GETTING INTO THE CLASSROOM

Sieve Analysis – Classroom Exercise - Example

This section will discuss the creation and implementation of a classroom exercise that can be used to represent some of the behind-the-scenes jobs that the "Heavy Civil" industry can provide to people wanting to work in the industry.

Meet with CTE Educators to discuss the availability of coming into the classroom and presenting a lesson on a practical real-world exercise that pertains to your area of expertise in the construction industry. This could be as simple as a PowerPoint presentation or can become a greater lesson with a shop experience and even leaving the class with a homework handout revolving around a real exercise you would have to perform in your job role.

Determine the time available for classroom visit.

a. Introduction = approximately 10 minutes
b. Exercise instructions = approximately 10 minutes
c. Hands-on-exercise = approximately 30 minutes
d. Q&A = approximately 10 minutes

This exercise needs approximately 60 minutes.

Once the presentation material is completed, set up a trial run at the school with the teachers to make sure timing and technical issues are worked out prior to the final run with students. Make sure the facility is setup for easy presentation. Coordinate any supplies necessary to complete the exercise.

Please make sure the presenters and assistants are familiar with the exercise and can answer questions as they arise.

Tip! Candy give aways are always a good thing to have when keeping the attention of students.

The following resources will help to give you a better understanding of the lesson that was presented along with developing a lesson in your field of expertise.

Sieve Analysis - Instructions: PDF Document – Step by Step instructions on how to present the exercise.

Sieve Analysis – Activity Handout: PDF Document - Activity Handout to explain the shop exercise and guide the students step by step through the math exercise.

Sieve Analysis – Supply List w/pictures: PDF Document – Pictures and list of supplies needed for exercise.

Sieve Analysis – Classroom Exercise – Instructions

This section provides instructions on how to present a "Sieve Analysis" classroom exercise detailing a step-by-step process. ***Safety glasses and gloves are highly recommended for this exercise.***

Step 1: Make sure to review the needed supply list and get all the materials needed on hand. The number of materials may vary depending on the classroom size and number of participants.

Step 2: Use the U.S.A. Standard Test Sieve's to separate sand & gravel in the specified gravel sizes matching the mesh screens. For this example we needed 4 sizes of gravel:

Sand & Gravel

1. **Gravel A** > 3/8" (Largest gravel) (6 cups needed for this example)
2. No. 4 < **Gravel B** < 3/8" (6 cups needed for this example)
3. No. 8 < **Gravel C** < No. 4 (6 cups needed for this example)
4. **Gravel D** < No. 8 (this material is left in the catch pan)(smallest sand) (6 cups needed for this example)

Step 3: Weigh 1 cup of each material to determine the approximate weight of each material using the kitchen food scale and document. Weigh an empty ½ gall on mason jar and document. Ounces are the best unit of measurement for this exercise.

Step 4: Label 4 ea. ½ gallon mason jars 1 – 4 to keep track of how much material is going into each specified jar. For this exercise each jar received a minimum of 1 cup of each material along with an alternating 1 cup from 2 different materials. The total amount of material in each jar is 6 cups.

Example:

Jar 1: Gravel A = 2 cups, Gravel B = 2 cups, Gravel C = 1 cup, Gravel D = 1 cup

Jar 2: Gravel A = 1 cups, Gravel B = 2 cups, Gravel C = 2 cups, Gravel D = 1 cup

Jar 3: Gravel A = 1 cups, Gravel B = 1 cup, Gravel C = 2 cups, Gravel D = 2 cups

Jar 4: Gravel A = 2 cups, Gravel B = 1 cup, Gravel C = 1 cup, Gravel D = 2 cups

Step 5: Weigh each jar to get a total weight and to double check the math on to make sure nothing seems unordinary. For this example, each type of gravel weighed between 14 ounces and 16 ounces, so take an average of 15 ounces to double check the weights of the jars. **HINT:** Create an Excel Spreadsheet to enter the weights and calculations to be able to quickly check the math. See attached examples.

Step 6: Pour each jar of material in the U.S.A. Standard Test Sieve's and shake side-to-side for approximately 10 minutes. Remove the top screen (3/8") and pour the material into a measuring pour container. Place the lid back on the sieve and shake side-to-side for an additional minute. Remove the next top screen (No. 4) and pour the material into a measuring pour container. Place the lid back on the sieve and shake side-to-side for an additional minute. Remove the next top screen (No. 8) and pour the material into a measuring pour container. Finally pour the remaining material caught in the catch pan into a measuring pour container.

Step 7: Pour 1 each of the materials from the measuring pour container into the ½ gallon mason jar and taking a weight. *Make sure to only pour 1 type of material into the jar. Also, make sure the lid is also on the jar. Document this weight on the activity handout. Pour the material from the jar back into the measuring pour container.

Repeat Step 7 until all materials have been weighed and documented on the activity handout. You should have completed Step 7 a total of 4 times!

Step 8: Complete the classroom activity handout by performing the math calculations to find the end results. You are looking for both the weight of materials being retained on each screen along with the weight of the material passing through the screen.

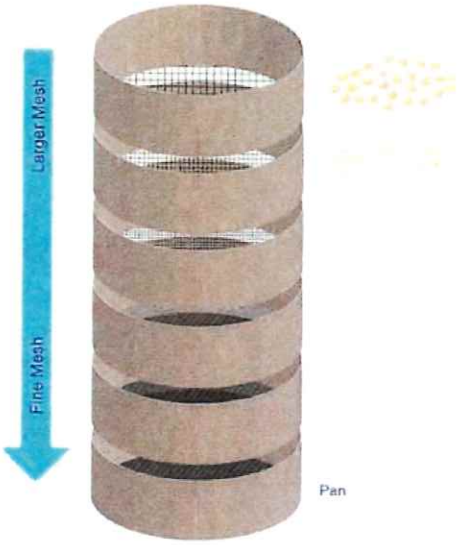
Step 9: Q&A ***HINT** – make sure to emphasize how this is used in an actual construction project along with the job opportunities this type of work provides.

Step 10: Return all materials back into the ½ gallon mason jars and cleanup.

Congratulations you have completed a hands-on activity!!

Tips: For materials, contact your local Sand & Gravel company, Earthwork Contractor, Materials Testing Lab, Department of Transportation, or Municipality for donations.

Example Photos:



tion	Sieve Size (mm)	TP1 Passing %	Pas
	75	100	
	63	100	
Coarse	50	100	
	37.5	100	
	28	100	
Medium	20	100	
	14	100	
	10	98.25	
	6.3	90.04	
Fine	5	84.08	
	3.35	75.47	
Coarse	2.0	62.23	
	1.18	46.34	
Medium	0.600	25.82	
	0.425	13.24	
	0.212	5.30	
Fine	0.150	0.66	
	0.00	0.00	
Passing	0.063	0.00	


#1
#2
#3
#4

SIEVE ANALYSIS - CLASSROOM PROJECT

MATERIAL 1 - PROJECTED		
Total weight of material & jar	118.55	ounces
Weight of jar	28.55	ounces
Total weight of material	90	
Total weight of material	90	ounces
Weight of material A	30	ounces
% of material A retained on the 3/8" screen	33.333333	%
% of material passing the 3/8" screen	66.666667	%
Total weight of material	90	ounces
Weight of material B	30	ounces
% of material A retained on the #4 screen	33.333333	%
% of material passing the #4 screen	33.333333	%
Total weight of material	90	ounces
Weight of material C	15	ounces
% of material A retained on the #8 screen	16.666667	%
% of material passing the #8 screen	16.666667	%
Total weight of material	90	ounces
Weight of material D	15	ounces
% of material A retained in the catch pan	16.666667	%

MATERIAL 1 - ACTUAL		
Total weight of material & jar	121.78	ounces
Weight of jar	28.55	ounces
Total weight of material	93.23	
Total weight of material	93.23	ounces
Weight of material A	30	ounces
% of material A retained on the 3/8" screen	32.178483	%
% of material passing the 3/8" screen	64.356967	%
Total weight of material	93.23	ounces
Weight of material B	30	ounces
% of material A retained on the #4 screen	32.178483	%
% of material passing the #4 screen	32.178483	%
Total weight of material	93.23	ounces
Weight of material C	15	ounces
% of material A retained on the #8 screen	16.089242	%
% of material passing the #8 screen	16.089242	%
Total weight of material	93.23	ounces
Weight of material D	15	ounces
% of material A retained in the catch pan	16.089242	%

SIEVE ANALYSIS - CLASSROOM PROJECT

MATERIAL 2 - PROJECTED		
Total weight of material & jar	118.55	ounces
Weight of jar	28.55	ounces
Total weight of material	90	
Total weight of material	90	ounces
Weight of material A	15	ounces
% of material A retained on the 3/8" screen	16.666667	%
% of material passing the 3/8" screen	83.333333	%
Total weight of material	90	ounces
Weight of material B	30	ounces
% of material A retained on the #4 screen	33.333333	%
% of material passing the #4 screen	50	%
Total weight of material	90	ounces
Weight of material C	30	ounces
% of material A retained on the #8 screen	33.333333	%
% of material passing the #8 screen	16.666667	%
Total weight of material	90	ounces
Weight of material D	15	ounces
% of material A retained in the catch pan	16.666667	%

MATERIAL 2 - ACTUAL		
Total weight of material & jar	119.05	ounces
Weight of jar	28.55	ounces
Total weight of material	90.5	
Total weight of material	90.5	ounces
Weight of material A	15	ounces
% of material A retained on the 3/8" screen	16.574586	%
% of material passing the 3/8" screen	82.872928	%
Total weight of material	90.5	ounces
Weight of material B	30	ounces
% of material A retained on the #4 screen	33.149171	%
% of material passing the #4 screen	49.723757	%
Total weight of material	90.5	ounces
Weight of material C	30	ounces
% of material A retained on the #8 screen	33.149171	%
% of material passing the #8 screen	16.574586	%
Total weight of material	90.5	ounces
Weight of material D	15	ounces
% of material A retained in the catch pan	16.574586	%

SIEVE ANALYSIS - CLASSROOM PROJECT

MATERIAL 3 - PROJECTED		
Total weight of material & jar	118.55	ounces
Weight of jar	28.55	ounces
Total weight of material	90	
Total weight of material	90	ounces
Weight of material A	15	ounces
% of material A retained on the 3/8" screen	16.666667	%
% of material passing the 3/8" screen	83.333333	%
Total weight of material	90	ounces
Weight of material B	15	ounces
% of material A retained on the #4 screen	16.666667	%
% of material passing the #4 screen	66.666667	%
Total weight of material	90	ounces
Weight of material C	30	ounces
% of material A retained on the #8 screen	33.333333	%
% of material passing the #8 screen	33.333333	%
Total weight of material	90	ounces
Weight of material D	30	ounces
% of material A retained in the catch pan	33.333333	%

MATERIAL 3 - ACTUAL		
Total weight of material & jar	119.23	ounces
Weight of jar	28.55	ounces
Total weight of material	90.68	
Total weight of material	90.68	ounces
Weight of material A	15	ounces
% of material A retained on the 3/8" screen	16.541685	%
% of material passing the 3/8" screen	82.708425	%
Total weight of material	90.68	ounces
Weight of material B	15	ounces
% of material A retained on the #4 screen	16.541685	%
% of material passing the #4 screen	66.16674	%
Total weight of material	90.68	ounces
Weight of material C	30	ounces
% of material A retained on the #8 screen	33.08337	%
% of material passing the #8 screen	33.08337	%
Total weight of material	90.68	ounces
Weight of material D	30	ounces
% of material A retained in the catch pan	33.08337	%

SIEVE ANALYSIS - CLASSROOM PROJECT

MATERIAL 4 - PROJECTED		
Total weight of material & jar	118.55	ounces
Weight of jar	28.55	ounces
Total weight of material	90	
Total weight of material	90	ounces
Weight of material A	30	ounces
% of material A retained on the 3/8" screen	33.333333	%
% of material passing the 3/8" screen	66.666667	%
Total weight of material	90	ounces
Weight of material B	15	ounces
% of material A retained on the #4 screen	16.666667	%
% of material passing the #4 screen	50	%
Total weight of material	90	ounces
Weight of material C	15	ounces
% of material A retained on the #8 screen	16.666667	%
% of material passing the #8 screen	33.333333	%
Total weight of material	90	ounces
Weight of material D	30	ounces
% of material A retained in the catch pan	33.333333	%

MATERIAL 4 - ACTUAL		
Total weight of material & jar	118.84	ounces
Weight of jar	28.55	ounces
Total weight of material	90.29	
Total weight of material	90.29	ounces
Weight of material A	30	ounces
% of material A retained on the 3/8" screen	33.226271	%
% of material passing the 3/8" screen	66.452542	%
Total weight of material	90.29	ounces
Weight of material B	15	ounces
% of material A retained on the #4 screen	16.613135	%
% of material passing the #4 screen	49.839406	%
Total weight of material	90.29	ounces
Weight of material C	15	ounces
% of material A retained on the #8 screen	16.613135	%
% of material passing the #8 screen	33.226271	%
Total weight of material	90.29	ounces
Weight of material D	30	ounces
% of material A retained in the catch pan	33.226271	%

Sieve Analysis Activity Handout **Name**_____ **per**_____

GROUP #: _____

How does math get used in road construction? Consider the roads we all use. What is involved in building a road? A road can't be built on just the "regular" untouched ground for many reasons but primarily because the natural ground does not have the right mixture of sand & gravel and is most likely too soft and won't support the traffic over time. Eventually, the road could fail causing a dangerous situation. Thus, contractors will use different types of materials to construct the road for optimum performance.

Dilemma: How do you make sure the material you are using is correct?

This activity will replicate on a small scale what road contractors deal with on a large scale with every project. It is crucial to determine the type of material you are working with and if that material is correct for the application. Soils engineers determine the best materials for the type of road being built and give the contractors a sieve (gradation requirement) for the materials to be used. This application is used based on the type of traffic required, from small roads in remote areas of Alaska to large airports that must be able to support large jet airplanes.

For this activity there will be 4 groups with specific job functions per person. The goal of this exercise is to separate the particle sizes of sand & gravel to get weight measurements of each size. This will help determine if the material is of the correct mixture required by the project sieve.

Step 1: Choose a jar of material and get an accurate weight. **(HINT – there are 16 ounces per pound)**

1. Total Weight of Jar (completely full as given): _____ ounces

Step 2: Pour the material into the given copper screens (make sure to put on lid).

Step 3: Shake the material side to side, up and down, side to side for 6 minutes. Take turns within the team as this can be strenuous.

Step 4: Remove the 3/8" screen and pour material into one of the empty measuring pour cups. Label this material **"A"**.

Step 5: Put lid on top of the No. 4 screen and shake the material for 2 minutes.

Step 6: Remove the No. 4 screen and pour material into one of the empty measuring pour cups. Label this material **"B"**.

Step 7: Put lid on top of the No. 8 screen and shake the material for 2 minutes.

Step 8: Remove the No. 8 screen and pour material into one of the empty measuring pour cups. Label this material **"C"**.

Step 9: Pour the remaining material left in the catch pan into one of the measuring pour cups. Label this material **"D"**.

Step 10: Take the empty jar and get an accurate weight.

1. Total Weight of Jar (empty w/lid on): _____ ounces
2. Total Weight of Jar (completely full) subtract weight of empty jar to get the Total Weight of all the materials: _____ ounces

Step 11: Pour material **"A"** into the jar and get an accurate weight.

1. Total weight of material "A" w/jar: _____ ounces
2. Weight of empty jar w/lid: _____ ounces
3. Subtract to get Total weight of material **"A"**: _____ ounces
4. Divide the weight of material "A" by the weight all materials and multiply by 100 to get the percentage of material retained on the 3/8" screen: _____ % (carry out to the hundredths place)
5. Challenge! How much material passed through the 3/8" screen: _____ %

Step 12: Pour material **"B"** into the jar and get an accurate weight.

1. Total weight of material "B" w/jar: _____ ounces
2. Weight of empty jar w/lid: _____ ounces
3. Subtract to get Total weight of material **"B"**: _____ ounces
4. Divide the weight of material "B" by the weight all materials and multiply by 100 to get the percentage of material retained on the No. 4 screen: _____ % (carry out to the hundredths place)
5. Challenge! How much material passed through the No. 4 screen: _____ %

Step 13: Pour material **"C"** into the jar and get an accurate weight.

1. Total weight of material "C" w/jar: _____ ounces
2. Weight of empty jar w/lid: _____ ounces
3. Subtract to get Total weight of material **"C"**: _____ ounces
4. Divide the weight of material "C" by the weight all materials and multiply by 100 to get the percentage of material retained on the No. 8 screen: _____ % (carry out to the hundredths place)
5. Challenge! How much material passed through the No. 8 screen: _____ %

Step 14: Pour material **"D"** into the jar and get an accurate weight.

1. Total weight of material "D" w/jar: _____ ounces
2. Weight of empty jar w/lid: _____ ounces
3. Subtract to get Total weight of material **"D"**: _____ ounces
4. Divide the weight of material "D" by the weight all materials and multiply by 100 to get the percentage of material retained in the catch pan: _____ % (carry out to the hundredths place)

Step 15: Determine if your material would be acceptable to use on the project if it had to meet the below sieve analysis? YES NO (circle one)

Sieve Analysis:

1. % of material passing the 3/8" screen = 55 – 70 %
2. % of material passing the No. 4 screen = 40 – 54 %
3. % of material passing the No. 8 screen = 25 – 39 %

Group activity discussion about outcomes and key points from the exercise to relate to how contractors must use information like this to do estimates, procure materials, allocate resources, and schedule projects.

Sieve Analysis – Classroom Exercise – Supply List

Supply List w/pictures:

Materials:

U.S.A. Standard Test Sieve

1. Lid (1 ea. per student group, this example needs 4 ea.)
2. 3/8" copper screen (1 ea. per student group, this example needs 4 ea.)
3. No. 8 copper screen (1 ea. per student group, this example needs 4 ea.)
4. No. 4 copper screen (1 ea. per student group, this example needs 4 ea.)
5. Catch pan (1 ea. per student group, this example needs 4 ea.)

Sand & Gravel

1. **Gravel A** > 3/8" (Largest gravel) (6 cups needed for this example)
2. No. 4 < **Gravel B** < 3/8" (6 cups needed for this example)
3. No. 8 < **Gravel C** < No. 4 (6 cups needed for this example)
4. **Gravel D** < No. 8 (this material is left in the catch pan)(smallest sand) (6 cups needed for this example)

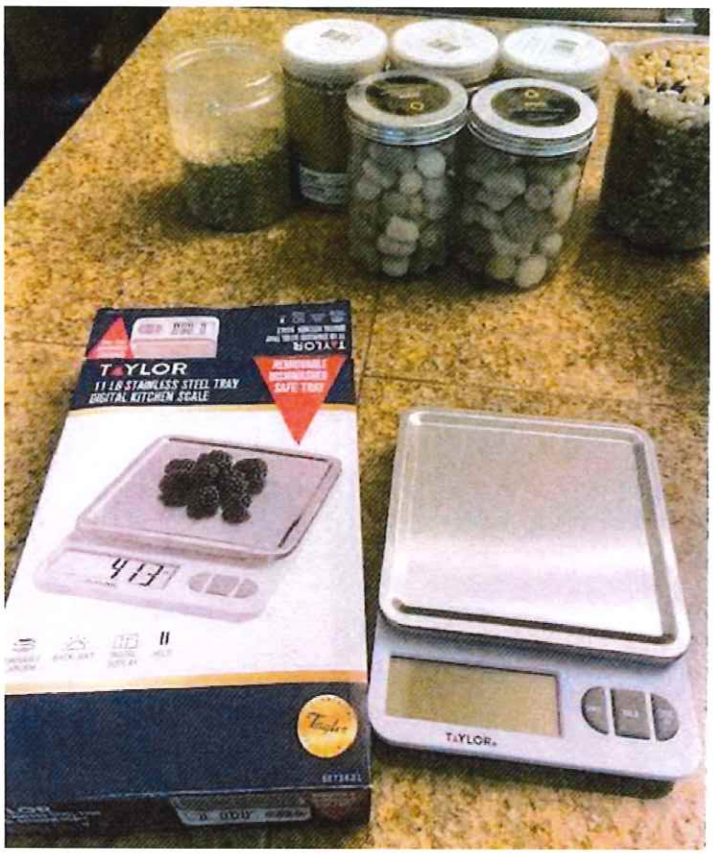
Kitchen Food Scale – weigh up to 11 lbs. (this example needs 4 ea.)

½ Gallon Mason jars (wide mouth) (this example needs 4 ea.)

Measuring Pour Cup (this example needs 16 ea.)

Large Metal Spoon (this example needs 4 ea.)(used to tap outer ring on copper screens to help vibrate screen to allow for material to pass through)


WHITE


TAYLOR
11 LB STAINLESS STEEL TRAY
DIGITAL KITCHEN SCALE
TAYLOR


MADE IN U.S.A.
BPA FREE
Ball
MASON JARS
6 HALF GALLON (64 OZ | 1.8 L)