CURRENT FLOOR SCREED COMPOSITIONS AND EVALUATING READINESS FOR INSTALLATION TKB REPORTS 1 AND 2 (UG 15)

The EU regulation on the reduction of CO_2 emissions led to a drastic reduction in the energy consumption of the cement industry from 2010 onwards. The technical process of cement production has been optimised as far as possible and a noticeable reduction in energy consumption was therefore not possible. By adding further materials to the Portland cement clinker, the energy balance of the end product can nevertheless be improved.

Significant for screed construction: Not only has the composition of the cement used changed, but since the work of Werner Schnell in the 1980s, there have been further fundamental changes to screed systems. The result:

DOES THE EQUILIBRIUM MOISTURE CONTENT DETERMINED IN THE PAST APPLY TO ALL CURRENT SCREED COMPOSITIONS?

The moisture balance of a screed is essentially determined by the proportion and type of binder and the pore structure. These variables are influenced in turn by the type of cement (more precisely by the other main constituents of a composite cement besides Portland cement), the W/C ratio, which in turn can be controlled by screed additives, and the ratio of binder to aggregate, which has also shifted in the last 30 years. It cannot therefore be assumed that the moisture balance of screed compositions determined in the 1980s and 1990s also applies to today's screed compositions.

Portland composite cement (CEM II) as replacement for classic Portland cement (CEM I)

In addition to the classic Portland cement, the new CEM II cements contain a further main component which reacts hydraulically, pozzolanically or otherwise. CEM III, CEM IV and CEM V cements contain high to very high proportions of latent hydraulic or pozzolanic main components, but are generally not used for screed production.

Blast furnance slag

Blast furnace or slag sand are produced by granulating molten blast furnace slag with water and/or air. It is a fine-grained, glassy by-product of pig iron production. Ground granulated blast furnace slag has been used for over 100 years in a mixture with Portland cement as Portland blast furnace slag or blast furnace cement. Now, for example, it bears the designation CEM II/A-S for slag. Concrete with these cements is particularly resistant to attack by alkalis such as road salt. The hydration, however, is somewhat slower.

Fly ash

Fly ash is produced during the combustion of coal in power stations with dust firing at temperatures >1000°C. It is separated from the smoke and collected. The ash consists mainly of round grains. The main components of fly ash are silicon dioxide, aluminium oxide and iron oxide. These are also the main components of natural pozzolans. Due to its suitable particle size distribution and latent reactivity, fly ash significantly increases the strength of concrete.

Pozzolans

Pozzolan essentially describes the glassy deposition of volcanic ash. Its properties are very similar to those of fly ash, but pozzolans are natural rocks and therefore sharp-edged.

Limestone

The latest modern type of cement incorporates limestone into the cement, which becomes a binding agent through burning and also lends it good strength. One possible designation is CEM II/A-LL with LL for "Limestone".

WHAT ARE THE CONSEQUENCES FOR SCREED CONSTRUCTION?

The CEM II cements used as an alternative to CEM I cements have a lower cement clinker content and a considerable proportion of latent hydraulic or pozzolanic constituents, which varies within defined limits. This results in other, usually lower, hydration rates, a changed shrinkage behaviour and a different position of the sorption isotherms, i.e. also of the balancing humidity and the resulting guide values for readiness for overcoating. The modes of action and the effects of the screed additives mainly used today in screed production are still only partly understood or known for CEM I cement screeds; this is particularly true then for composite cement screeds. The exact calculation of the water requirement for complete hydration or good workability is not possible with CEM II cement screeds because the exact composition of the cement is not known.

FINDINGS FROM TKB REPORT 1

The position of the sorption isotherms strongly depends on the screed composition, in particular on the W/C value. The consequence is that the standard values for CT of 2.0 CM% and 1.8 CM% (for hot water underfloor heating) do not indicate the readiness for overcoating for every screed. The proportion of water chemically bound in hydrate phases is not significantly lower for CEM II cements than for CEM I cements, certainly for screeds that are at least 2 to 3 weeks old.

WHAT ARE THE CONSEQUENCES FOR FLOOR INSTALLERS?

The floor installer can no longer be sure that a measured value of 2.0 CM% for a cement screed or 1.8 CM% for a cement screed with hot water underfloor heating indicates that the screed is ready for covering.

IS THE CM MEASUREMENT STILL USEFUL?

The installer is obliged to check that a screed is ready to be overcoated. The moisture content of a screed is only one of many criteria that define the readiness for covering. The method used for many years and preferred by the vast majority of experts for determining screed moisture is the CM measurement. If a CM measurement has been properly carried out, duly recorded and the measurement results have shown that the screed is ready to covering with regard to its moisture content, it is generally to be assumed that the installer is exempt from liability for the screed not being ready to be covered (in view of its moisture content). Perform a CM measurement, determining CM values and careful recording of these are therefore of great importance for the installer. The subsequent determination of the readiness for covering on the basis of the CM values determined is, however, only possible if the screed composition is known; the guide values of 2.0 and 1.8 CM% respectively can no longer generally be used. The screed recovering values that apply for a screed must be specified by the screed layer or client.

CAPACITIVE MEASUREMENT: AS A PRELIMINARY TEST FOR CM MEASUREMENT TO DETERMINE THE DAMPEST SPOT

Electronic measurements measure the change in an electric field caused by the change in moisture in a component. The simplest way to do this is the capacitive method, where either capacitor plates are held against directly, or a ball is used in which the capacitor plates are fitted. The electric field thus penetrates the component and changes depending on the conductivity of the component, which is essentially determined by moisture.
A measurement takes only a few seconds here. However, the conductivity of the component is also dependent on factors other than moisture alone and, in addition, a certain field strength is always applied to determine the penetration depth. If the component is much thinner or stronger than the penetration depth predicted, parts cannot be measured at all or the signal is falsified. In addition, the electric field on the surface naturally has a much stronger effect than in the component.

RESISTANCE MEASUREMENT

The resistance measurement works similarly. However, this method usually involves placing 2-4 electrodes in the screed and investigating the resistance between the electrodes. With this method, also called impedance measurement, it is even possible to generate a depth-resolved moisture profile. However, the electrodes have to be inserted somehow into the component or installed in it right from the beginning. This is done quite frequently in buildings such as bridges or similar structures, where permanent monitoring is necessary.

OVEN-DRY METHOD

The oven-dry method is a laboratory method that requires a precisely adjustable drying oven to function. The current discussion is which water is recorded at 105°C (cement) and 40°C (gypsum or calciumsulfate) as a function of its bonding state, and the resulting consequences for the definition of readiness for covering.

MEASURING THE CORRESPONDING RELATIVE HUMIDITY IN THE SUBSTRATE

This determines the humidity of the air in the screed as a structural component. A humidity sensor is inserted into a borehole in the substrate (concrete ceiling or thick screed), the opening is tightly closed and a value for the relative humidity in the depth of the borehole is read off after adjusting the equilibrium. The accuracy of the measurement depends to a large extent on the sealing quality.

FOIL MEASUREMENT - QUALITATIVE OBSERVATION OF MOISTURE DIFFUSION FROM THE SCREED SURFACE

A foil is glued onto the screed, under which either a measuring instrument is located or is inserted after 1 day. In addition, accumulations of moisture under the film can indicate that the screed is too damp. Here, too, the sealing quality is of importance. The measurement takes a long time.

TKB REPORT 2: THE KRL METHOD

The KRL method is the measurement of the corresponding relative humidity on a screed sample.

For this purpose, a hole, similar to the one used for CM measurement, is wreck, the material is crushed and placed in a plastic bag or bottle. In order to accelerate the moisture equilibrium adjustment, the plastic bottle must be filled as much as possible, or the air from the bag must be brushed out as far as possible before closing. A humidity sensor is inserted and the bottle/bag is sealed tightly. After setting the moisture equilibrium, the corresponding relative humidity is read off after approximately 30 minutes.

For this KRL value, there are various international guideline values for the readiness for covering. Depending on the standard, country and surface covering, these vary between a relative humidity of 60% and 90%. The most common and, in our opinion, safe values are a relative humidity of <80% for unheated screeds and of <75% for screeds with a hot-water floor heating. Our recommendation is in line with TKB report 2 as well as experience.

Disadvantages of the KRL method are that the measurement is, of course, temperature-dependent and the sensor of the measuring device can quickly become soiled due to dust.

The advantages are that measurement can be carried out parallel to CM measurement and provides additional information. This method of measurement is suitable for building sites, is sufficiently accurate and does not require exact weighing of the material to be measured. It is easy to carry out and does not depend on the screed binder or additive. The original TKB reports 1 and 2 can be found at www.klebstoffe.com