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Tech Experts

An Alternative Sand Silt Content Test (in the absence of Sand Equivalent equipment)

Farhan J. Nawab - Area Technical Manager

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Features

Introduction:

Silt/clay content and plastic fines in sand, if present in high quantities, will affect fresh and hardened concrete properties by increased water demand and preventing better bonding between cement paste and aggregates.

Scope:

This test method determines percentage of silt content in sand by volume. It is an on-site test to quickly assess the percent of silt/clay and fine particles in sand that are detrimental to concrete quality. Through initial correlation testing for a given sand, sand equivalent value can be estimated through correlation graphs in absence of sand equivalent test equipment.

Appratus:

a. 250 ml measuring cylinder
b. 1% (w/v) salt solution (prepare by adding 1gm of salt to 100 ml water)
c. Sieve #4 (4.75mm)

Apparatus

Sample:

Sample and reduce the size of sand to be tested in accordance with ASTM D75 and ASTM C702 respectively. Prepare the test specimens from material passing the 4.75mm sieve. Dry the material to constant weight in lab oven or microwave and cool to room temperature before testing.

Test Procedure: (@site lab & main lab)

Step 1: Fill 1% salt solution in 250 ml measuring cylinder up to 50 ml mark and add sand sample until the level of salt solution reaches 100 ml mark.

Step 2: Add salt solution up to 150 ml (V1) mark.

Step 3: Shake well the prepared salt-sand solution.

Step 4: Keep the test solution on flat surface undisturbed for at least 2 hours. Silt/clay will appear at the top of the sand layer.

Step 5: Record the thickness of silt/clay layer in ml (V2).

Setp 1

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Setp 2:
(V1=150ml)

Setp 3:
Shake Well

Setp 4 & 5:
Keep undisturbed & Record clay reading

Calculation:

% Silt/Clay by volume = V2/V1 *100

Correlation Testing:(@ main lab only once for a given source of sand)

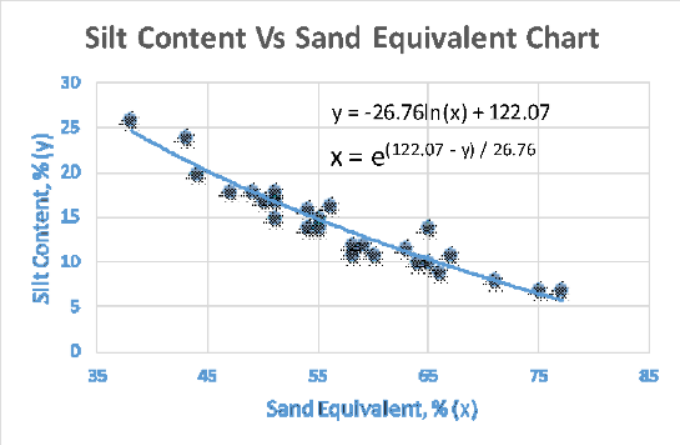
Obtain parallel samples from the same test sample prepared initially for silt content test and test for sand equivalent as per ASTM D2419. Record both silt/clay % and sand equivalent % for a given sample in a table as below:

Sample	Sand Equivalent %	Silt Content %
1		
2		
3		
4		

Comparison Graph:

Plot at least 20 readings on a graph Silt Content % Vs. Sand Equivalent %. Draw trend line to arrive at an equation. Once silt content % is known, sand equivalent, % can be quickly estimated by using this chart and equation which is prepared for a given type of sand.

An example graph of correlation testing is shown below for ready reference.



Cement Types – Comparison of Different Cements as per ASTM Standards

Syed Arif Husain

Cement:

Cement is a binder, a substance that sets and hardens and can bind other materials together. Cement is essentially consisting of minerals containing calcium, silicon, aluminum, and iron.
The raw materials of cement are fed into kiln "huge cylindrical oven" which heats the material to a temperature of about 1500°C, at which material particles are partly molten, and forms clinker.
After the clinker is discharged from the kiln and cooled down, it is ground in ball mills together with a small amount of gypsum until it is so fine. Gypsum is added to control the setting time of the cement.

Composition:

Type	% C3S	% C2S	% C3A	% C4AF	% Gypsum	Fineness m^2/kg
OPC	60	15	10	5	4	350
RHPC	60	15	10	5	4	450
SRC	45	30	2	15	4	380
LH	30	45	5	14	4	330

Manufactory:

OPC: Normal Manufactory
RHPC: Same as OPC but more finely ground 450m2/kg
SRC: Low C3A made by adding iron oxide to the kiln feed, this increase amount C4AF leaving little or no Alumina for C3A
LH: Made by either: Low C3S and C3A and high C2S or coarse grinding

Types of Cement:

There are eight types of Portland cement as per ASTM C150.
1. Type I—For use when the special properties specified for any other type are not required.
2. Type IA—Air-entraining cement for the same uses as Type I, where air-entrainment is desired.
3. Type II—For general use, more especially when moderate sulfate resistance or moderate heat of hydration is desired.
4. Type IIA—Air-entraining cement for the same uses as Type II, where air-entrainment is desired.
5. Type III—For use when high early strength is desired.
6. Type IIIA—Air-entraining cement for the same use as Type III, where air-entrainment is desired.
7. Type IV—For use when a low heat of hydration is desired.
8 Type V—For use when high sulfate resistance is desired.

Where to use:

Fineness m2 /kg	Typical uses
OPC	General Construction
RHPC	Cold weather & precast
SRC	Exposed & marine
LH	Marin and massive structure

Main Four Types are as per BS:

1- Ordinary Portland Cement
2- Rapid Hardening Portland Cement.
3- Sulphate Resisting Portland Cement.
4- Low Heat Portland Cement

The five types of Portland cements exist, with variations of the first three according to ASTM C150.[15]

Type I Portland cement is known as common or general-purpose cement. It is generally assumed unless another type is specified. It is commonly used for general construction especially when making precast and precast-prestressed concrete that is not to be in contact with soils or ground water. The typical compound compositions of this type are:

55% (C3S), 19% (C2S), 10% (C3A), 7% (C4AF), 2.8% MgO, 2.9% (SO3), 1.0% ignition loss, and 1.0% free CaO

Standard Composition Requirements

Cement TypeA	Applicable Test Method	I &IA	II &IIA	III & IIIA	IV	V
Aluminum oxide (Al2O3), max, %	C 114	...	6.0	...	...	...
Ferric oxide (Fe2O3), max, %	C 114	...	6.0B,C	...	6.5	...
Magnesium oxide (MgO), max, %	C 114	6.0	6.0	6.0	6.0	6.0
Sulfur trioxide (SO3),D max, %	C 114					
When (C3A)E is 8 % or less		3.0	3.0	3.5	2.3	2.3
When (C3A)E is more than 8 %		3.5	F	4.5	F	F
Loss on ignition, max, %	C 114	3.0	3.0	3.0	2.5	3.0
Insoluble residue, max, %	C 114	0.75	0.75	0.75	0.75	0.75
Tricalcium silicate (C3S)E, max, %	See Annex A1	...	...	...	35[B]	...
Dicalcium silicate (C2S)E, min, %	See Annex A1	...	...	...	40[B]	...
Tricalcium aluminate (C3A)E, max, %	See Annex A1	...	8	15	7B	5[C]
Sum of C3S + 4.75C3AG, max, %	See Annex A1	...	100H	...	...	...
Tetracalcium aluminoferrite plus twice the tricalcium aluminate (C4AF + 2(C3A)), or solid solution (C4AF + C2F), as applicable, max, %	See Annex A1	...	...	...	...	25[C]

A limitation on the composition is that the (C3A) shall not exceed 15%.

Type II gives off less heat during hydration. This type of cement costs about the same as type I. Its typical compound composition is:

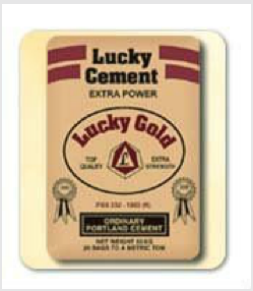
51% (C3S), 24% (C2S), 6% (C3A), 11% (C4AF), 2.9% MgO, 2.5% (SO3), 0.8% ignition loss, and 1.0% free CaO
A limitation on the composition is that the (C3A) shall not exceed 8%, which reduces its vulnerability to sulfates. This type is for general construction exposed to moderate sulfate attack and is meant for use when concrete is in contact with soils and ground water, especially in the western United States due to the high sulfur content of the soils. Because of similar price to that of type I, type II is much used as a general purpose cement, and the majority of Portland cement sold in North America meets this specification.

Note: Cement meeting (among others) the specifications for types I and II has become commonly available on the world market.

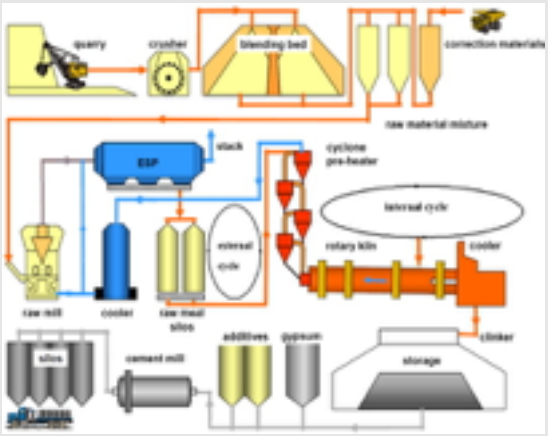
Type III has relatively high early strength. Its typical compound composition is: 57% (C3S), 19% (C2S), 10% (C3A), 7% (C4AF), 3.0% MgO, 3.1% (SO3), 0.9% Ignition loss, and 1.3% free CaO. This cement is similar to type I, but ground finer. Some manufacturers make a separate clinker with higher C3S and/or C3A content, but this is increasingly rare, and the general purpose clinker is usually used, ground to a specific surface area typically 50–80% higher. The gypsum level may also be increased a small amount. This gives the concrete using this type of cement a three-day compressive strength equal to the seven-day compressive strength of types I and II. Its seven-day compressive strength is almost equal to 28-day compressive strengths of types I and II. The only downside is that the six-month strength of type III is the same or slightly less than that of types I and II. Therefore, the long-term strength is sacrificed a little. It is usually used for precast concrete manufacture, where high one-day strength allows fast turnover of molds. It may also be used in emergency construction and repairs and construction of machine bases and gate installations.

Type IV Portland cement is generally known for its low heat of hydration. Its typical compound composition is: 28% (C3S), 49% (C2S), 4% (C3A), 12% (C4AF), 1.8% MgO, 1.9% (SO3), 0.9% Ignition loss, and 0.8% free CaO. The percentages of (C2S) and (C4AF) are relatively high and (C3S) and (C3A) are relatively low. A limitation on this type is that the maximum percentage of (C3A) is seven, and the maximum percentage of (C3S) is thirty-five. This causes the heat given off by the hydration reaction to develop at a slower rate. However, as a consequence the strength of the concrete develops slowly. After one or two years the strength is higher than the other types after full curing. This cement is used for very large concrete structures, such as dams, which have a low surface to volume ratio. This type of cement is generally not stocked by manufacturers but some might consider a large special order. This type of cement has not been made for many years, because Portland-pozzolan cements and ground granulated blast furnace slag addition offer a cheaper and more reliable alternative.

Type V is used where sulfate resistance is important. Its typical compound composition is: 38% (C3S), 43% (C2S), 4% (C3A), 9% (C4AF), 1.9% MgO, 1.8% (SO3), 0.9% Ignition loss, and 0.8% free CaO. This cement has a very low (C3A) composition which accounts for its high sulfate resistance. The maximum content of (C3A) allowed is 5% for type V Portland cement. Another limitation is that the (C4AF) + **2(C3A) composition cannot** exceed 20%. This type is used in concrete to be exposed to alkali soil and ground water sulfates which react with (C3A) causing disruptive expansion. It is unavailable in many places, although its use is common in the western United States and Canada. As with type IV, type V Portland cement has mainly been supplanted by the use of ordinary cement with added ground granulated blast furnace slag or tertiary blended cements containing slag and fly ash.



(Above) Different types of Cement



Cement manufacturing process