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Increase in quality through CO_2 in curing chambers – vision or trend?

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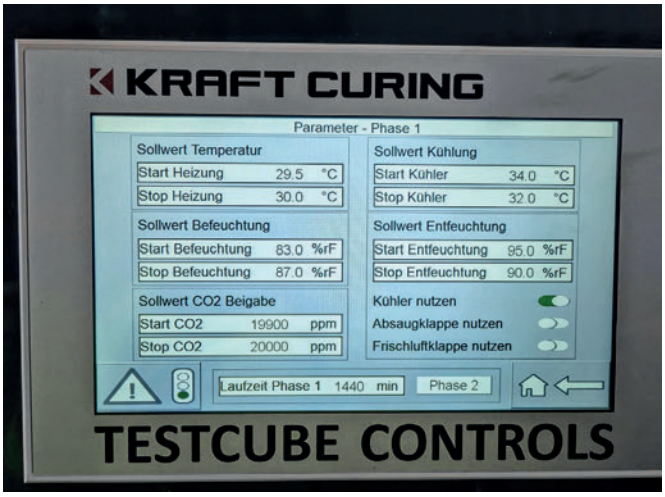
As previously described in the last issue of the CPI, Kraft Curing Systems GmbH has been working for over 30 years with curing systems that make it possible to feed CO_2 into the chambers and into the concrete. Some plants in Germany have been working with such a chamber for years, and this technology is now gaining in importance again. Depending on the quantity and curing time, this not only has a positive effect on the product, but also offers the possibility to store CO_2 in considerable quantities in the long term. However, since the Lindern-based company Kraft Curing Systems has so far only been able to rely on customer feedback and had little tangible information itself, it has decided to carry out a first field trial and has dealt more intensively with the topic.

There are currently two major motivating factors why customers are concerned with the topic of CO_2 in curing chambers. On the one hand, the use of smaller quantities in the chambers can improve the surface quality of the concrete products and increase the colour durability, even with quantities of only 5000 ppm. The colours remain brilliant for longer and secondary efflorescence can be prevented by carbonation. The second possibility is to put larger quantities in curing chambers in order to use the concrete product as a CO_2 storage. Currently, the dynamics of plants that are close to potential sources of CO_2 are being taken up. Like many other companies, these larger companies with high CO_2 emissions are certainly working on so-called CO_2 capture. If this is successful, the captured CO_2 could be fed to the curing chambers of the nearby concrete plants. Both ways, whether the optimization of product quality or the use of the products as CO_2 storage, are sensible measures that help the environment.

Kraft Curing Systems GmbH has dealt with the first variant and only added a small amount of CO_2 to the chamber to see how the products behave at lower amounts of CO_2 and what quality improvements can be achieved. It was not pri-

Production boards with fresh products in the TestCube



Control of the cube – adjustment of heat, humidity, CO_2

marily about the documentation of measurements or values in the form of numbers and facts, but about a visual assessment of the surface and the colour intensity. The test was carried out with the Kraft TestCube, which is sold or rented by Kraft Curing to customers for such purposes. The Cube was installed at Gerwing Steinwerke GmbH in Holdorf. The company provided the project team with production boards with fresh products. No adjustments were made to the existing concrete mix designs for this test. A commercially available cement was also used.

For the test, five production boards were taken from the running production and inserted into the TestCube. The aim was to gas these products with 5000 ppm each within 24 and 48 hours and with 10,000 and 20,000 ppm CO_2 in 24 hours.

What these amounts of CO_2 mean in detail was discussed in the aforementioned report in the last issue of CPI.

In order to ensure better comparability, the values in the Cube were adjusted to the existing curing chamber temperature and humidity values. This is particularly important since the curing process can already show clear changes due to heat and moisture if different curing conditions are created. In order to determine the displacement factor of the TestCube for CO_2, it was emptied and gassed before the test. This generated a factor that is important for the evaluation.

Products wetted with phenolphthalein indicator.

No significant differences in the carbonation depth are discernible regardless of the curing time.

The cured products were broken and wetted with phenolphthalein. The indicator turns purple in the non-carbonated areas, so that it is easy to see which areas of the product have already been carbonated and which ones still need time.

Evaluation

The first finding of the orientation experiment was that there was barely a noticeable difference in the amount of CO_2 consumption, irrespective of whether the concrete was cured with 5,000, 10,000 or even 20,000 ppm CO_2. This question was to be deepened in further tests and was an interesting finding for Kraft Curing Systems GmbH.

Visually, it was determined that in comparison to the current curing chamber without CO_2, the carbonation depth increases, even with the addition of a small amount of CO_2. The products in the middle of the production board were less carbonated than those in the edge area. The tests were mainly carried out with anthracite-coloured products that have a dark colour. The images show that the products that have been cured with CO_2, heat and moisture also have a darker surface compared to products that have been treated exclusively with heat and moisture. This confirmed the knowledge of Kraft Curing Systems GmbH, which other customers have already been able to determine through the TestCube.

Interestingly, the products in the yard happened to be covered in snow one day. The snow remained on the CO_2-cured products while it had melted on the products from the company's curing chamber. This could mean that the surface has been sealed better and faster by the addition of CO_2 and that it has almost no alkalinity.

Consumption and costs

In this test, CO_2 consumption was also of interest to make the possibilities more tangible. As already mentioned, there were no major changes in the concrete based upon the amount of CO_2 introduced, regardless of the concentration. The consumption amount was about 1 m³ in all tests carried out, regardless of the curing time. This corresponded to 0.38 kg per board. If a factory produces 3,500 boards of concrete products in three-shift operation, this is over 1,300 kg of CO_2

Product from above with CO_2 on the left and without CO_2 on the right

per day. The costs per square metre would therefore only be in the single-digit cent range. However, it is important to note that buying CO_2 makes little sense for sustainability reasons, even if the costs remain reasonable. Optical changes and increased quality are certainly possible. However, sustainability is only guaranteed if you can reliably obtain CO_2 from a local company using carbon capture technology.

Conclusions

The issue of CO_2 reduction and storage concerns us all. Unfortunately, research and tests in this area are often carried out behind closed doors and customers are reluctant to talk about results or evaluations. Plants use different mixtures in the core and facing concrete and do not want to disclose this information to competitors. Nevertheless, it would be useful if the possibilities for storing large amounts of CO_2 were disclosed in particular. It is well known that CO_2 has a positive influence on product quality and that the mixtures can be optimised accordingly. Kraft will try to counteract this trend with its own tests and share as much information as possible. The TestCube from Kraft Curing Systems GmbH is available to all interested parties.

This test should also be a food for thought and encourage readers or interested parties to take up tests themselves and to test in more depth in this direction. ■

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