

Reliable Measurement of Material Moisture at different Grain Sizes of the Bulk Material

Bulk goods and aggregates such as sand and gravel show different shapes and grain sizes and therefore inhomogenities exists with deviating dielectric constants. When this happens, the inhomogeneity will behave like an oscillating dipole which radiates on its part an electromagnetic scattered wave. But scattering losses can not be neglected, significant problems arise concerning the measurement accuracy. Material moisture sensors should not be influenced by such inhomogeneous conditions.

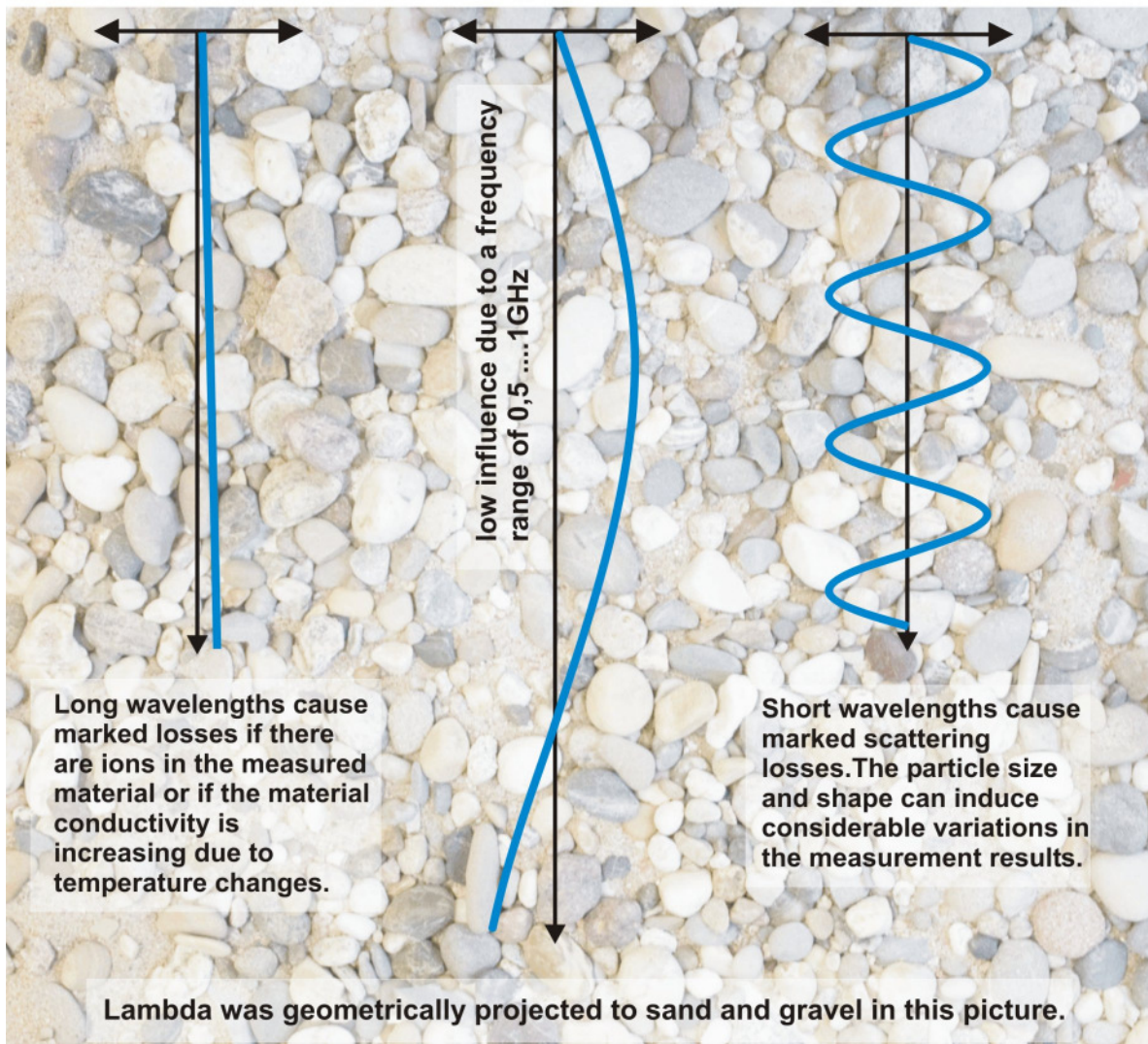
The Wavelength λ (Lambda) in Relation to Particle Size and Shape:
 Electromagnetic waves are penetrating the measured material.

$$\lambda = \frac{c}{f} \quad c_0 = \text{Speed of light or electromagnetic waves in vacuum} \\ (\text{lightspeed} = 299\,792\,458 \text{ m/s} \sim 300\,000 \text{ km/s})$$

Capacitive Probes
 $\lambda = 10\text{m to }30\text{m}$
 $f = 10\text{MHz to }30\text{MHz}$

TDR Probes
 $\lambda = 30\text{cm to }60\text{cm}$
 $f = 0,5\text{GHz to }1\text{GHz}$

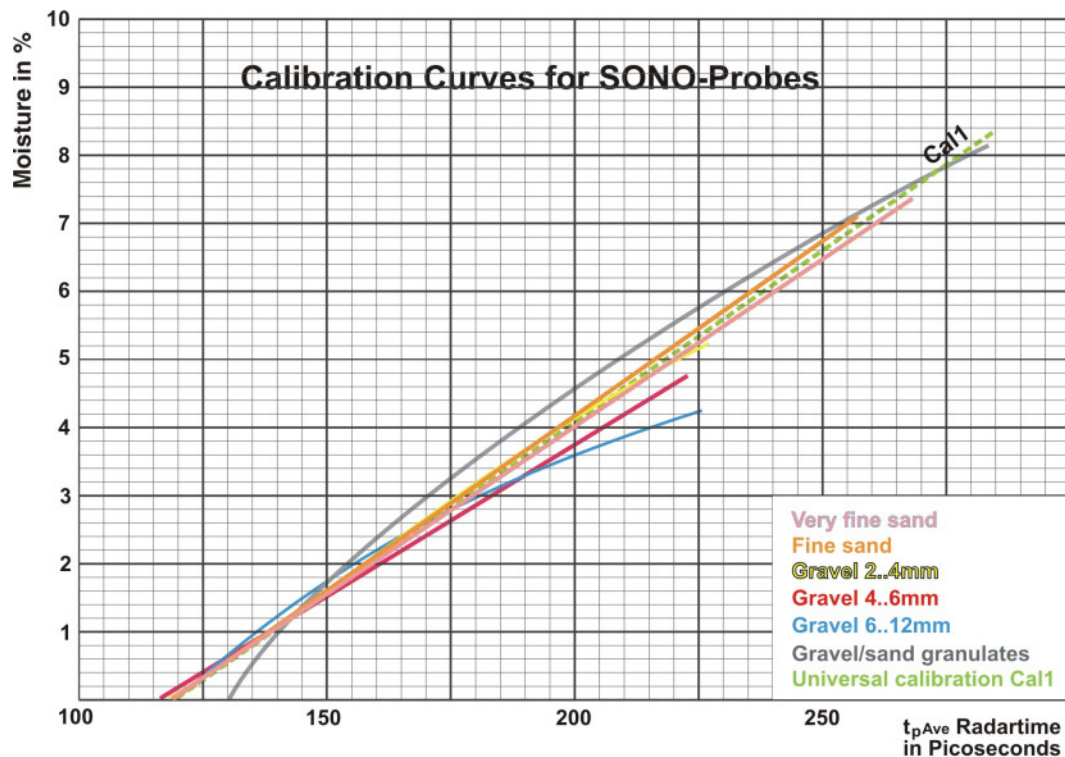
Microwave Probes
 $\lambda = 30\text{mm to }100\text{mm}$
 $f = 3\text{GHz to }10\text{GHz}$



SONO-Probes for measuring moisture of Sand and Aggregates

SONO's TDR technology with the radar method offers high reliability for measuring moisture of sand and aggregates, as different grain sizes do not cause high distortions of the measurement result.

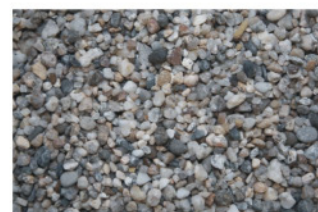
The calibration curve Cal1 "Universal Sand Mix" is suitable for measuring the moisture in different bulk sand, gravel and gravel/sand granulates. The deviations to the universal calibration curve Cal1 are approximately $\pm 0.5\%$ for bulk sand and the below listed gravel/sand types, depending on the moisture range.



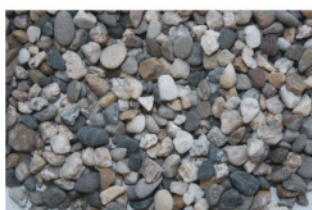
Very fine sand



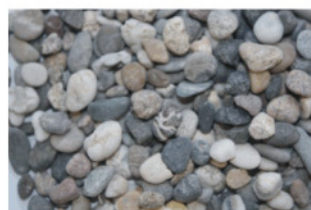
Fine sand



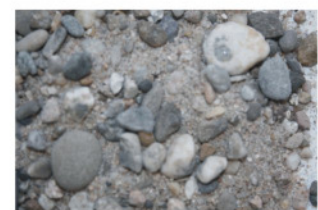
Gravel 2..4mm



Gravel 4..6mm



Gravel 6..12mm



Gravel/sand granulates