Civil ConceptContributed by,Civil Engineer – Sushmita NiraulaRead Also,Aggregates for concrete | Aggregates sizes for concreteSplit tensile strength of concrete- StepWise ProcedureLos Angeles abrasion test- Step by Step Producers and with ReportAggregate impact value test- step by Step Procedure with Report 0 ratings0% found this document useful (0 votes)395 viewsThis document provides the standard method of test for sieve analysis of fine and coarse aggregates. It outlines the scope, referenced documents, terminology, summary of method, significance...AI-enhanced title and descriptionSaveSave AASHTO T27 (2020)_Sieve analysis of fine and coars... 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