



TIRE-DERIVED FUEL



Scrap tires, if not properly managed, can create an environmental nuisance and eyesore. What's more, they can constitute an environmental hazard if they burn in an uncontrolled manner, such as in a field or landfill.

However, by utilizing cement kilns' controlled combustion environment, **scrap tires can be an environmentally-sound source of energy** in the manufacture of cement.

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TIRE-DERIVED FUEL

continued



Like fossil fuels such as coal, oil, and natural gas, tires contain hydrocarbons. Pound for pound, tires have more fuel value than coal. Hundreds of millions of used tires are generated annually in the United States. By simply disposing of these tires, we miss an important recycling opportunity: the chance to recover their energy and conserve our resources of fossil fuels.

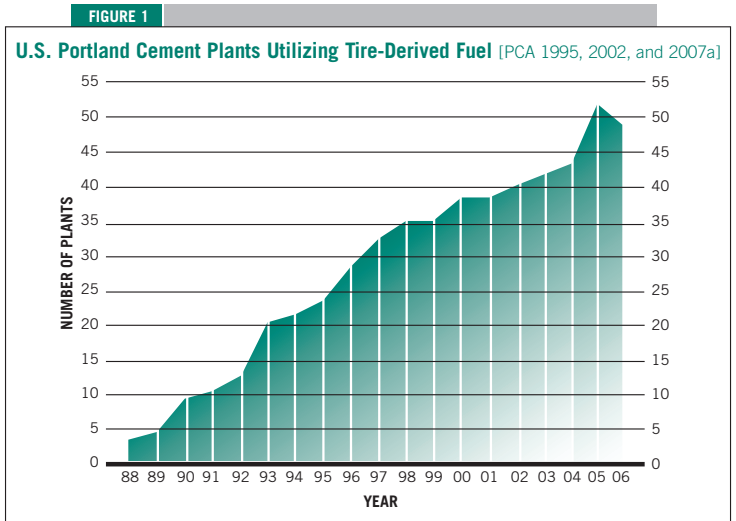
Cement making is an ideal process for recovering this energy. The intense heat of the kiln ensures complete destruction of the tires. There is no smoke or visible emissions from the tires. In fact, the use of tires as fuel can actually reduce certain emissions.

An Alternative to Traditional Fossil Fuels

The Rubber Manufacturers Association (RMA) has estimated that 58 million scrap tires were used as fuel in portland cement plants in 2005 out of the 299 million tires produced that year [RMA 2006]. The United States Environmental Protection Agency (USEPA) states that tire-derived fuel (TDF) contains about the same amount of energy as oil and 25% more energy than coal [USEPA 2007b]. This means that each ton of TDF used by a portland cement plant has the potential to replace 1.25 tons of coal, and the impacts of coal mining, processing, and transporting are avoided. In energy terms, the cement industry consumed 12.6 trillion BTUs of TDF in 2006 which is approximately 3.6% of all of the non-electrical energy required by the manufacturing process [PCA 2007a].

TDF Use Is Increasing

The number of cement plants utilizing scrap tires as a supplemental fuel has risen dramatically over the last 19 years. Figure 1 shows the increase in portland cement plants utilizing TDF [PCA 1995, 2002, and 2007a]. As of 2006, state and local environmental agencies have approved the use of TDF at 48 plants in 21 states (Table 1).



THE CEMENT-MAKING PROCESS

Portland cement manufacturing is a four-step process:

1. Raw materials, including limestone and small amounts of sand and clay, come from quarries usually located near the cement manufacturing plant. Limestone is typically about 80% of the raw mix and is the source of calcium. The remaining raw materials provide the silica and the necessary small amounts of alumina and iron.
2. The materials are carefully analyzed, precisely combined and blended, and then ground for further processing.
3. The ground materials are heated in an industrial furnace, called a kiln; kilns are a rotating vessel ranging in length from 60 to over 200 meters (200 to >650 feet) long with a diameter ranging from 3 to 7.5 meters (10 to 25 feet). The kiln reaches temperatures of 1,450° C (2,650° F). The heat causes the materials to turn into a new marble-sized substance called clinker. The kiln flame is fueled by powdered coal, powdered petroleum coke, natural gas, oil, and/or recycled materials burned for energy recovery.
4. Red-hot clinker is cooled and ground with a small amount of gypsum. The end-result is a fine powder called portland cement. At each stage, process data are continuously monitored to produce a high-quality product, improve energy efficiency, and minimize emissions.

CEMENT OR CONCRETE?

The terms cement and concrete are often misused. Cement is an ingredient of concrete. It is the fine powder that, when mixed with water, sand, and gravel or crushed stone, forms the rock-like mass known as concrete. Cement acts as the binding agent or glue in concrete.

TABLE 1

Summary of 48 Portland Cement Manufacturing Plants Currently Permitted and Utilizing Tire-Derived Fuels
[PCA 2007b and RMA 2006]

Ash Grove Cement Co. Chanute, KS Durkee, OR Foreman, AR Inkom, ID Midlothian, TX Nephi, UT Seattle, WA	CEMEX Brooksville, FL (South) Brooksville, FL (North) Clinchfield, GA Demopolis, AL Knoxville, TN New Braunfels, TX Odessa, TX Victorville, CA	Holcim (US) Inc. Ada, OK Clarksville, MO Dundee, MI Florence, CO Hagerstown, MD Mason City, IA Midlothian, TX Morgan, UT Theodore, AL	Lehigh Cement Company Fleetwood, PA Leeds, AL Redding, CA
Buzzi Unicem USA, Inc. Cape Girardeau, MO Oglesby, IL Pryor, OK Sweetwater, TX	ESSROC Cement Corp. Bessemer, PA Frederick, MD	Lafarge North America Inc. Calera, AL Grand Chain, IL Harleyville, SC Tulsa, OK Whitehall, PA	Mitsubishi Cement Corp. Lucerne Valley, CA
California Portland Cement Co. Colton, CA	Florida Rock Industries, Inc. Newberry, FL		Monarch Cement Company Humboldt, KS
Capitol Aggregates, Inc. San Antonio, TX			National Cement Company Lebec, CA Ragland, AL
			Texas Industries, Inc. New Braunfels, TX Oro Grande, CA
			Texas-Lehigh Cement Company Buda, TX

Additional U.S. plants have expressed interest in obtaining a permit or have received a permit but have not begun utilizing scrap tires as a fuel. The delay in utilizing TDF may be due to equipment limitations at the cement plant, regional TDF availability, state regulatory agency review, and local community discussions. Figure 2 shows the locations of all of the facilities currently utilizing in TDF.

Beneficial Effects

The environmental benefits of utilizing scrap tires as a supplemental fuel in the portland cement manufacturing process are multifold. When whole tires are combusted in cement kilns, the steel belting becomes a component of the clinker, replacing some or all of the iron required by the manufacturing process.

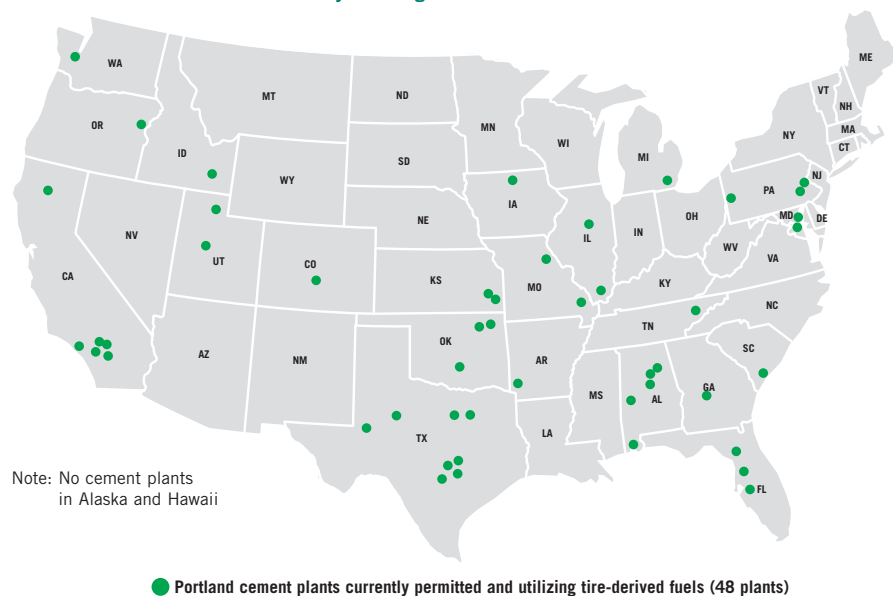
In 2008, PCA member companies completed a study on the impact of TDF firing on cement kiln air emissions. The study's data set included emission tests from 31 of the cement plants presently firing TDF. Dioxin-furan emission test results indicated that kilns firing TDF had emissions approximately one-third of those kilns firing conventional fuels – this difference was statistically significant. Emissions of particulate matter (PM) from TDF-firing kilns were 35% less than the levels reported for kilns firing conventional fuels (not statistically significant due to the low PM emissions reported for essentially all cement plants). Nitrogen oxides, most metals, and sulfur dioxide emissions from TDF-firing kilns also exhibited lower levels than those from conventional fuel kilns. The emission values for carbon monoxide and total hydrocarbons were slightly higher in TDF versus non-TDF firing kilns.

However, none of the differences in the emission data sets between TDF versus non-TDF firing kilns for sulfur dioxide, nitrogen oxides, total hydrocarbons, carbon monoxide, and metals were statistically significant. Separate studies conducted by governmental agencies and engineering consulting firms have also indicated that TDF firing either reduces or does not significantly affect emissions of various contaminants from cement kilns [PCA 2008].

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FIGURE 2

U.S. Portland Cement Plants Currently Utilizing Tire-Derived Fuel



MID-KILN INJECTION OF SCRAP TIRES

With every revolution of their kiln, the Ash Grove Cement Company plant in Midlothian, TX injects one or two scrap tires through a special port. This automated system allows the plant to utilize whole tires to replace up to 25% of the traditional fossil fuels required by the manufacturing process.



TIRE HANDLING SYSTEM AT A PORTLAND CEMENT PLANT

At the Capital Aggregates cement plant in San Antonio, TX, scrap tires are received and stored in semi trailers. These trailers are hydraulically lifted to allow the tires to roll into a singulator which extracts one tire at a time and places it on the conveyor system. The automated conveyor transports the scrap tires to the injection point in the kiln system.



FOR ADDITIONAL INFORMATION REGARDING THIS SUBJECT, PLEASE CONTACT:

Tyrone Wilson, Ph.D.
 Portland Cement Association
 500 New Jersey Avenue, N.W. 7th Floor
 Washington, DC 20001
 Voice: 202.408.9494
 Fax: 202.408.0877
 Email: twilson@cement.org



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Under their program for the voluntary reporting of greenhouse gases, the United States Department of Energy (USDOE) has estimated that the combustion of TDF produces less carbon dioxide (CO₂) per unit of energy than coal [USDOE 2007a]. This means that when TDF replaces coal in a portland cement kiln—for example, when scrap tires are used to heat the precalciner vessel instead of coal—less CO₂ will be produced. The Mojave Desert Air Quality Management District in California has determined that TDF use is NOx RACT (“Reasonably Available Control Technology”) for portland cement kilns [CARB, 2002].

The use of TDF is common in other parts of the world. In Japan, there were 103 million scrap tires generated in 2006 with 16% being used as a fuel in the cement industry. For that year Japan recycled 54% of all scrap tires through heat utilization [JATMA 2007]. Of the approximately 3.2 million metric tons of scrap tires handled annually in Europe, 31.6% are directed to energy recovery systems including portland cement kilns [ETRMA 2007].

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Portland Cement Association is a trade association representing cement companies in the United States and Canada. PCA's U.S. membership consists of 30 companies operating 115 plants in 36 states. PCA members account for more than 98 percent of cement-making capacity in the United States and 100 percent in Canada.

Portland Cement Association

5420 Old Orchard Road
Skokie, Illinois 60077-1083
847.966.6200 Fax 847.966.9781

500 New Jersey Avenue, N.W. 7th Floor
Washington, DC 20001
202.408.9494 Fax 202.408.0877

www.cement.org

