

WHY CURE CONCRETE? Michael K. Kraft

“Whether choosing Vapor, Quadrix™, Convect-Air™, ThermalCure™ or an air circulation system, the consistency achieved by controlling the curing portion of the production process will become immediately evident - providing a sense of having made an overdue change for the better.”



Michael K. Kraft
Director
for Curing Systems

In his capacity, Michael concentrates on the ever changing technology involved in producing manufactured concrete products to ensure Kraft meets the needs of its valued customers. He is responsible for the overall company marketing strategy and for sales in Eastern USA, European and International markets. He holds a Bachelor of Science degree from Cornell University.

All manufacturers are in the business of making money. Precast concrete producers are no different in that respect. At Kraft, we're dedicated to helping concrete producers get the most from their curing investment.

Precast concrete producers differ from some manufacturers in that they have a two-step manufacturing process where the second step is sometimes seen as optional. The first step, precast concrete casting, is a given. But the second step, curing, is sometimes neglected. The reason for skipping curing is usually the same from producer to producer: it costs money. And since concrete producers are in the business of making money, it can be difficult to choose to spend additional money in the production process.

Precast concrete producers who look at the big picture, however, realize that accelerated curing provides cost savings in both time and materials that not only offset the expense but also provide additional return on the investment. And, accelerated curing provides a better quality product, which satisfies customers and reduces waste. Many of our customers are investing a lot of money in new, more sophisticated production equipment. They realize that investing in the front end only doesn't make sense. The back end of the process, the curing process, deserves their attention as well.

In this book, you can learn more details about the cost savings and benefits of concrete curing systems from Kraft.

Here is a summary of how accelerated concrete curing systems save money:

- ▶ Lower the cost of producing concrete products by reducing the amount of cement and other additives required in the mix.
- ▶ Decrease energy costs by efficiently using heat created by cement during curing.
- ▶ Reduce turnaround time for hardened products, which frees up rack space and makes better use of production personnel.
- ▶ Dramatically lessen the number of rejects and customer complaints.

An example I often use to illustrate these concepts involves concrete pavers: there are both financial and quality incentives to accelerate the curing of concrete pavers.

Accelerating the hardening of the pavers reduces the amount of rack space, building space and pallets required – reducing the initial capital expense of a green-field project.

Reduced hardening times of no more than 12 hours allow for immediate secondary processing (splitting, grinding and polishing, tumbling, etc.) without intermediate yard storage, saving a huge amount of money on strapping materials, transportation and yard space. Accelerated curing allows for the use of GGBFS (ground granulated blast furnace slag) and other latent hydraulic by-products that reduce material costs.

From a quality aspect, proper curing improves the consistency of all concrete properties including color, strength and durability, and it reduces the likelihood of secondary efflorescence and lessens complaints.

Whether choosing Vapor, Quadrix™, Convect-Air™, ThermalCure™ or an air circulation system, the consistency achieved by controlling the curing portion of the production process will become immediately evident – providing a sense of having made an overdue change for the better.

At Kraft, we are dedicated to concrete curing and appreciate your interest in the subject. This book is an example of our commitment to this industry.

We trust it will educate you about concrete curing and guide your decisions in incorporating curing systems into your business.

We are here to answer your questions and want to help you select the best accelerated curing system for your business.



Cement hydration under an electron microscope



Efflorescence prevention is of major interest to manufacturers of concrete pavers.



Switching from boiler steam to vapor not only reduces energy costs by up to 60%, but also increases color consistency.



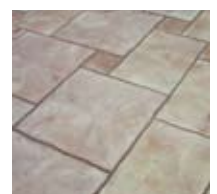
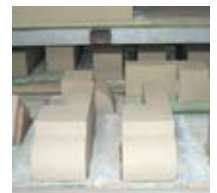
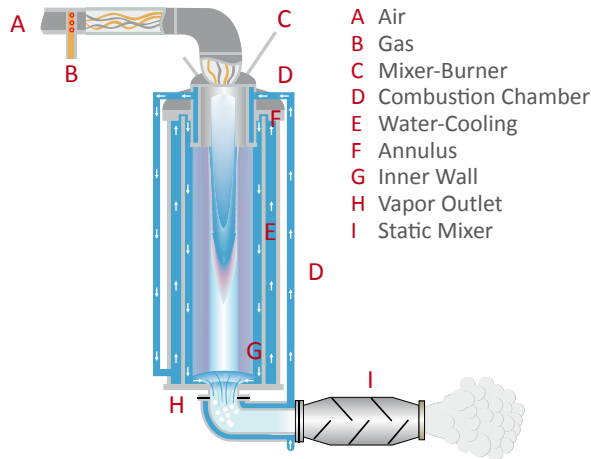
Vapor cured bulb-T members await transport and final installation on Atlanta Hartsfield's fifth runway project.

VAPOR CURING

PRINCIPLE

Pre-mixed air **A** and gas **B** are ignited in the water cooled mixer-burner **C** mounted on top of the stainless steel combustion chamber **D**. A precisely metered quantity of water enters the outer jacket **E** of the double-walled, stainless steel combustion chamber.

The water flows up the outer jacket across the annulus **F** and down the inner wall **G**. As the water moves down the inner wall, towards the vapor outlet **H**, it is heated, through direct contact, by the extremely hot combustion gases. As the mixture exits the combustion chamber, it passes through the static mixer **I** to insure homogeneous mixing.



APPLICATIONS

The direct-fired vapor generator is designed for accelerated concrete curing of precast concrete products. Precast concrete applications include cast stone, block, paver, flag/slab and curb, manhole and roof tile products. This economical direct-fired vapor generator provides the benefits of accelerated concrete curing - moisture and heat, such as:

BENEFITS

- 40 % to 60 % energy and maintenance savings
- controllable vapor temperature and moisture content
- low pressure system (< 200 mbar/3 PSI)
- installation and operation licences are not required
- CO₂-rich vapor
- requires little space
- low emission
- simple to install and operate
- no chimney
- controllable curing process

HIGHER EARLY STRENGTH

- shorter hardening time
- 30% less racks and pallets
- In-line secondary processing
- immediate shipping

HARDER CORNERS AND EDGES

- less breakage
- quicker packaging
- less rejects

MORE COMPLETE HYDRATION

- higher ultimate strength
- reduced cement consumption

UNIFORMITY

- strength
- color



AutoCure – utilizing the rock-solid performance of the Siemens S7-300 series controller in combination with a color touch screen interface – provides sophisticated curing technology at its finest – a high degree of flexibility and information as well as incredibly simple to operate.



An Economical Alternative:
The Millenium control evaluates the curing data and controls the curing process to assure a constantly uniform concrete curing process.

CONVECT-AIR

HEATED AIR CIRCULATION

PRINCIPLE

Warm dry air has the natural tendency to rise – causing temperature stratification within the insulated curing chamber. The single most important function of Kraft Systems' distribution system is the maintenance of consistent temperature throughout the entire chamber.

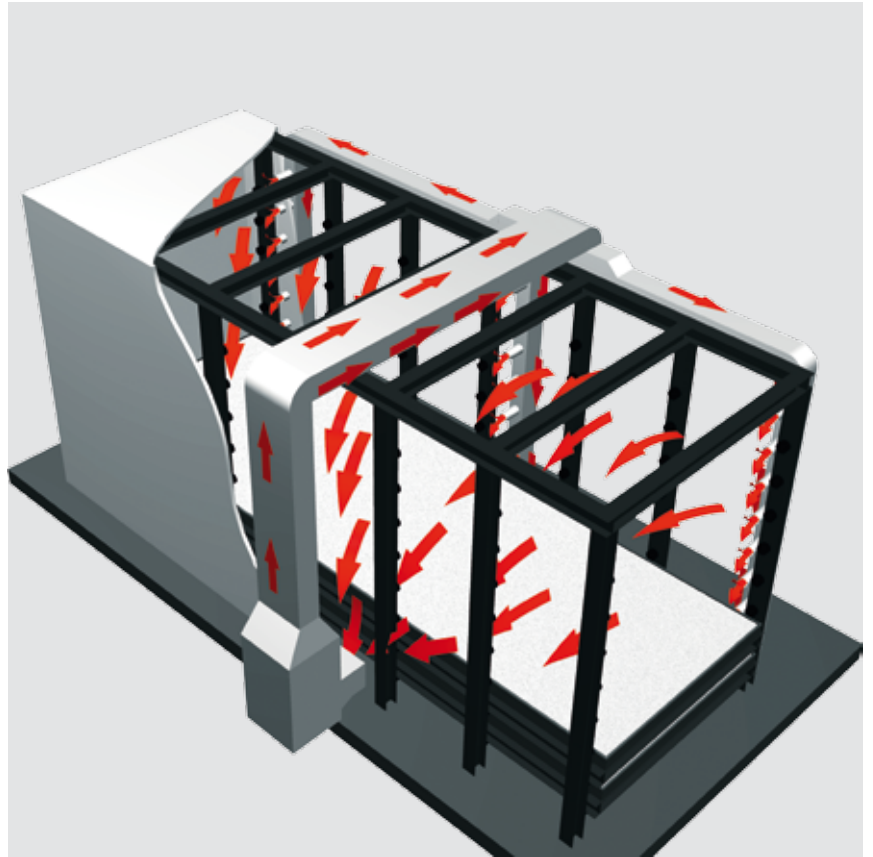
Kraft Systems concept places the air heater on the opposite side of the chamber from the air distribution system. The heater pulls the supply air from the lowest point in the curing chamber and exhausts the heated air across the length and height of the chamber on the opposite wall.

The number of distribution ducts across the length of the chamber as well as the number of nozzles in each distribution duct is calculated based on three parameters:

- pressure zones
- temperature zones
- pallet location

Once the macro-environmental parameters have been calculated, the addition of a mechanical damper in each nozzle allows for fine tuning the system.

All ductwork, dampers and nozzles are manufactured of low restriction, high volume galvanized sheet steel. Flanges are bolted.



APPLICATIONS

The Convey-Air Curing System is designed for the accelerated curing/hardening of precast concrete products in insulated enclosures. Temperatures from 40° to 60° C (105° F to 140° F) allow for removal of concrete products from the curing chamber within 6 to 8 hours.

Convey-Air utilizes a heavy-duty air heater and high performance radial ventilator to provide a consistent warm curing environment throughout the entire chamber.

Upon reaching the desired temperature, the heater switches off. The circulation ventilator continues operating in order to maintain even temperatures. As fresh concrete products are added, the heater switches on in order to maintain the desired temperature.

The recirculation of the chamber environment eliminates temperature stratification and provides a 92% operating efficiency.



CURING CHAMBERS AND TENTS

CUSTOMIZED SOLUTIONS



Tarp doors
open / closed



Automatic insulated
roller-shutter doors
provide the benefit of
insulation for conden-
sation reduction.

INSULATED CURING CHAMBERS

Kraft Systems offers complete curing system solutions, including curing chambers built to customer specifications. Based on years of experience, Kraft Systems has a solution to meet the needs of the manufactured concrete industry.



Telescoping tents
require minimal
storage space and
can be easily moved
on tracks.

KRAFT SYSTEMS CURING RACK SYSTEMS

Kraft Systems supplies and provides installation of complete curing chamber racks for block, paver and flag/slab plants using the transverse and finger car system. The prefabricated galvanized rack systems may be designed in any number of configurations as the customer requires and space dictates.



Tents as large as
30 meters (100 ft)
x 30 meters (100 ft)
or larger are easy to
move for expansion
or retraction

COMBUSTION CHAMBER

The standard premix burner on all Kraft Vapor Generators can produce the lowest emission levels for fuel burning equipment - less than 12 ppm of NOx and less than 50 ppm of CO - allowing these units to be installed in areas with the strictest pollution regulations without modifications or extra cost.

Kraft developed a stainless steel combustion chamber that produces clean, soot-free vapor through the use of a high-performance air compressor and an exemplary water handling system.

The combustion chamber is the heart of the Kraft Vapor Generator.

SYSTEM PROCESS

- ▶ Pre-mixed air and gas are ignited in the water-cooled mixer/burner mounted on top of the stainless steel combustion chamber.
- ▶ A precisely metered quantity of water enters the outer jacket of the double-walled combustion chamber.
- ▶ The water flows up the outer jacket, across the annulus and down the inner wall.
- ▶ As the water moves down the inner wall toward the vapor outlet, it is heated through direct contact with extremely hot combustion gases.
- ▶ As the mixture exits the combustion chamber, it passes through the static-mixer to ensure homogeneous mixing.

BENEFITS OF KRAFT'S

COMBUSTION CHAMBER

- ▶ 40% - 60% energy and maintenance savings compared to boiler systems
- ▶ Control of vapor temperature and water content from 212°F (2 gal/min/m BTU) to 650°F (1/2 gal/min/mm BTU)
- ▶ Low pressure system (<200 mbar [3 psi])
- ▶ Low emissions
- ▶ No exhaust stack/chimney
- ▶ Soot free vapor due to the addition of excess air for complete combustion

GUARANTEED QUALITY

Combustion chambers from Kraft are built to the highest standards. These certified stainless steel water-cooled combustion chambers are manufactured with high-grade machined materials.

During manufacturing, extensive quality control measures are completed.

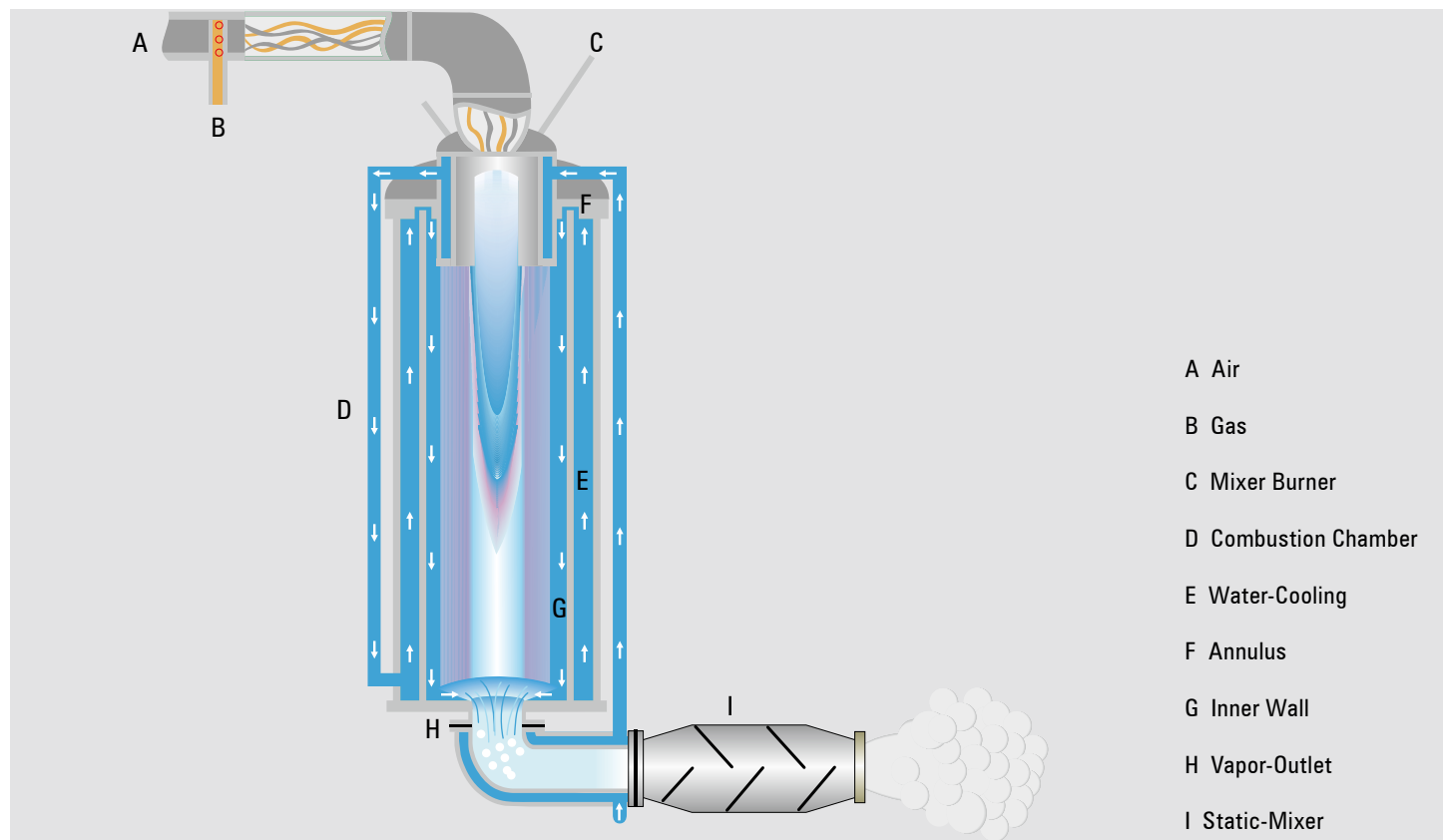
- ▶ The upper and lower plates, as well as the inner and outer tubes are machined for a precise fit, greater gasket durability and consistency of water flow around the inner tube.
- ▶ Before assembly of components, all measurements are quality checked against approval drawings.
- ▶ Upon assembly, all measurements and tolerances are checked again for deviation from approved drawings.
- ▶ Gap testing is performed to ensure even water flow around the inner surface of the combustion chamber eliminating hot spots, which cause premature wear in the combustion chamber.

SAVING TIME AND MONEY

A damaged combustion chamber leads to incomplete curing which leads to production downtime and costs the concrete producer money. Kraft believes that quality does not cost money – it saves money.

PLATINUM LIFETIME WARRANTY

Vapor Generators from Kraft come with a personalized Platinum Lifetime Warranty booklet. The booklet gives the user a guarantee of quality and commitment. If the combustion chamber becomes damaged or fails, it will be replaced immediately.



DESIGN PRINCIPLES

CONCRETE CAST STONE

For large producers as well as small family businesses, Kraft provides vapor curing systems that substantially improve product quality, productivity and the return on capital.

Kraft is proud to work with some of the leading cast stone manufacturers in the United Kingdom and the United States in the design, installation and commissioning of vapor curing systems.

BENEFITS OF VAPOR CURING CAST STONE

- ▶ Vapor gives the dry mix external moisture for better cement hydration, which can lead to reducing required cement levels.
- ▶ Reduced amount of cement required through improved cement hydration.
- ▶ Harder edges and corners.
- ▶ Increased early strength by approximately 50% allowing for easier handling and less breakage.
- ▶ The carbon-dioxide content in the vapor substantially reduces efflorescence.

AVAILABLE CURING SYSTEMS

Concrete cast stone can be cured with Kraft's entire line of Vapor Curing Systems as well as the Quadrix™ Curing System.



This photo has been graciously provided by Kraft customer Olde World Cast Stone. The cast stone products seen here were cured with a Kraft Vapor Generator in an insulated curing chamber.

CONCRETE VENEER STONE

Kraft can provide a vapor curing system that will have significant impact on the quality and look of the product.

Concrete veneer stone is a replica of natural stone and is manufactured by combining the basic ingredients in natural stone such as lightweight aggregates, cement and iron oxide pigments.

The process of making veneer stone is very intricate and requires a certain level of precision to create something that not only looks natural but also is lightweight and economical. Veneer stone requires the use of expensive, artisan-designed molds and demands a natural final color.

BENEFITS OF CURING VENEER STONE

- ▶ Ensures more uniform and brighter colors
- ▶ Decrease time to early strength allowing for faster mold turnaround
- ▶ Reduced mold expense due to faster mold turnaround times
- ▶ Decreases the occurrence of spotting and efflorescence due to incomplete curing

Because Kraft's direct-fired vapor systems are highly efficient, energy costs are usually half that of comparable systems.

AVAILABLE CURING SYSTEMS

- ▶ Kraft Vapor Curing Systems
- ▶ Kraft's Quadrix™ Curing System
- ▶ Kraft's Air Circulation Systems
- ▶ Kraft's Convect-Air™ System



APPLICATIONS

CURING CHAMBERS

INSULATED CURING CHAMBERS

Kraft provides custom designed and built curing chambers. With years of experience in fabricating concrete curing chambers, Kraft has a solution to suit every need in the manufactured concrete products industry.

OPERATING FEATURES

- ▶ Steelwork is designed to resist corrosion through the use of hot-dipped after fabrication galvanized steel, aluminum and/or stainless steel components
- ▶ Fabrication is carried out prior to the galvanization process to prevent the oxidation of exposed steel during fabrication
- ▶ Sandwich-panel insulation units do not absorb moisture and are made with 25 μ m-thick polyester-coated galvanized sheet steel
- ▶ Joints are interlocking tongue-and-groove with foam vapor barrier
- ▶ Exposed edges and corners are professionally finished with either stainless steel or 25 μ m-thick polyester-coated galvanized sheet steel moldings

A QUICK WORD ABOUT CODES AND CODING ISSUES

Kraft is your competent and experienced partner when it comes to working with seismic, wind and snow load issues, as many racks and chambers are newly classified under the applicable IBC (International Building Codes) standards. Kraft has design and structural engineers and fabrication facilities to provide a complete construction solution. In addition to meeting building codes, Kraft meets fire and combustion standards in its insulation materials. For more information on codes, please refer to the Building Codes Compliance section in this book.



Insulated large chamber with drop ceiling, curtain doors and lighting





First-In,
First-Out
Curing
System
with roller-
shutter
doors on the
entry
and exit
openings.

10



CURING ENCLOSURES

KRAFT SYSTEMS INSTALLATION SERVICE

As manufactured concrete producers have little time or manpower available to install new equipment, Kraft has responded by offering installation services. By offering high-quality equipment, customer service and installation services, Kraft prevents concrete producers from having to deal with multiple suppliers as well as ensures the equipment is installed correctly the first time.

PROJECT MANAGEMENT

- ▶ The professionals at Kraft efficiently manage the entire installation process from the beginning to ensure the project is completed on time and on budget.
- ▶ During the initial sales call, project managers develop a timeline for installation and define potential holdups.
- ▶ At the project initiation, drawings are created from a technical site survey for the customer's review.
- ▶ When the drawings have been finalized all distribution pipe, steel frames, insulation panels, doors and exhaust system components are prefabricated to reduce on-site labor.
- ▶ Components are professionally packaged and loaded for transportation to the site.
- ▶ Kraft installation engineers arrive on site to complete the entire project or work with the customer's personnel if necessary.

TURNKEY CURING SYSTEMS

Kraft wants to make the purchase and installation of a new concrete curing system as convenient as possible, so we employ project managers and engineers who give customers turnkey curing systems.

In response to the success of vapor curing systems and due to the overwhelming interest from the industry, Kraft Systems developed its complete line of concrete curing equipment. Every year we can broaden our range of equipment and meet the ever growing curing needs of the industry. Our comprehensive equipment line results in an improved manufacturing process and better concrete product.

Kraft's personnel specialize in turnkey curing solutions because they know that the proper system combined with professional installation produces the best possible result.



