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Thermal images help assessing insulation issues in curing chambers

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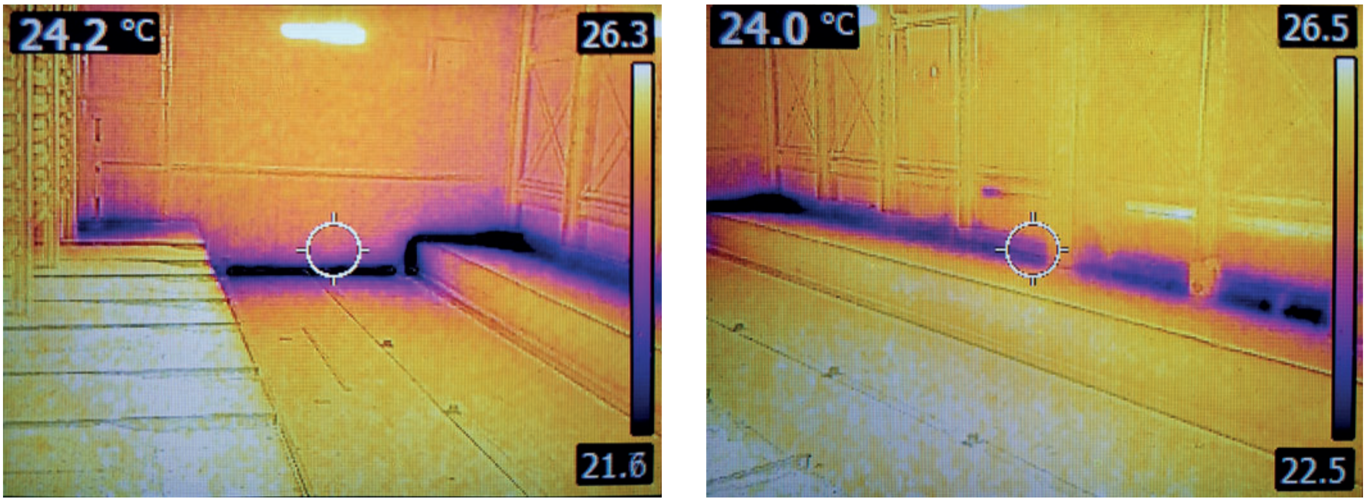
Due to its lower capital cost, low energy and maintenance costs and highly positive impact on the consistency of concrete color, strength and durability, the single atmosphere concrete curing chamber (big room) has become the most popular way to cure concrete pavers, curbs, slabs/flags and blocks.

Single atmosphere curing chambers operate throughout the concrete industry at a temperature between 35°C and 50°C with a relative humidity between 80% and 98%. Best practice indicates the relative humidity be as close to 100% without actually reaching 100%. Although each concrete products manufacturer has their own "perfect climate," once that nirvana is found, it should preferably remain at that consistently constant temperature and relative humidity regardless of the day, month and season. Doing so will provide the highest level of consistency in terms of appearance, strength, durability and mix design. Consistency not only helps to create a better product, but also allows the fine-tuning of the mix design to eliminate wasteful over-dosing of cement, admixtures and pigments in order to compensate for varying hardening conditions.

High quality manufacturers of concrete products have come to rely on the benefits of the single atmosphere curing chamber, but are struggling with one of the great side effects and headaches caused by this chamber design – standing water on the floor of the chamber. And not just anywhere, but the standing water is most prevalent around the perimeter of the chamber, in the transfer car area and around the elevator/stacker and lowerator/destacker. These are important areas in which structural columns and expensive equipment operates and standing water causes the steel to corrode and the electrical equipment to malfunction. In addition, standing water can cause an unsightly and unhealthy environment inside the chamber as it may form bacteria and black mold.

Sadly, in an effort to reduce or eliminates standing water on the curing chamber floor, operators often reduce the relative humidity in the chamber which does reduce water formation.



These thermal images show a well heated and circulated curing chamber – only lacking insulation of the concrete slab around the outside of the perimeter of the curing chamber. The floor in the transfer car area is bright yellow to orange, turning to darker purple as it proceeds to the exposed concrete slab. This is especially noteworthy in the recessed transfer car area. Adding insulation to this exposed slab would prevent the chance of standing water in this area.

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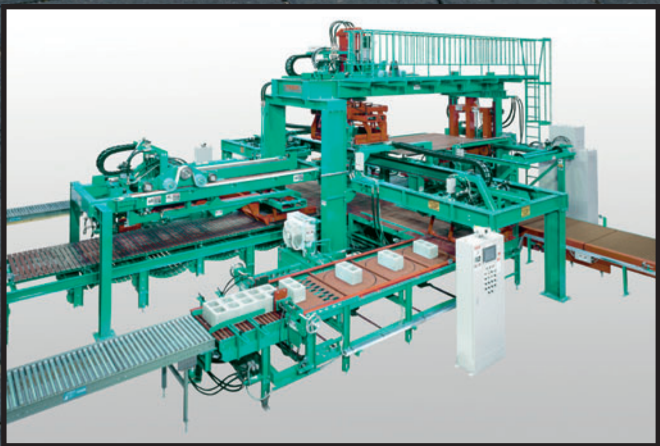

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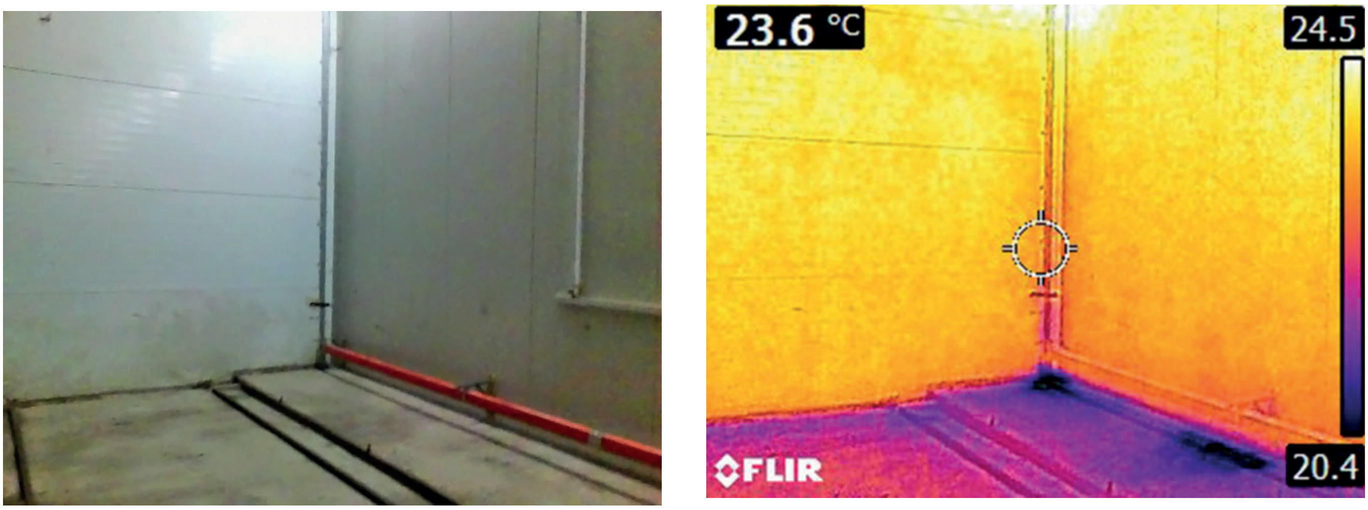
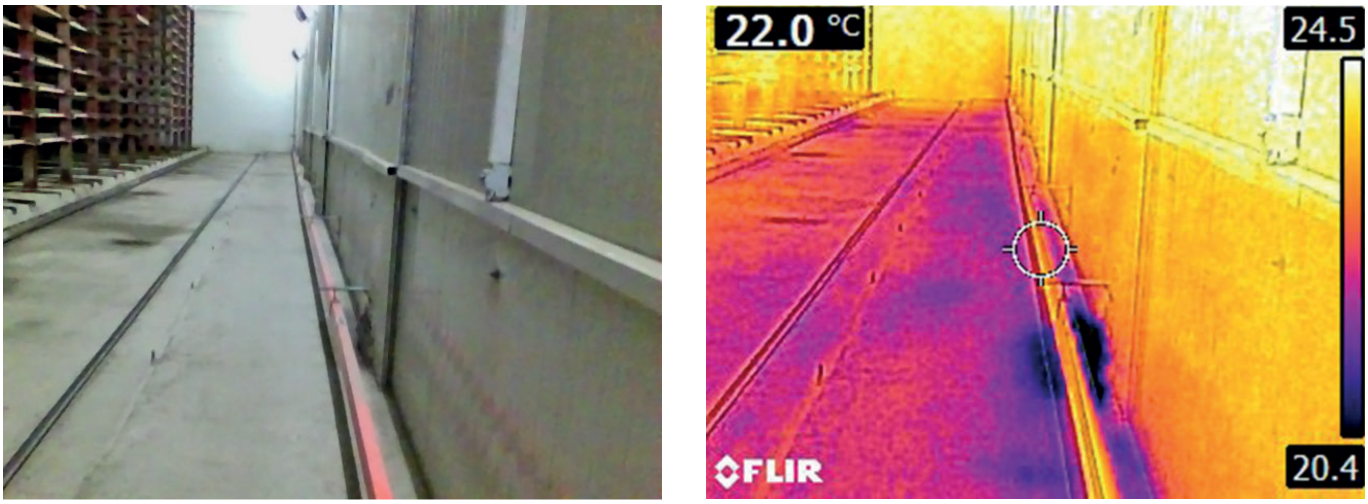


A corner of the curing chamber in which the concrete slab inside the chamber is exposed to the cold weather outside. The standing water may be seen in the picture while the ingress of cold, causing this standing water, is seen as purple on the thermal image.



A typical transfer car area with an insulated exterior wall. Damp spots are seen throughout the area and the thermal image shows very well the coldness of the floor in the transfer car area due to poor air circulation. The dark purple spot and areas along the outside wall are indications of cold leaking into the chamber through the concrete floor.

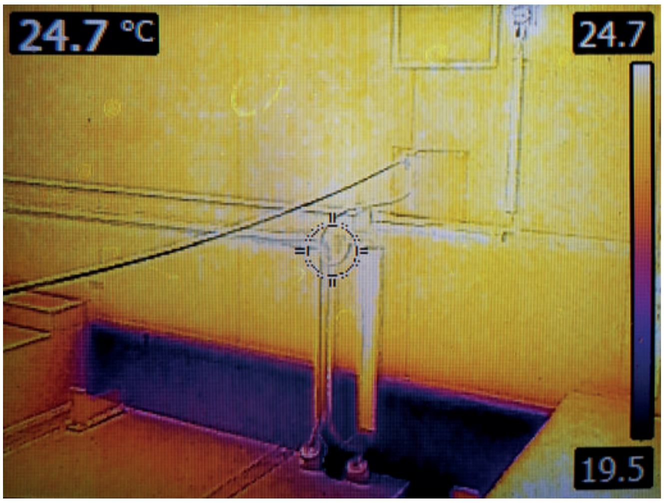
This "solution" for the problem of standing water causes another problem for concrete quality. By reducing the relative humidity in the chamber, the air, not fully saturated with water, acts as a sponge and evaporates moisture from the surface of the concrete products in the chamber – reducing the density and creating a permeable surface that benefits the appearance of secondary efflorescence. Reducing the curing humidity is simply not the right way.

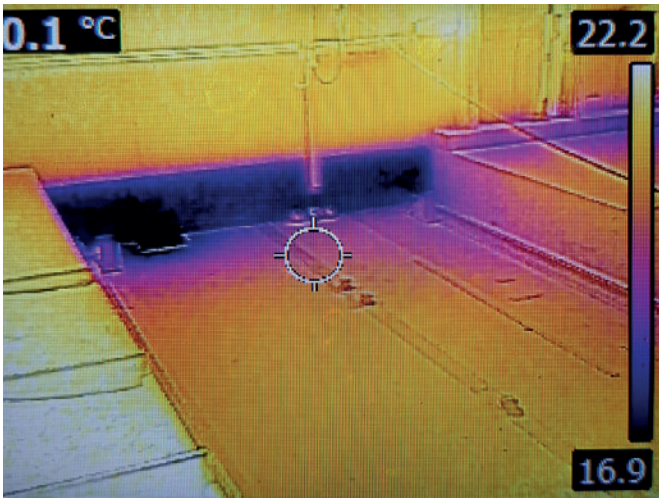
Suppliers of steel racks, curing chambers and curing systems must provide a more comprehensive solution in order to prevent standing water and eliminate rack corrosion and unhealthy conditions.

The current state of the industry is to use insulated sandwich panels to enclose the curing area. While this is a sensible solution, it does not go far enough to address the issue of thermal bridging.

Thermal bridging is the leaking of hot and cold through materials. These materials can be steel, plastic, wood or even, concrete. Thermal bridging takes place when the same piece of material comes in contact with two different temperatures. The material transfers the cold temperature in to the warm zone and transfers the warm temperature into the cold zone.

Enclosing the curing chamber with insulation panels eliminates the thermal bridging of the air from outside the chamber to inside the chamber, but that is only part of the story. The insulated panels are usually mounted upon a concrete floor and while thermal bridging through the air is effectively stopped, thermal bridging continues unabated through the

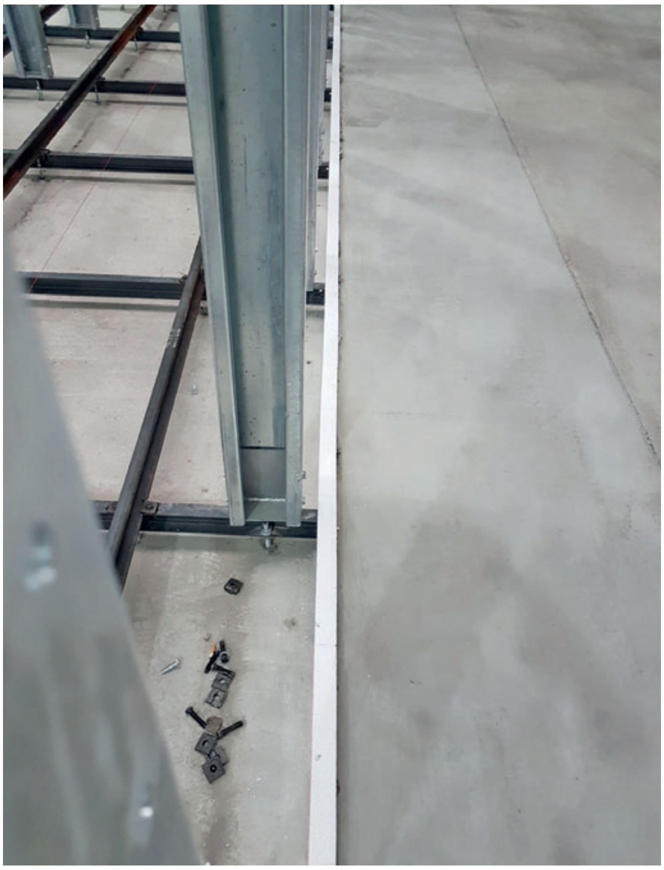




Dark purple areas at the chamber outside perimeter walls lighten slightly as the floor becomes warmer further away from the walls. The high amount of purple throughout the picture indicates poor air circulation.

concrete floor. The cold in the concrete outside of the chamber in the production hall is transferred through the concrete slab into the curing chamber.

When the 35°C warm and 90% humid air in the chamber comes in contact with the cold that has crept into the chamber via the concrete floor, the temperature of the air drops and the relative humidity soars to over 100% at which time it stops being humidity and becomes water – forming on the cold concrete floor inside the perimeter of the curing chamber. Drops become puddles and puddles become lakes of water on the floor in the racks, transfer car, elevator and lowerator areas.

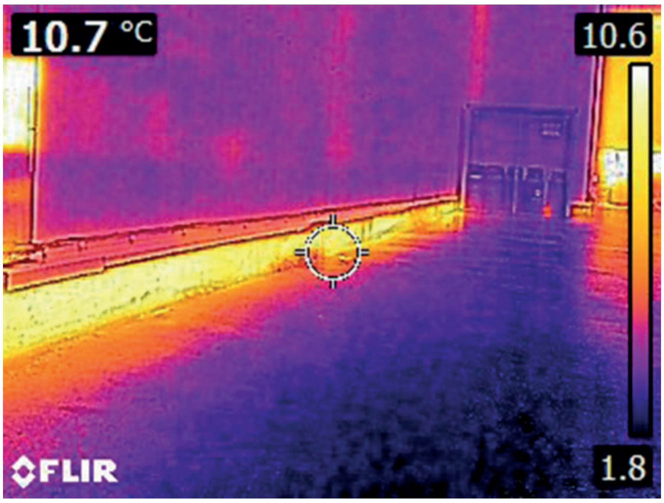


Insulation board is the solution for insulating the perimeter of the curing chamber after installing the rack and rails, but prior to placement of the screeded floor. All steel support beams for the production building must in insulated and isolated from the concrete inside the curing chamber. These steel columns are highly efficient thermal bridges and can cause numerous issues in the way of standing water.

What makes thermal bridging so difficult to understand and prevent is that it is invisible to our eyes. The best way to "see" thermal bridging is with an infra-red camera. The enclosed pictures show the "warm" areas in yellow and orange and the "cold" areas in purple.

An investment in a high-quality thermal imaging camera is most likely not a priority of most concrete production sites. On the other hand, Kraft Curing Systems has several cameras on hand in order to better identify weak spots in traditional curing chamber design and assist in remedial work in order to eliminate the causes of standing water.

Director of Applications Engineering at Kraft Curing, Marius Boeckmann explains: "Our first thermal imaging camera, in use since 2014, provided us with visual evidence of the areas



Thermal bridges are also a cause for high energy consumption. These pair of photographs shows very clearly the heat loss from through the raised concrete slab of the curing chamber. With an outside temperature equal to 2°C, this slab is radiating 10°C heat to the atmosphere. Insulating this slab would not only prevent standing water in the curing area, but also reduce energy costs.

in the chamber that were contributing to the formation of condensation and standing water. The thermal imaging cameras have become part of our standard tool box and are used during site surveys on existing chambers, the construction of new chambers as well as the benchmarking for future curing chambers. I cannot imagine successfully installing a curing chamber without the use of this essential tool."

Eliminating the thermal bridge is easiest to do when the curing chamber is in the design and build phase. The use of 40 mm to 80 mm insulation board is inexpensive and installed quickly as a thermal break in the concrete floor or curb around the perimeter of the chamber. This thermal break is as effective as the insulation panel walls at preventing condensation and will, as part of a complete professional solution of air circulation, heating and moisturizing, provide relief from standing water.

As an experienced designer and producer of concrete curing environments, Kraft offers their expertise to customers who face standing water on their production floors. Concrete producers are welcome to consult Kraft to assess the thermal efficiency of their chambers and other curing enclosures in order to optimize concrete production and elminate issues that result from inefficient insulation and air circulation. ■

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