Kraft Curing Systems GmbH, 49699 Lindern, Germany

Low-emissions curing system offers significant cost savings

In April 2013, Sovereign Concrete of Australia contacted Kraft Curing Systems to replace an outdated boiler system. In compliance with local standards and Sovereign's unique specifications, Kraft designed a complete energy-efficient curing system for Sovereign's two production buildings. The latest data revealed that the new system saved an average of 69% in gas consumption costs on top of 80% in reduced maintenance costs. The proven combination of efficiency gains and reduced emissions make vapor generators an attractive replacement for conventional boilers nearing the end of their lifecycle.

Mark Kraft, Kraft Curing Systems GmbH, Germany

"Prior to the change, we had little idea how inefficient our aging boiler was," said Laurie McKenna, General Manager of Sovereign Concrete Products. For over 15 years, Sovereign Concrete had been using the same boiler for curing concrete. The Victoria, Australia-based precast concrete producer soon realized it would not pass inspection by local authorities unless it made extensive repairs to its boilers.

"We hoped for gas savings around 40% and were pleasantly surprised to see savings beyond 65% at peak production," said McKenna. "On top of the obvious advantage of saving money, the replacement of the boiler removed the hazards and maintenance issues associated with a having a live pressure vessel on site."

Working closely with Bliss & Reels its distributor for Australia and New Zealand on the ground, Kraft Curing Systems delivered two (2) 98% efficient direct-fired Vapor Generators to supply low-pressure vapor to Sovereign's production areas. The vapor is a combination of hot exhaust gases and vaporized water that is routed through steel pipes to the various curing areas.

Advantages of a direct-fired vapor generator

The direct-fired Vapor Generators have several notable benefits. First, they are not classified as boilers, bypassing the need for a boiler license or permit. Second, they are considered low pressure, removing the need for pressure vessel insurance or inspection, or even a full-time boiler operator. Versatile and cost-efficient, they operate on any available gas including methane, propane, butane, LPG and CNG.

For operations such as concrete curing, the direct-fired system is 40 - 60 % more efficient than a conventional boiler system due to lower radiant heat losses, reduced stack losses, no idling cost or long warm-up period, and the ability of this type of system to utilize a portion of the high heating value of the fuel.

Since they operate only when vapor is required and the carbon dioxide in the vapor is partially absorbed by the concrete through carbonization, the total amount of emissions produced by a direct-fired system is approximately 60-80 % less than that produced by a boiler.

The curing process using direct-fired vapor

In the new Vapor Generator system, the concrete is covered and heated to 50-60 degrees Celsius in a 99% relative humidity environment to accelerate the cement hydration process. Accelerated curing is preferred because it achieves high early strengths for quicker demolding times and reduction in cement and accelerators. Curing in these conditions also improves concrete durability through reduction in shrinkage cracking, as well as harder corners and edges, higher freeze/thaw durability and less breakage in handling and transport of the product.

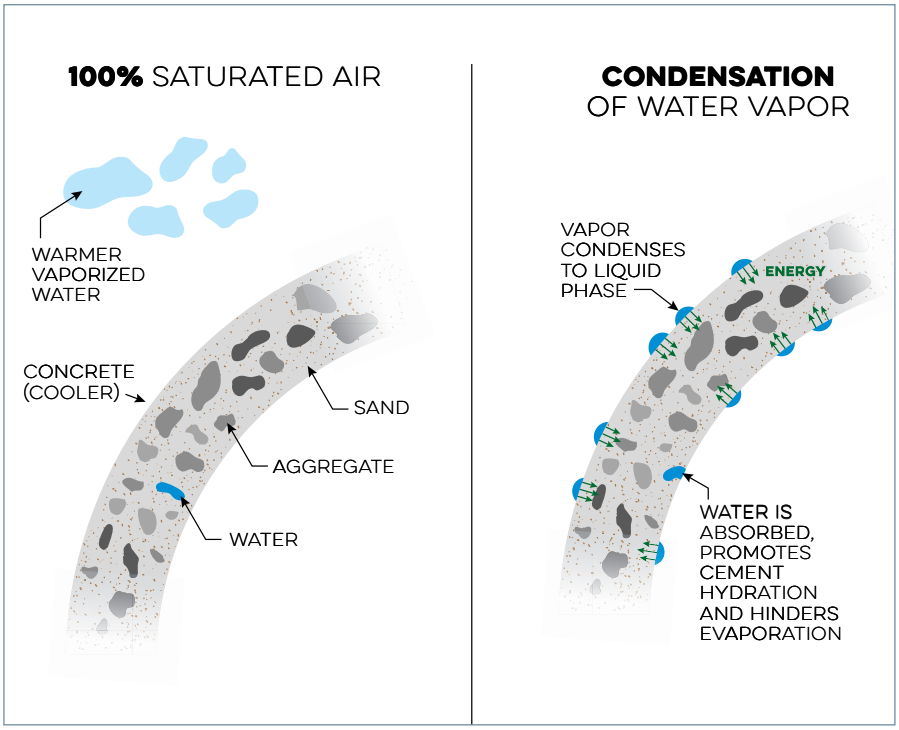

Fig.1: The gas (vapor) transitions to a liquid state as it condenses on the surface of the concrete.

Fuel Cost Saving - Boiler vs. Kraft Curing Vapor Generator
Sovereign Concrete Products, Ballarat, Victoria, Australia

Time Period	Gas Consumption							
	Kraft Curing Vapor Generator 20/1S - MJ	Kraft Curing Vapor Generator 25/2S - MJ	Total MJ	Concrete Cast - cubic meter	Kraft Vapor Generator Usage - MJ per cubic meter	Boiler Energy Usage - MJ per cubic meter (historical data)	Energy Savings - MJ per cubic meter	Cost savings per month based on total production*
Apr. - June, 2015	458,844	18,668	477,512	1,350	354	860	506	AUD9,573.65
June-Aug., 2015	302,209	55,548	357,758	1,038	345	860	515	AUD7,493.73
Aug. - Oct., 2015	302,605	73,659	376,264	1,465	257	860	603	AUD12,372.11
Oct. - Dec., 2015	375,203	58,324	433,527	1,555	279	860	581	AUD12,649.21
Dec., 2015 - Feb., 2016	469,989	9,255	479,244	1,909	251	860	609	AUD16,276.15
Feb. - Apr., 2016	345,399	12,307	357,706	2,649	135	860	725	AUD26,884.88
			Average MJ per cubic meter concrete:		270	Annual Fuel Savings:		AUD85,249.743

* based on natural gas costs for this time period of A$ 0.014/MJ

Fig. 2: With the Kraft Vapor Generator, the average energy usage was 270 MJ/m³ of concrete, or a 69% reduction in energy costs.

The system leverages an exothermic process releasing the latent heat of vaporization, which refers to the flow of energy during a transition from one state to another. In this case, the gas (vapor) transitions to a liquid state as it condenses on the surface of the concrete (see Fig. 1). The large value of the enthalpy of condensation of water vapor is the same reason steam/vapor provides highly effective heat transfer.

Fig. 3: The compact Kraft Curing KC 20-1S Vapor Generator (right) installed next to the boiler it replaced. Vapor Generators take up significantly less space than a conventional boiler of comparable output.

Fig. 4: Control Valves located throughout the production area control the flow of vapor automatically based on concrete temperature.

The curing process is controlled by an automatic temperature control system called AutoCure™ which can control the four stages of the curing process–preset; ramp; soak; cooldown–via automatic vapor valves and temperature probes. Every curing cycle for each curing area is recorded and stored on the VaporWare™ System. VaporWare enables record-keeping for quality control purposes. Furthermore, it allows local inspectors to ensure adherence to curing specifications for the project, and to national codes.

Results

Sovereign was able to track its gas consumption over a 12-month period. Substantial historical data from over a decade of use indicated that the old boiler needed an average of 860 Megajoules (MJ) per cubic meter concrete cast. With the Kraft Vapor Generator, the average energy usage was 270 MJ/m³ of concrete, or a 69% reduction in energy costs. This translated to a resulting A$ 85,250.00 in cost savings over one year. In addition, maintenance costs were greatly reduced compared to the boiler by approximately 80%. Said McKenna, "Replacing our steam boiler with a Kraft steam generator has exceeded our expectations."

FURTHER INFORMATION

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