



CTS Rapid Set Cement A “GREEN” Hydraulic Cement

Reducing CO2 emissions by 32% - 36% over conventional Portland Cement

By Waldemar A. Klemm

CTS Rapid Set Cement differs from ordinary Portland Cement in most high performance construction applications, such as concrete highways, airport runways, bridges, and slab floors where superior durability and rapid strength gain are required. CTS Rapid Set Cement gains strength faster than Portland Cements and in many instances can be put into service in as little time as 1 hour. CTS Rapid Set reaches compressive strengths in one day that an equivalent Portland Cement mix would require one month to achieve. For larger projects, CTS Rapid Set Concrete mixtures may be batched using conventional ready mix equipment.

Carbon Footprint:

More importantly CTS Rapid Set Cement has a much smaller “**Carbon Footprint**” than Portland Cement. This means that in its manufacturing process, with normal cement plant production equipment, it generates far less Carbon Dioxide (CO₂) than Portland Cement emits during its production process. Carbon Dioxide is a “Greenhouse Gas” and is a major contributor to global warming and climate changes. Thus, CTS Rapid Set Cement is a “Green” hydraulic construction material that is far superior in most respects to Portland Cement.

Lower Production Temperatures:

There are a number of reasons for the exceptional “Green” characteristics of CTS Rapid Set Cement and concrete. In the case of cement production practice, the emissions of Carbon Dioxide gas result from two aspects of high temperature manufacturing process.

First, at the extremely high temperatures of a rotary cement kiln, the cement raw materials (limestone, clay, etc) decompose and chemically react to form a marble sized product called “cement clinker”, which is subsequently cooled and then ground into fine powder fineness to produce the final cement product. During the heating or pyroprocessing stage, the limestone (calcium carbonate) constituent of the raw material kiln feed mixture loses its carbon content as evolved carbon dioxide.

Secondly, the combustion of fuel (generally coal) with air in a cement kiln, also releases carbon dioxide as a combustion product, much the same as carbon dioxide gas is emitted from the exhaust pipe of a vehicle that is burning gasoline or diesel fuel.

CTS Rapid Set Cement

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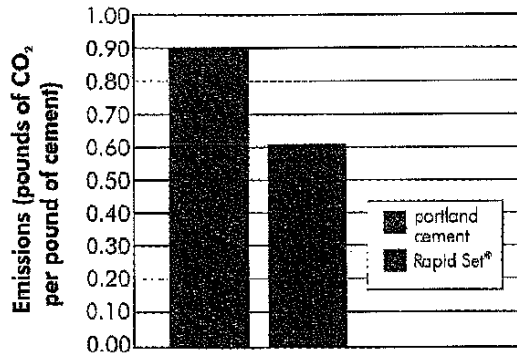


Fig. 1: CO₂ Emissions of portland cement compared to Rapid Set® cement

In the case of Portland Cement production, approximately 40% of emitted CO₂ results from the burning of the fuel in a kiln, and the remaining 60% of CO₂ comes from the decarbonation of the limestone in the kiln feed raw materials. Worldwide, the emission of carbon dioxide from cement production is equivalent to 0.5 kilograms of CO₂ per 0.5 kilogram of cement clinker that is burned. However, in Portland Cement production the clinker factor usually is 0.95, meaning that the Portland clinker is interground into cement in large grinding mills with about 5% gypsum to control cement or concrete setting process when water is later added to the dry mixture. In a recent change to the ASTM Standard Specification for Portland Cement (C-150), further additions of up to 5% limestone are permitted, with the gypsum, in the final grinding step. With these additional dilutions to the Portland clinker constituent, the clinker factor may be somewhat lower. In fact, a recent estimate for carbon dioxide emissions for Portland Cement production in the U.S. is 0.4 kilograms of CO₂ per 0.5 kilograms of ground Portland Cement (Fig 1).

The manufacturing of CTS Rapid Set Cement clinker demonstrates significant reductions in North American and potentially global emissions of carbon dioxide from cement production. An analysis of CTS Rapid Set Cement manufacturing raw materials composition, pyroprocessing techniques, and cement grinding has established a **baseline emission of 0.28 kilograms of CO₂ per 0.5 kilogram of CTS Rapid Set Cement produced.**

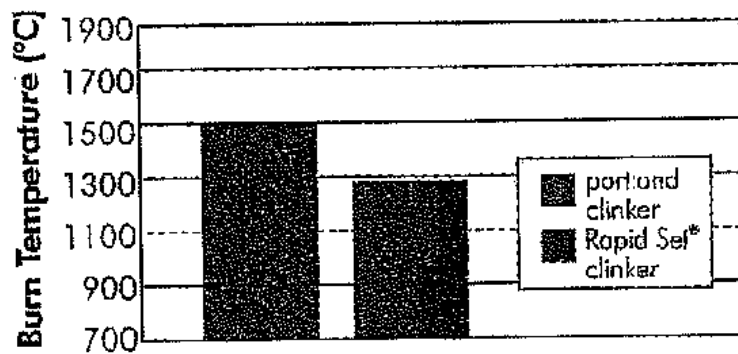


Fig. 2: Clinker burning temperature of portland cement and Rapid Set® cement

CTS Rapid Set Cement exhibits a significantly smaller “carbon footprint” which is 60% - 70% the size of that produced by most Portland Cements made in the United States.

Environmental Advantages

- CTS Rapid Set Cement pyroprocessing emits 0.1 kilograms of CO₂ per 0.5 kilograms of cement from fuel (coal) combustion
- CTS Rapid Set Cement pyroprocessing emits 0.2 kilograms of CO₂ per 0.5 kilograms of cement from thermal decarbonation of calcium carbonate (limestone)
- CTS Rapid Set Clinker is directly ground into cement with only very minimal, if any, additions of gypsum
- CTS Rapid Set Cement is never blended with Portland cement to produce a fast setting or rapid strength developing product
- Although CTS Rapid Set Cement is somewhat similar to Portland cement in mineralogical composition, its main constituents are calcium sulphoaluminate, dicalcium silicate, and anhydrous calcium sulfate. No tricalcium silicate is formed.
- The burning temperature of CTS Rapid Set Clinker is 1,280°C, which is significantly lower than Portland clinker burning temperatures
- The average burning temperature of Portland clinker is about 1,500°C or more (Fig 2)
- The low-sulfur coal used to produce CTS Rapid Set Clinker has an energy value of 12,300 BTU per 0.5 kilogram of coal, and a fixed carbon content of about 48%
- The reduced burning zone temperature needed to form CTS Rapid Set Clinker has the additional advantage of producing lesser amounts of smog producing oxides of nitrogen
- The softer and more friable nature of CTS Rapid Set Clinker also lends itself to much easier grinding therefore, a lower grinding mill energy consumption
- Hardened CTS Rapid Set Concrete is much more durable than portland cement concrete, and has a particularly greater resistance to sulfate or other types of chemical attack. Due to its very rapid strength producing ettringite formation, lower porosity, and subsequent internal self desiccation, CTS Rapid Set Concrete is extremely impervious to carbonation, freeze thaw susceptibility, and acid rain leaching. Thus, it has a proven record of field performance that exceeds the normal useful life span of Portland cement concrete.

In summary, CTS Rapid Set Cement not only is greener cement due to its smaller carbon footprint than Portland cement when manufactured, but also is a cement, mortar, or concrete that exhibits superior performance, durability, and an extended lifetime under most ambient temperature and field usage conditions.

The Author:

Waldemar A. Klemm is a consultant in the Cement Industry. He has over 40 years experience in the Cement Industry in plant process, chemistry, research and development activities, and environmental studies. He has authored 43 technical reports and scientific papers in clinkering chemistry, cement hydration, admixture research, cement manufacturing, an environmental analysis.

Waldemar holds patents on expansive cement production and fluoride mineralizers for clinkering. He has been an invited speaker at prestigious cement and concrete conferences and symposiums. He is a member of the American Chemical Society; the American Society for Testing and Materials (ASTM); and a Fellow of the American Ceramic Society.

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