QUIKRETE®
CEMENT & CONCRETE PRODUCTS™

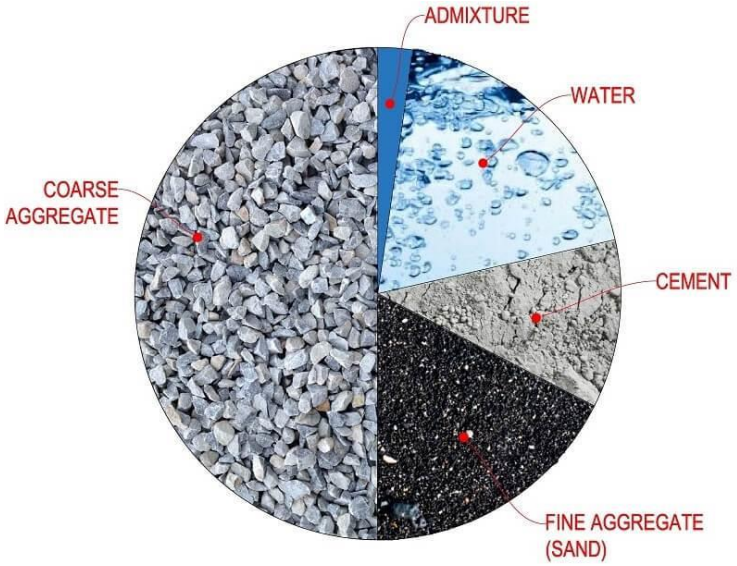
TRAINING MODULE 1

Concrete & Cement: The Basics

What is the Difference Between Cement and Concrete?

The terms cement and concrete are often used interchangeably.

- ***Cement is actually the "glue" that holds concrete together.***
- ***Concrete is a proportional mixture of three primary components:*** portland cement, fine aggregate (sand) and coarse aggregate (gravel or stone).
- ***Other ingredients, called admixtures, are often added to improve concrete characteristics*** *such as strength, workability, crack resistance and durability.*



How Does Concrete Work?

Concrete Doesn't Really Dry…

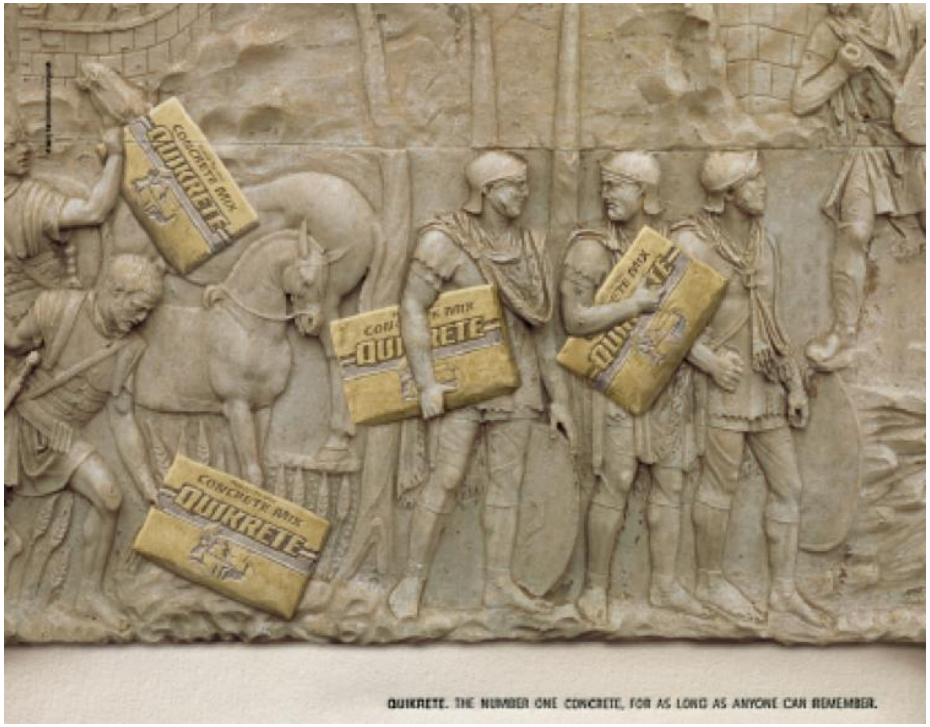
When water is added to the concrete mix, a chemical reaction called "Hydration" takes place. During the hydration process the cement and water harden, binding the aggregates together in a solid mass or matrix.

The History of Cement & Concrete

For centuries, concrete has been used as a durable and versatile building material. In fact, dating back more than 2000 years, Roman's used a volcanic ash based pozzolanic concrete to construct 5300 miles of roads, some of which still exist today. Other examples of structures made from these concretes are notably the huge monolithic dome of the Pantheon in Rome and the vast system of Roman aqueducts, which also made extensive use of hydraulic cement.

The History of Cement & Concrete (cont'd)

Amazingly, the secret of pozzolanic cement was soon lost and the use of structural concrete disappeared in medieval Europe, and was not re-discovered until the 18th century. For almost 1500 years builders were limited because an ancient method of improving simple cement was lost. Historical evidence also indicates that ancient Egyptians used a mixture of lime and gypsum to make mortars and concrete used to build the pyramids.



The History of Modern Cement

Modern (portland) cement was patented in 1824 by Joseph Aspdin, a mason from Leeds, England. He called his hydraulic cement "portland cement" because it resembled the color of the stone quarried on the Isle of Portland, off the coast of England. Aspdin's process involved blending proper proportions of limestone and clay, pulverizing and burning the mixture until it fuses together into clinker; then, he ground it into powder.

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How is Cement Made?

Portland cement today essentially uses the same basic ingredients: calcium, silica, aluminum and iron, as it did almost 100 years ago. What has changed is the manufacturing process. Concrete has become so widely used in commercial and residential construction that cement manufacturing facilities throughout the United States must produce more than 90 million tons of portland cement annually. It is common for single cement plants to produce over 1 million tons per year.

How Cement is Made

The cement manufacturing process starts at raw material source where limestone, silica, alumina and iron oxide are mined, crushed and screened to the appropriate size. These materials are fed into the raised rotary kiln – a 300 foot wide metal pipe 10-15 feet in diameter – and heated with a flame jet to 2700° F - 3000° F. As the material moves slowly through the kiln, pellet sized clinker is formed from the molten ingredients. Once cooled, the clinker is ground into a fine powder; small amounts of gypsum are added to control the setting characteristics.

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Performance Characteristics of Cement

Performance characteristics such as setting time, chemical resistance and strength gain can be modified during the production process by changing various ingredients or proportions, or by changing the size of the cement particle during the grinding process. Various performance standards have been established to maintain consistency and uniformity throughout the world.

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Types of Cement

Although all portland cement has the same basic ingredients 8 types of cement are manufactured to meet specific physical and chemical requirements:

Type I: *Also known as "Ordinary portland cement."* It is suitable for most applications

White: White cement is made from materials that contain little or no iron or magnesium, the two components that give cement its gray color.

Type II: Moderate sulfate resistance

Type I & Type II cement are most often used in packaged concrete and cement mixes. Type V cement is used in several regions of the country (Nevada, Arizona, Utah, California) where high concentrations of sulfates are present in the soil.

Type III: "High-early strength" cement is designed to develop strength earlier than ordinary portland cement. Type III is a Type I that is ground to a smaller size, so it has more surface area for reactivity. Typically Type III cement will reach normal 3 day strength in one day, 7 day strength in 3 days and 28 day strengths in 7 days.

Type V: Resists chemical attack by soil and water high in sulfates

Type IV: Low heat of hydration.

Type IA: Are cements that contain air entrainment material that create IIA, IIIA microscopic air voids in the concrete. The air voids provide area for water to fill where it expands as it freezes; Preventing damage to the cement matrix.

Masonry: Blend of Type I portland cement, limestone, air entraining agent and workability enhancers.

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Masonry Cement

Masonry cement is used specifically for brick, block and stone applications and typically contains portland cement, ground limestone, air entraining agents and other ingredients. Masonry Cements are manufactured to achieve specific compressive strengths, air content, water retention and fluidity for various application types.

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Mortars

When combined with sand, masonry cement will produce a workable mortar designed to support the weight of masonry units and provide a controlled bond.

Types of Mortar

Type O: Historical restoration and tuck pointing applications. High lime content mortar. 350 psi minimum compressive strength (@ 28 days)

Type N: Non-Structural applications. 750 psi minimum compressive strength. Primarily used for veneer applications of brick and manufactured stone.

Type S: Structural Mortar applications. 1800 psi minimum compressive strength (@ 28 days) For use with masonry block, structural brick and stone.

Type M: Structural Mortar applications. 2500 psi minimum compressive strength (@ 28 days) For use on masonry block was typically used on institutional projects and prisons.

Concrete 101 Quiz – Part 1

1.The terms “cement” and “concrete” mean the same thing.

True
False

2.Portland cement’s basic ingredients include the following:

a)Limestone
b)Silica
c)Iron
d)Alumina
e)All of the above
f)None of the above

Concrete 101 Quiz – Part 2

3. What is the name of the marble size material that is formed in a cement kiln from the molten ingredients?
   a) Gypsum
   b) Clinker
   c) Oxide
   d) Zinc

4. Ordinary portland cement is called:
   a) Type I
   b) Type III
   c) Type IV
   d) Type V

5. Masonry Cement can be used for making mortar and concrete mix:
   a) True
   b) False

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Concrete 101 Quiz – ANSWERS

1. False – Cement is the glue that holds concrete together.

2. All of the Above

3. Clinker

4. Type I

5. False – Masonry cement will only produce a workable mortar