CALPORTLAND®

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concrete solutions®

CEMENT: WHAT IS IT AND WHERE DOES IT COME FROM?

What is cement? If you ask one of your neighbors or even one of your own family members you might be told that it is the stuff driveways or sidewalks are made of. As most of us in the industry know, concrete is what we build things out of and cement is what holds the concrete together. Yes, cement is the glue.

Cement comes from, not surprisingly, a cement plant, where hundreds of little elves take many different materials like rocks and nails and clay and old tires and grind them all up and turn them into this mysterious gray stuff. Well, that's not exactly true, there are no elves, but there are a lot of hard working, knowledgeable and dedicated people there and they do use rocks and iron, clay and yes, even old tires along with coal and turn them into cement. They do this by first grinding all the different materials up very fine, so fine in fact that 80% of all the material will pass a #200 sieve. That means most of the particles are less than 3/1000ths of an inch in diameter! Of the materials required to make portland cement, limestone or calcium carbonate ($CaCO_3$) constitutes the largest percentage at about 80%, about 20 to 22% made up of silica (SiO_2, which is sand), about 8% alumina (aluminum oxides usually coming from clay or bauxite), and about 12% iron from various sources. For those of you who are sticklers for detail, you may have noticed that 80 + 20 + 8 + 12 totals more than 100%. It actually totals about 120%. That's because when we put it all together and run it through the kiln with ground coal and burn it at temperatures of 1500°C (that's about 2650°F) some of the material is driven off as a gas leaving the balance in the form of cement clinker.

Inside the approximately 175' to 200' long kiln of a dry process cement plant (that's a plant where all the materials are fed dry) there are 3 temperature zones that all the raw materials pass through. The first is the preheating zone where temperatures are from 212 - 1020°F where the last of any water is driven off and the materials are brought up to reaction temperatures. The second is the calcining zone. This refers to the area from 1020 - 1830° F where the limestone is calcined. Calcining is the process of breaking down limestone ($CaCO_3$) into free lime (CaO) and driving off the carbon dioxide (CO_2) so that the reactive form of lime is available. The third zone is the sintering zone where the materials reach about 2650°F. In this zone the alumina and iron phases melt and create a liquid much like lava in a volcano. In that molten liquid the lime reacts with the clay to create the chemical compounds present in portland cement. Once the materials are combined they tumble out of the kiln and cool later to be blended with gypsum and limestone and ground up very fine to produce portland cement. Standard portland cements are classified into five types though only three are commonly used locally.

Cement Types:

Type I	Normal use
Type II	Moderate sulfate resistance
Type III	High early strength
Type IV	Very low heat of hydration
Type V	High sulfate resistance

(*Types IV and V are regional cements*)

While these general classifications of cements are still as they have been for more than a hundred years, our industry is making changes to the cement making process and materials to reduce the overall byproduct of CO_2. We can still make the same great cement that we build all our buildings and infrastructure with that lasts a lifetime and at the same time significantly reducing our carbon footprint. To do this we are adding things like the same limestone we use in manufacturing cement but add it in the grinding process and no longer drive off the CO_2. This results in about a 10% reduction of CO_2. Or we may add materials like natural pozzolan (naturally deposited volcanic minerals) to make a pozzolan cement. This also reduces the CO_2 by 10% or more. CalPortland is working diligently to develop and produce new cements like these under the product line ADVANCEMENT, in order to continue supplying resilient products to the construction industry for the next 125 years! So if you know any elves that would like to be part of improving our environment and helping build the infrastructure that will last lifetimes, our head elves would love to hear from you!

IT'S TIME FOR ADVANCEMENT

ADVANCEMENT™ is a line of portland-limestone blended cements that addresses our customers' increasing demand for sustainable options. By replacing clinker with up to 10% additional limestone during the grinding process, less clinker is produced during the energy intensive phase of manufacturing cement. In accordance to ASTM C150, cement manufacturers currently implement up to 5% limestone addition into their production process. However, in accordance to ASTM C595, portland-limestone cement (PLC) can implement up to 15% limestone — resulting in a dramatic decrease in CO_2 emissions over ordinary portland cement.

There are now two products that offer resilience, performance and a lower carbon footprint: ADVANCEMENT™HS and ADVANCEMENT™LT. Customers currently using ordinary portland cement can now use **ADVANCEMENT™ HS**. HS is used in high sulfate areas and for general use concrete construction such as structural concrete applications, prestressed and precast concrete and prepackaged products like premixed concrete and mortars.

Users of Type IL cements will enjoy **ADVANCEMENT™LT**, where aesthetic properties are desired. In addition to lower carbon emissions, the ADVANCEMENT™ line of products are comparable in

performance, enhance aesthetics, and have the environmental qualities sought after in cement.

The use of PLCs in concrete mix design can often be substituted in ordinary portland cement mixes. Common performance attributes such as strength, shrinkage, and durability are comparable if not better than ordinary portland cement. Combining a PLC like ADVANCEMENT™ HS with other concrete carbon reduction technologies will further enhance performance and increasingly reduce the embodied carbon of concrete, the world's most widely used building product.

ADVANCEMENT
Building a Foundation for Environmentally Friendly Cement.

To learn more about the ADVANCEMENT™ product line, please visit ADVANCEMENT.CalPortland.com

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GOOD CONCRETE PRACTICES

A proper concrete mix and quality construction practices will produce concrete that is durable and has a good quality appearance rather than abused concrete with surface defects and poor durability. There are no substitutes for good workmanship , quality materials and protection from the elements by good curing practices. Let's review what happens to abused concrete.

When you add only one gallon of additional water to one cubic yard of properly designed concrete:

- You increase the slump by about one inch
- You reduce the 28 day compressive strength by as much as 200 psi.
- You waste the effect of 15 to 24 pounds of cement.
- You increase the drying shrinkage potential by about 10%.
- You increase the possibility of seepage of water through the concrete by up to 50%.
- You decrease the freeze/thaw resistance by about 20%.

Curing is a must for quality concrete.

Let's remember…..

High quality concrete is made with good quality rock, sand, cement and admixtures. Poor quality concrete is made with the same materials if added water is abused and/or the concrete is not cured.

Please note information contained in this newsletter is for educational purposes only and should only be used as a guide.

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