BRIEFING

Concrete Thinking for a sustainable world

Frequently Asked Questions About Cement, Concrete, and Sustainability

General

Q. What is the difference between cement and concrete?
A. While the terms are sometimes used interchangeably, concrete and cement are not the same. Cement, a fine gray powder, is a key ingredient in concrete production. Cement typically comprises 10 to 12 percent of the entire mix. When cement is mixed with water, sand and gravel, it turns into concrete–the rock-like substance associated with sidewalks, roadways, building foundations, and more.

Q. What is Portland Cement Association or PCA?
A. Portland Cement Association is a group of about 50 cement companies in the U.S. and Canada. Since 1916, PCA has focused on improving cement and its uses. On behalf of its members, PCA promotes the industry's goals through market development, education, research, technical services, and government affairs. It has taken a leadership role in educating its industry and the business community about the importance of sustainable development and how concrete plays a vital role in environmentally sound construction.

Q. What is sustainability and why is it important?
A. Sustainability refers to the ability to build for today and tomorrow without depleting future resources. A growing global population is beginning to strain the finite resources available on the planet. Sustainability seeks to balance the economic, social and environmental impacts, recognizing that population growth will continue. Sustainable development brings this evaluation to the design and construction industry.

Q. Why the recent demand for sustainable development?
A. Recognizing that U.S. buildings use nearly 10 percent of the world's energy, there is an increasing demand for sustainable development and green building practices. In fact, U.S. buildings use three times more energy than similar buildings in similar climates in Europe. Therefore, the U.S government is adopting green building programs and an increasing number of states are offering tax benefits for green public buildings.

Q. What is a green building?
A. The U.S. government defines green buildings as those that demonstrate the efficient use of energy, water and materials; limit impact on the outdoor environment; and provide a healthier indoor environment. Studies show that green buildings offer improved air quality and more access to daylight in addition to energy and cost savings.

Sustainability and Concrete

Q. What makes concrete a sustainable/green building material?
A. Concrete is a responsible choice for sustainable development. Its durability is a significant sustainable attribute of concrete because it will not rust, rot, or burn, requiring less energy and resources overtime to repair or replace. Structures built with concrete have optimal energy performance. Additionally, concrete is easy to use, incurs little waste and can be readily recycled.

Q. What makes concrete so durable?
A. The primary ingredients of concrete, sand, gravel, and cement are mineral based. When mixed with water, the cement molecules chemically combine with the water to create a crystalline matrix of high compressive strength. This matrix binds the sand and gravel together, creating what is sometimes known as "liquid stone." Unlike other construction materials which can rust or rot, moisture is a necessary component in making concrete.

Q. What is energy efficient about concrete?
A. Structures built with concrete have optimal energy performance. Homes and buildings constructed with insulated concrete walls are not subject to large daily temperature fluctuations. This means home or building owners can lower heating and cooling bills up to 25 percent. Also heating, ventilating and air-conditioning can be designed with smaller-capacity equipment. High performance insulated concrete wall systems provide high R-value and thermal mass with low air infiltration to provide superior thermal efficiency.

Q. How does concrete relate to recycling?
A. Recycling is part of concrete's life cycle from the beginning. Several common industrial byproducts like fly ash and slag that would otherwise add to landfills are incorporated into concrete mixes. Use of these byproducts also reduces reliance on raw materials. Finally, when a concrete structure has served its purpose, it can be crushed for use as aggregate in new concrete or as base materials for roads, sidewalks and concrete slabs. Even the reinforcing steel in concrete (which often is made from recycled materials) can be recycled and reused.

Q. How does concrete effect the environment compared to wood and steel?
A. Concrete is one of the most inert building materials in use today. It does not rot, burn or rust, providing durability that significantly outlasts many other building materials including wood and steel. The cement industry utilizes industrial byproducts like fly ash and consumes less energy than its competitors. According to the Department of Energy, U.S. cement production accounts for 0.33 percent of energy consumption—lower production levels than steel production at 1.8 percent and wood production at 0.5 percent. In addition, it places less stress on our environment to acquire the raw materials for concrete than steel or wood. Thus, concrete is an excellent choice for sustainable development.

Q. What is the urban heat island effect and how does concrete fit in?
A. Scientists observed that urban areas with more buildings and paving and less vegetation are typically warmer than surrounding rural areas. This is partially attributed to the dark surfaces of roofing and paving used to create our built environment. Temperature increases have been measured as high as 8 degrees Fahrenheit. This additional heat causes air conditioning systems to work harder and consume more energy, as much as 18 percent. The additional heat also enhances the conditions for the creation of smog. Concrete's natural light color can reduce urban heat islands. Light-colored concrete reflects more solar energy than dark-colored

materials – whether on parking lots, driveways, or sidewalks–thereby reducing the high temperatures.

Q. What are the environmental downsides to using concrete?
A. Manufacturing cement is an energy-intensive process that creates carbon dioxide. The industry has addressed this issue by significantly reducing its carbon dioxide output–there has been a 33 percent reduction since 1975. Industry research and changes in manufacturing standards are seeking ways to reduce the carbon dioxide production even further. Concrete's durability and energy-efficiency minimize maintenance, repair and heating and cooling needs, providing benefits which outweigh manufacturing energy needed.

Manufacturing

Q. How is cement made?
A. The four steps to cement manufacturing are:

1. Virgin raw materials such as limestone and small quantities of sand and clay come from a quarry usually located near the cement manufacturing plant. The materials are blended and ground together.
2. The materials are heated in a kiln, which reaches temperatures of 1,870 degrees Centigrade or 3,400 degrees Fahrenheit. During this process, an intermediate product called clinker is formed.
3. Once cooled, the clinker is ground with a small amount of gypsum, forming a fine gray-colored powder called portland cement.

Q. Isn't cement manufacturing one of the most energy intensive manufacturing processes?
A. No. According to the Department of Energy, U.S. cement production accounts for 0.33 percent of energy consumption — lower production levels than steel production at 1.8 percent and wood production at 0.5 percent. Since 1975, the cement industry has improved energy efficiency by 33 percent. Today, the cement industry accounts for less than 1.5 percent of U.S. carbon dioxide emissions, well below other sources such as electric generation plants for heating and cooling (33 percent) and transportation (27 percent).

Q. What are the current levels of energy used in the manufacturing of cement?
A. According to the Department of Energy, U.S. cement production accounts for 0.33 percent (one-third of one percent) of energy consumption. The current level is low compared with other industries, such as petroleum refining at 6.5 percent, steel production at 1.8 percent, and wood production at 0.5 percent. The greatest consumers of energy are the homes and buildings we live in (38.8 percent) and the cars and trucks we drive (27.6 percent). New technology and equipment coupled with increased use of alternative fuels and alternative raw materials have reduced the industry's energy consumption by one-third since 1975.

Q. What has the cement industry done to improve its manufacturing process?
A. New technology and equipment, coupled with increased use of alternative fuels and raw materials, have reduced energy consumption by one-third since 1975. Today, cement and concrete can contain recycled materials that utilize industrial byproducts that would otherwise clog landfills. The industry has reduced its own waste by recycling more than 75 percent of cement kiln dust (CKD) – nearly eight million tons each year – directly back into the cement kiln as raw material. By doing so, manufacturers conserve energy and reduce use of limestone and other virgin raw materials.

Q. What is being done about carbon dioxide emissions during the cement manufacturing process?
A. The industry was among the first to tackle the issue of climate change, and it has remained at the forefront of developing policies and improving the manufacturing process. Since 1975, the cement industry has reduced emissions by 33 percent. In 2000, the industry created a way to measure carbon dioxide emissions, and by the year 2020, the industry plans to voluntarily reduce carbon dioxide emissions by 10 percent below the 1990 baseline.

The most recent progress involves newly introduced guidelines that will allow for greater use of limestone as a raw material of cement, which will ultimately reduce CO_2 by more than 2.5 million tons per year.

Q. How does the industry compare to others in terms of carbon dioxide emissions?
A. Today, the cement industry accounts for less than 1.5 percent of U.S. carbon dioxide emissions, well below other sources such as electric generation plants for heating and cooling (33 percent), transportation (27 percent), and industrial operations (19 percent).

Q. How does the industry plan to reduce carbon dioxide levels?
A. By 2020, the industry aims to reduce carbon dioxide emissions by 10 percent below the 1990 baseline levels. To achieve this goal, the cement industry has adopted a three-part strategy:

1. Improve the energy efficiency by upgrading plants with state-of-the-art equipment
2. Improve product formulation to reduce energy of production and minimizes the use of natural resources
3. Conduct research and develop new applications for cement and concrete that improve energy efficiency and durability

Q. How much recycled industrial byproducts are used in concrete production?
A. Concrete contains recycled materials and therefore helps reduce industrial byproducts that would otherwise clog landfills. For example, 11,400,000 metric tons of fly-ash – a byproduct of coal combustion at electric utilities – were used in concrete in 2001. Concrete production uses about 3 million metric tons of recycled slag, a byproduct of steel production.

Q. What recycled materials are used in cement production?
A. While maintaining superior quality, the use of raw materials has been significantly reduced by replacing them with recycled industrial byproducts. The industry has also reduced its own waste by recycling more than 75 percent of cement kiln dust (CKD) – nearly eight million tons each year – directly back into the cement kiln as raw material. By doing so, manufacturers conserve energy and reduce use of limestone and other virgin raw materials. Other industrial byproducts that can be recycled for use in the production of cement include:

- Foundry sand, a byproduct of metal casting
- Mill scale or slag, a material recycled from the iron and steel industries
- Fly ash, a byproduct of coal combustion at electric power utilities
- Lime sludge, a waste product generated by recycling paper

Q. What is cement kiln dust and how is it used in the manufacturing process?
A. Cement kiln dust, or CKD, is created during the third stage of manufacturing when clinker is formed. Electrostatic and bag filters capture the dust for recycling. The industry recycles more than 75 percent of cement kiln dust – nearly eight million tons each year – directly back into the cement kiln as raw material. Recycling this byproduct also reduces the need for limestone and

other raw materials and helps conserve energy. Other uses for CKD include agricultural soil benefaction and soil stabilization.

Q. How are scrap tires are used in cement production?
A. In 2001, the cement industry used about 53 million scrap tires, or 19 percent of the total amount of scrap tires that year, as an alternative fuel source during cement production. Pound for pound, tires contain 1/3 more energy than coal. Recycling tires in this way effectively removed them from landfills or other disposal methods.

Q. How is the cement industry's relationship with government agencies?
A. Portland Cement Association (PCA) and its member companies are proactively engaged and committed to environmental stewardship and sustainable development. In 2000, the cement industry received Environmental Protection Agency's (EPA) Climate Protection Award for its partnership with Climate Wise. PCA continues to work closely with the EPA and Department of Energy to make future improvements.