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New Technology for Aggregate Moisture Measurement in Concrete Production

Polarmoist is a new optical moisture sensor designed for detecting moisture content of concrete aggregates. The sensor embeds a micro-processor and uses LED's as light sources. Moisture content is determined as percentage of water by weight of dry aggregate. The sensor is most optimal when used above conveyors or silo feeders to detect moisture content in moving samples. A non-contacting remote measurement guarantees stable performance and long life time of the sensor.

Coarse aggregates can contain 0-2% surface moisture by weight and fine aggregates even up to 10%. These numbers exclude absorbed water, which ranges typically from 0.5 to 4%. Ultimately, wet aggregates may contain moisture more than is desirable to preserve the water-cementitious material ratio (w/cm) in

design limits without overdosing cement. In practice, moisture content of aggregates must be known to fractions of percent to minimize variability in concrete quality and to enable optimal usage of cement. Accurately measured moisture in aggregates allows optimizing strength, durability and shrinkage of concrete products. Also knowing the right moisture content prior to mixing permits faster mixing times, when there is no need to add water during mixing.

Background

Currently the most widely used moisture measurement in concrete industry is based on capacitive or microwave sensors. Capacitive and microwave sensors are installed typically in direct contact with the aggregate either in silos, silo feeders or even over a conveyor belt. The dipole nature of water molecule implies a high dielectric constant of water enabling simple detection in aggregates by coupling to a sensing electromagnetic field. Since the dielectric constant of most aggregates is fairly small compared to water, capacitive sensing produces often a fairly stable result. Nevertheless, direct contact to sample causes mechanical wearing of the sensor requiring occasional recalibration and finally replacement of either the sensor plate or the whole sensor.

Optical detection of material moisture allows noncontact detection with clear advantages for concrete industry. Optical moisture sensors are based on absorption peaks by water molecules at near infra-red wavelengths. There have been optical moisture sensors available for process industry over tens of years, but they have not been widely used in concrete plants due to their high price compared to microwave sensors. However, development of optoelectronic components thanks to optical communication technology has enabled designing more optimal and economical sensors for

measuring surface moisture in aggregates as Polarmatic's Polarmoist WCM411.

Performance

Figure 2 shows the results of a long term test in a plant environment. The data was collected within four months leaving the optical sensor untouched during the whole test period. The weighed reference values were collected by taking typically three manual samples from a given mixing batch and comparing water loss in drying to corresponding sensor readings.

The apparent scatter in the data has clearly increased as compared to calibration data. However, the standard deviation, 0.25% in moisture, is still fairly low. Surprisingly, the most significant reason for the scatter is not related to the performance of the optical sensor but instead to manual sampling problems of the weighed reference data. For practical reasons the reference samples are on the order of 1 kilogram by mass representing only a tiny fraction of the whole batch and thus being sensitive to local variation. Instead, the sensor readings represent average values of a much larger part of the batch thus representing more likely



Fig. 1: Polarmoist™ WCM411: Non-contact measurement, long lifetime due to solid state design, simple calibration, high accuracy and minimal maintenance

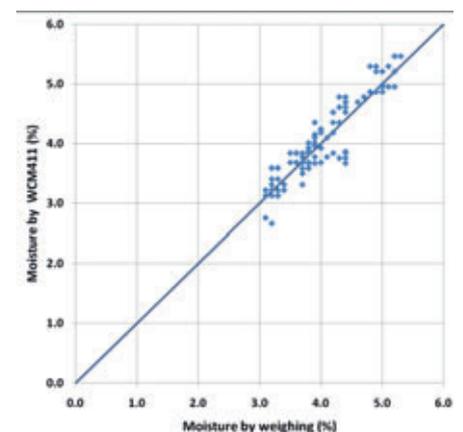


Fig. 2: Long term test in a plant environment

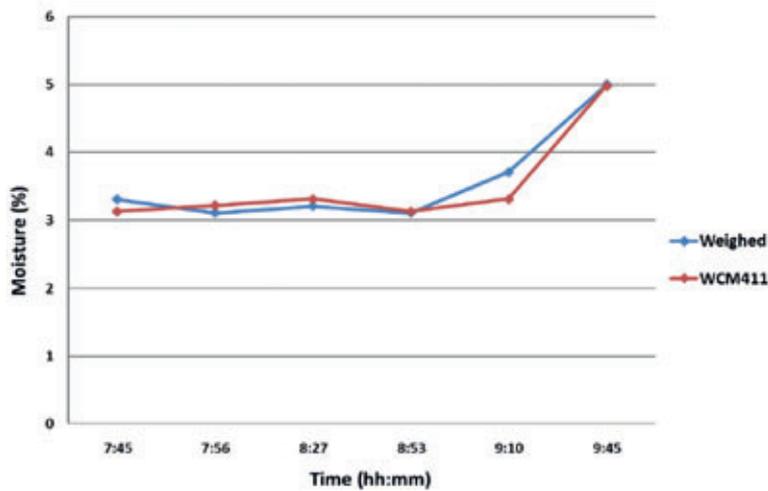


Fig. 3: Example of sudden variation in aggregate moisture

the average moisture of the batch. Often the three reference samples of a single batch varied almost one percent in moisture from each other whereas some other time the scatter was only a few tenths of percent.

An example of sudden variation in aggregate moisture is shown in figure 3. Up to about 9:00 the reference values and the sensor readings showed fairly stable moisture readings around 3.2%. Suddenly both of the readings started to increase ending to 5% and over. The large and fast increase in silo moisture was probably caused by a heavy raining period a few days earlier. This example shows why it is important to follow aggregate moisture continuously instead of taking only one daily reference sample.

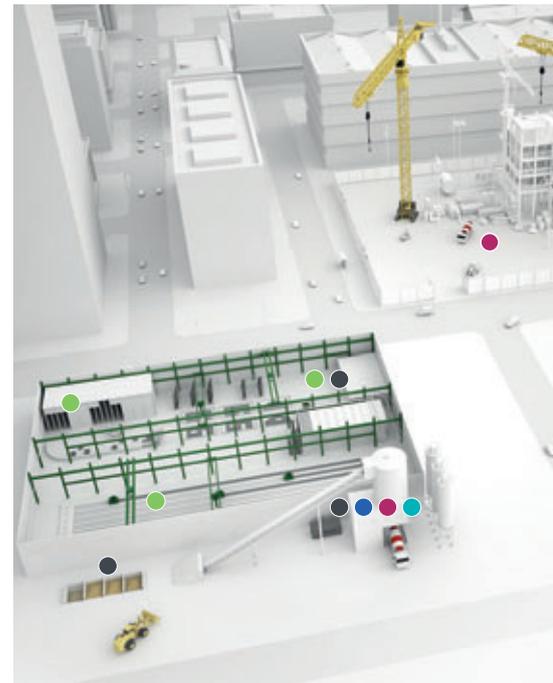
The Product

Polarmoist has been extensively tested in concrete plants with different grades of stone material. By proper calibration the accuracy of measuring water content outperforms hand made reference measurements in the case of a limited number of samples and a large variation of moisture in a given batch. Polarmoist has a serial and a current loop output and a wide power supply voltage range enabling easy integration to existing control systems.

Features and benefits:

- Remote optical measurement of moisture content
- Solid state design
- No moving nor wearing parts
- High accuracy and resolution
- Fast response

- Low noise
- Stable LED light sources
- Temperature compensated
- Easy to install and calibrate
- Output:
 - o serial interface
 - o current loop 4-20 mA
 - o 0-10V
- Power supply 9-30 VDC



HEATING



COOLING



CURING



CONTROL



INFORMATION

FURTHER INFORMATION



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