Application report

Moisture measurement of sand

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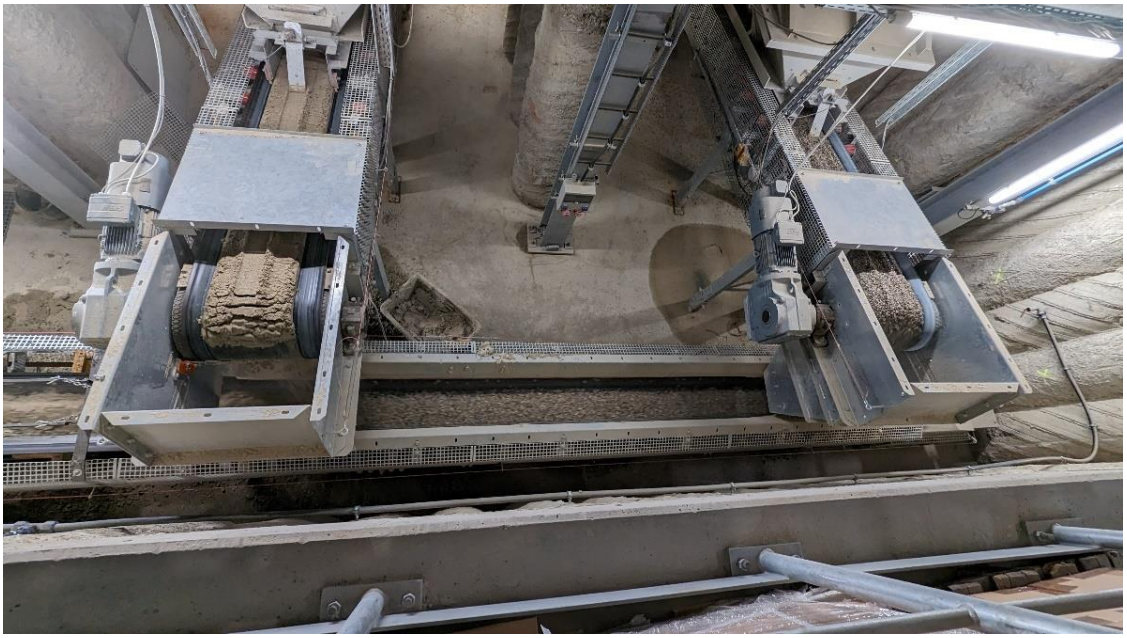
1. What is the initial situation?

- Sand is an important basic material in the production of building materials, but also an important raw material in glass production and in the manufacture of semiconductors. It is produced in a clearly defined state
    - sold as a raw product,
    - processed into a sand-gravel mixture,
    - used for the production of ready-mixed concrete, mortar, etc,
    - processed into blasting abrasives,
    - processed into quartz sand for semiconductors or
    - used in glass production.
- In all these applications, the moisture content is a specified quality characteristic and must generally be within a range of 0.1 - 0.5%
- The challenge is that the sand and other materials that may be added are stored outdoors in bunkers. Due to changing weather conditions, the moisture content can change quickly and experience has shown that it is in the range of 5 - 10%.
- The sand, the sand mixture (e.g. sand-gravel or sand-stone) or the end product is therefore dried down to the target value in a drying system (e.g. drum dryer).
- The strongly fluctuating, weather-dependent input moisture value makes dryer control difficult. Overdrying means unnecessary energy consumption, underdrying leads to a loss of quality in the material or in further processing.
- In many sand-processing plants, material samples are therefore regularly taken and the material moisture is determined in the laboratory. However, this process is very time-consuming and costly and the measured values are available very late. The dryer is set manually, and over-drying or under-drying may occur over a longer period of time.

2. Solution

- With the HUMY 300/3000 and the capacitive moisture sensor FMS 410, inline moisture measurement of the sand, the sand mixture or the end product can be realized

- If the mixing ratio is constant, the moisture of the end product can be measured downstream of the dryer, e.g. on the belt conveyor / screw conveyor. As the material can have a temperature of up to 150 °C after drying, a suitable measuring point and, if necessary, a moisture sensor with a cooling housing must be selected. Measurements are possible at process temperatures of up to 120 °C.
- If the mixing ratio or the bulk density of the end product changes regularly, the raw sand can alternatively be measured before mixing with gravel.
- The recommended sensor is an FMS 410 C with a ceramic surface, which protects the sensor against abrasion.
- If the sand is sticky, it is advisable to select a Teflon measuring surface. A Teflon wear cap (for moisture values > 1%) can be offered as an option.
- The measurement result is sent to the PLC via the 4-20mA analog output or Modbus, where it is displayed or used for automatic dryer control.



Measuring the moisture at the sand feed from the bunker. The picture shows the conveyor belts that transport the sand and gravel.

Measuring the moisture on the screw conveyor after drying

Measurement under a vibrating conveyor

3. What needs to be considered during planning and implementation?

- Use process questionnaire
- If possible, take a photo or video of the measuring point and send it in with the questionnaire for clarification
- Plan the application precisely and discuss it with the customer.
- When measuring the input moisture, ensure that the material has an almost constant bulk density (measure sand before mixing with gravel). Ice can form in winter, leading to incorrect measurements

- When measuring after the dryer at higher process temperatures, a measuring point must be selected where the process temperature is within the specified temperature range of the sensor (e.g. at the end of the belt conveyor or in the downstream conveyor)
- Under constant process conditions (constant product height, bulk density, product speed), an accuracy of up to 0.1% is achieved
- Clarify where and how calibration can be carried out (is sampling possible near the sensor? Calibration with at least two different moisture values possible? Calibration of the sensor at the same time as sampling, evaluate at least three laboratory samples per measuring point)

a) **Measurement in a screw conveyor**:
- The sensor is installed in a screw conveyor by approx. 20° in the direction of rotation
- Installation at the bottom of the screw conveyor should be avoided, as the screw helix is approx. 2 cm from the bottom, the material does not move there or is not constant
- Ensure sufficient loading of the screw conveyor and thus constant material coverage of the moisture sensor
- Calibration time should be 30-60 seconds
- Filter time for measured value output at least 30 seconds

b) **Measurement under vibrating feeder**:
- Stable measurement, pouring height must be reasonably constant
- Installation of a "scraper" in front of the sensor with a defined height is recommended (constant product height)

c) Measurement under chute (e.g. inlet to elevator):
- Sensor must always be covered with product
- Product flow should be as uniform as possible

d) **Measurement on belt conveyor**:
- Design of the sliding plate or ship according to belt width
- Suspension of the sliding plate rigid/flexible
- Ensure sufficient loading of the belt (accumulated or constant)
- Sensor surface must always be in contact with the product

e) **Measurement in the silo**:
- Installation in the hopper
- Static measurement of non-moving material is only possible to a limited extent; it is better to measure when the material is moving (e.g. while the product is being discharged).

- The fill level of the silo influences the bulk density and therefore the measurement result. It is recommended to always measure at a constant fill level or at a high fill level where the measured value no longer fluctuates

f) **Further information**:

- It is recommended to lay a 4-wire cable (shielded) from the RS485 interface of the Humy interface to the control room or laboratory (where measurement samples are taken or measured values are displayed)
- A laptop or PC can then be connected via RS485 - USB converter to configure the sensor and save measured values (Humy 301 only)
- The sensor must always be calibrated in the process (no static calibration on samples outside the measuring point)

4. Customer benefits:

- Consistently high product quality, both during storage (no sticking due to excessively moist storage) and during further processing
- Energy savings during drying
- Permanent monitoring of the process, fluctuations in the process can be analyzed in real time

5. What restrictions exist:

- Sticky, adhering material (possibly solve with Teflon sensor and Teflon ship)
- Products with constantly fluctuating bulk density (asymmetrical)
- Fluctuating conveyor speed influences the measurement result

6. Why our solution is the best:

- Robust measuring system with few failures
- High accuracy, no drifting of measurement results even at low moisture levels
- Stable and accurate measurement results even with extremely dry material

7. References

- Mossandl, Germany
  -Sievert (Quick-Mix), Germany
  -Saint Gobain Weber, Sweden

If you have any questions or concerns, please do not hesitate to contact us!

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