

CTS Rapid Set[®] Cement

A “Green” Hydraulic Cement

Reducing CO₂ emissions by 32% - 36% over conventional portland cement

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

CARBON FOOTPRINT

More importantly, Rapid Set[®] 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, Rapid Set[®] 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 Rapid Set[®] cement and concrete. In the case of cement production practice, the emissions of carbon dioxide gas result from two aspects of the high-temperature manufacturing process.

First, at the extremely high temperatures of a rotary cement kiln, the cement raw mix 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.

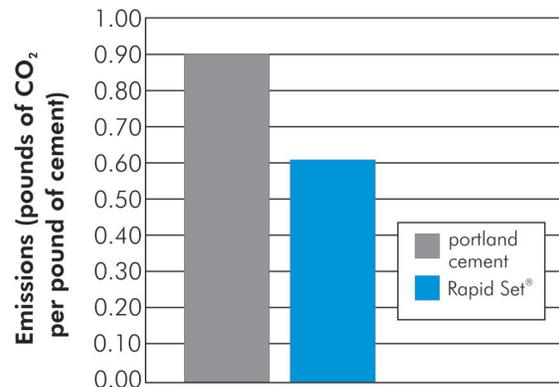


Fig. 1: CO₂ Emissions of portland cement compared to Rapid Set[®] cement

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. World-wide, the emission of carbon dioxide from cement production is equivalent to about one pound of CO₂ per one pound 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 the cement or concrete setting process when water later is 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 0.9 pounds of CO₂ per pound of ground portland cement (Fig. 1).

The manufacturing of Rapid Set[®] clinker demonstrates significant reductions in North American and potentially global emissions of carbon dioxide from cement production. An analysis of Rapid Set[®] manufacturing raw materials composition, pyroprocessing techniques, and cement grinding has established a **baseline emission of 0.61 pounds of CO₂ per pound of Rapid Set[®] cement produced (Fig. 1).**

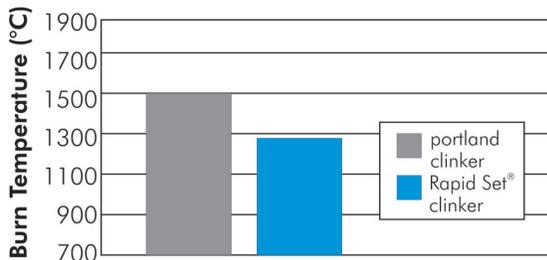


Fig. 2: Clinker burning temperature of portland cement and Rapid Set[®] cement

Rapid Set[®] exhibits a significantly smaller carbon footprint which is 60% to 70% the size of that produced by most portland cements made in the United States.

ENVIRONMENTAL ADVANTAGES

- Rapid Set[®] pyroprocessing emits 0.21 pounds of CO₂ per pound of cement from fuel (coal) combustion.
- Rapid Set[®] pyroprocessing emits 0.40 pounds of CO₂ per pound of cement from thermal decarbonation of calcium carbonate (limestone).
- Rapid Set[®] clinker is directly ground into cement with only very minimal, if any, additions of gypsum.
- Rapid Set[®] cement is never blended with portland cement to produce a fast-setting or rapid strength-developing product.
- Although Rapid Set[®] is somewhat similar to portland cement in mineralogical composition, its main constituents are calcium sulfoaluminate, dicalcium silicate, and anhydrous calcium sulfate. No tricalcium silicate is formed.
- The burning temperature of Rapid Set[®] clinker is 1,280°C (2,326°F), which is significantly lower than portland clinker burning temperatures (Fig 2).

- The average burning temperature of portland clinker is about 1,500°C (2,732°F) or more (Fig 2).

- The low-sulfur coal used to produce Rapid Set[®] clinker has an energy value of about 12,300 BTU per pound of coal, and a fixed carbon content of about 48%.

- The reduced burning zone temperature needed to form Rapid Set[®] clinker has the additional advantage of producing lesser amounts of smog-producing oxides of nitrogen.

- The softer and more friable nature of Rapid Set[®] clinker also lends itself to much easier grinding and, therefore, a lower grinding mill energy consumption.

- Hardened 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, Rapid Set[®] 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, Rapid Set[®] cement not only is a 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.



Waldemar A. Klemm is a consultant in the cement industry. He has over 40 years of experience in the cement industry in plant process, chemistry, research and development activities, and environmental studies. He has authored 40 technical reports and scientific papers on clinkering chemistry, cement hydration, admixture research, cement manufacturing, and environmental analyses.

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 Fellow of the American Ceramic Society.