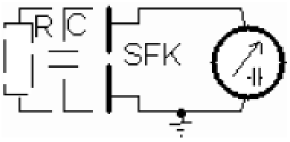
Technical data

Measurement Procedure Litronic FMS

1.1 The purely capacitive measurement procedure



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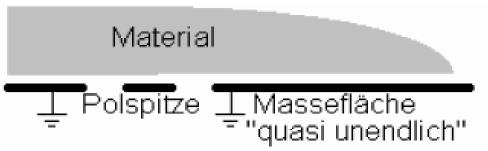

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The object to be measured will be brought before the plates of a stray field capacitator SFK as a so-called dielectric: this capacitator can be fitted as a pole tip, strip or comb behind a wear protection.

If the SFK is supplied with high-frequency energy, the arched field lines will permeate the material. The capacitator will change its capacity C depending for example on the moisture. The dielectric loss resistance is designated as R in the model, will reduce for moist material and has similarly detrimental dependencies as the conductive measurement method.

If the dielectric is subjected to complex evaluation, that is amount/phase or R/C, this is known as the capacitive measurement procedure. Note also that, by error, a dielectric measurement is frequently designated as a capacitive measurement.

The capacitive shares of the SFK behave somewhat more advantageously, in particular with regard to their electrolyte contents.

Due to the dipol character of the molecules - liquid water ($\varepsilon_r = 80$), in contrast to dry aggregates ($\varepsilon_r = 6$) - has a very high relative dielectric constant. Thus, ε_r ist also linear proportional to the water content (moisture) and to the capacity C, as

$$C = \varepsilon_r \cdot \varepsilon_0 \cdot k \frac{A}{d}$$

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$$\varepsilon_0 = 8{,}85 \frac{pF}{m}$$

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ε_0, plate clearance "d", plate surface "A" and form factor k are constant.

The capacity C of the SFK is determined earth-related at a high measurement frequency (>>10 MHz) and at a real capacity measurement without any influence by the dielectric losses to achieve the highest possible measuring precision.

The capacity value can then be processed electronically. (Temperature compensation, signal transmission, evaluation, indication).

The interrelationship moisture and C can be deemed to be linear within a wide measurement range.

1.2 Dissolved electrolytes

Even for products featuring good conductivity (carbon, metal particle contents), the Litronic - moisture sensor responds sufficiently clearly to water contents in the product. The reasons for this are: the purely capacitive measurement and the existing amplitude control. In the case of the Litronic moisture sensor, the dielectric losses (in conductivity) are continuously re-fed by the amplitude control. However, water dipoles contained therein clearly shift the dielectricity and thus cause a change in capacity.

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As the conductivity of the material is not evaluated, any dissolved electrolytes (pH-value) have an imperceptible effect on the measurement result.

Despite major losses in the dielectric losses, the effective plate voltage U - in contrast to the dielectric procedure - remain constant (amplitude control). As the plate clearance d and the plate surface A also remain constant, the electric field strength E also remain constant. The shift D (electric flow density) is

proportional to E. The water content of the material will then imperceptibly change the measurement volume.

For consideration - the homogenous field

$$E = \frac{U}{d}$$

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$$D = \varepsilon \cdot E$$

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$$Q = D \cdot A$$

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and the inhomogeneous field:

The enclosed surface A surrounds the charge Q. For the electric area flux originating from this charge, the following applies:

$$\Psi_0 = \oint_A D \, dA = Q$$

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1.3 Bulk density / grain size

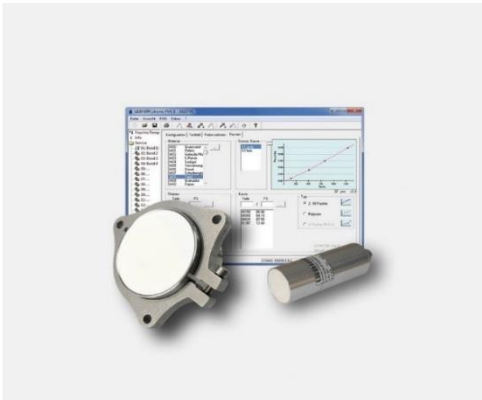
Here, an increase in measurement uncertainty - caused by variations in bulk density and grain size - is mainly a problem of volume / weight moisture and can best be handled by density compensation. Due to the various relative dielectric constants of the respective individual materials, the measurement signal must be evaluated specifically for each material.

1.4 Electrode contact pressure

As there is no electrically conductive contact with the material, the electrode contact pressure is insignificant.

1.5 Measurement frequency

In the case of the Litronic-moisture sensor, a frequency range was selected within which the loss factor of the water is reduced to a minimum. The vibration frequency will be counted with quartz-type precision.



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