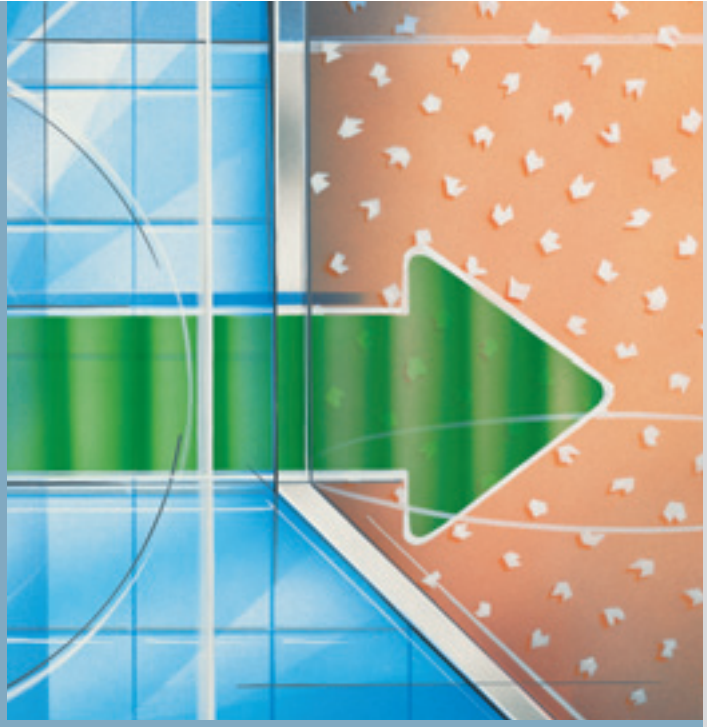


PROCESS CONTROL

Moisture Measurement on Bulk Materials

LB 350

BERTHOLD TECHNOLOGIES

Moisture Meter LB 350

The Moisture Meter LB 350 has been designed to measure the moisture content of a variety of different products.

For example:

- in bunkers
- on weighing tanks
- on feeding tanks

The large measuring volume of up to 1 meter in diameter assures a representative measured value.

Benefits

representative measured values due to large measuring volume

■

accurate measurement due to highly sensitive ^{3}He counter tubes

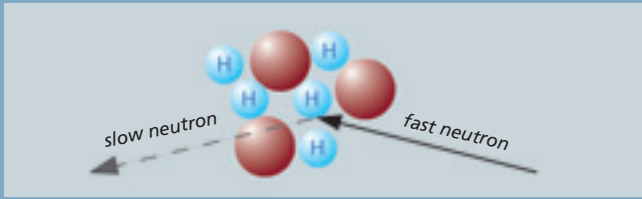
■

Not effected by:

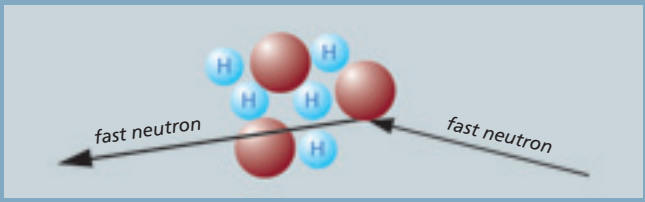
Temperature
Pressure
pH value
Color

Principle of Measurement

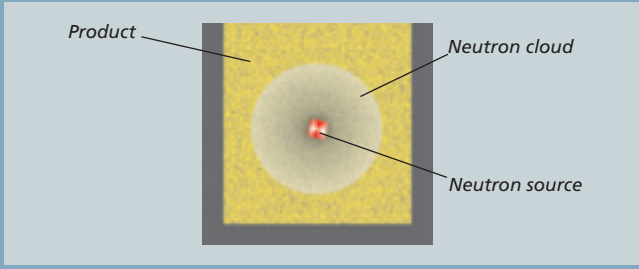
The nuclear method of moisture measurement is based on the principle that fast neutrons are slowed down by scattering the hydrogen nuclei.



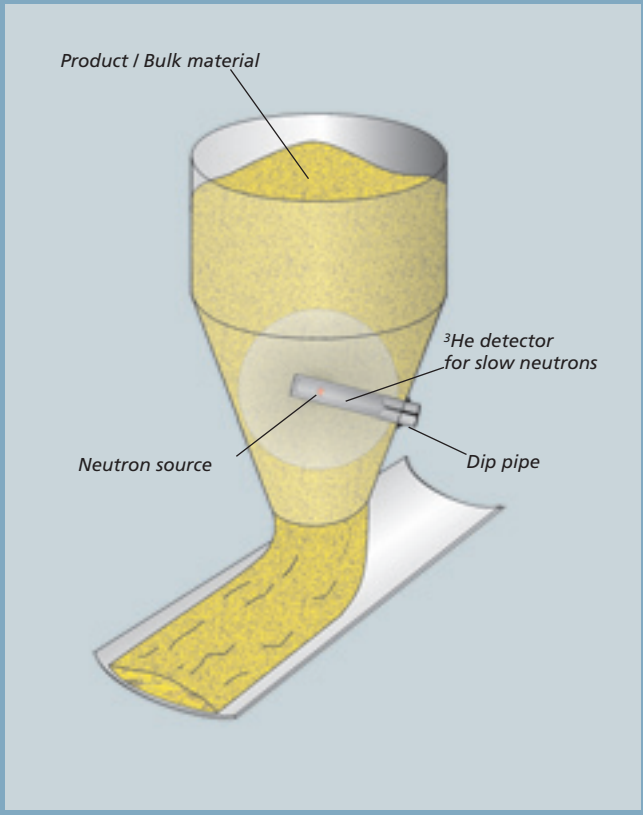
Fast neutrons are hardly slowed down by scattering materials of higher atomic numbers.



A cloud of slow neutrons is created around a source of fast neutrons, and its concentration essentially depends on the hydrogen content of the surrounding product.

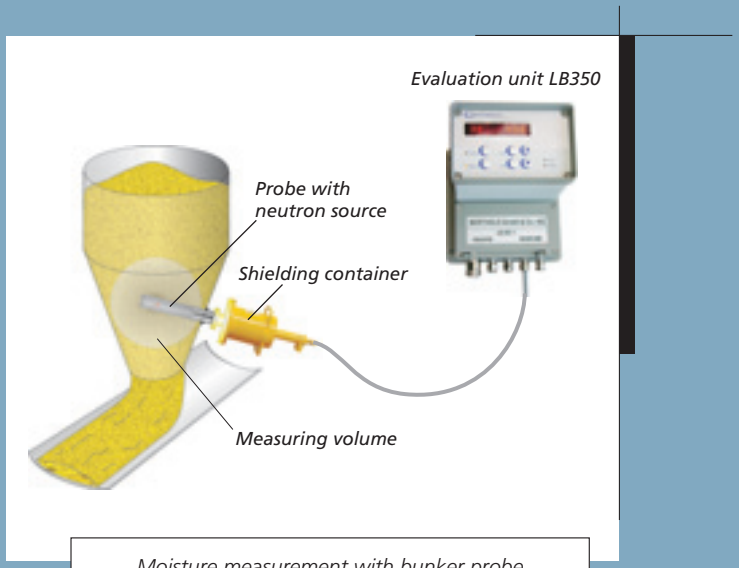


By combining a source for fast neutrons with a detector for slow neutrons, the measurement system is capable of determining the hydrogen content without contacting the measured medium. Since water contains hydrogen atoms (H_2O), the volume moisture is indicated directly.



Configuration with Bunker Probe

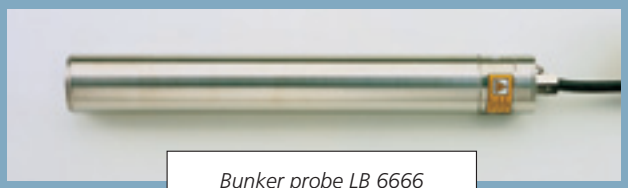
The probe is installed in the outlet section of a bunker or a continuous flow tank so that the built-in neutron source is sufficiently surrounded by material in accordance with the effective volume. The probe is mounted in a dip pipe, closed at the bottom end, which is installed into the tank at an angle of approx. 30 - 45° to the horizontal. Ideally, the wall thickness of the dip pipe should be between 3 to 5 mm to minimise signal attenuation at the detector. (The signal is reduced by about 5% per each 1 mm of steel.)
We recommend using a hardened dip pipe, or a dip pipe with ceramic jacket, to ensure a long life time, even when working with abrasive products.



Moisture measurement with bunker probe

Bunker Probe LB 6666

In this arrangement, the counter tube, radiation source and preamplifier electronics are accommodated in one housing.



Bunker probe LB 6666

Benefits

representative measured values due to optimum measurement position in the volume flow

■

accurate measurement results since the signal is not reduced by container walls

Engineering data

We need the following technical data to plan the optimum system configuration for you:

Product

■

Bulk density

■

Measuring range

■

Ambient temperature

■

Container drawing

■

Container wall construction

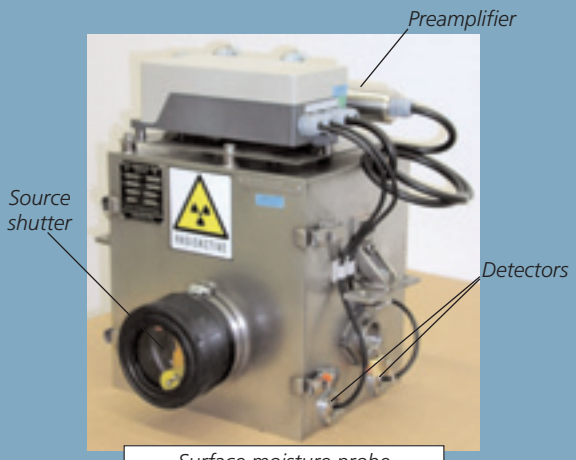
Applications

Product	Attainable accuracy in % moisture
Sand	+/- 0.3%
Vitreous sand	+/- 0.1%
Coke	+/- 0.5%
Sinter mixture	+/- 0.2%
Iron ore	+/- 0.3%

Configuration with Surface Probe

The Surface moisture measurement system should be used when:

- the dip pipe for the bunker probe is subject to a high level of abrasion from falling product
- the product may fall directly onto the dip pipe
- interferences in the material flow due to a dip pipe are likely to occur
- the bunker has to be accessed for revision purposes



Surface moisture probe LB 7410

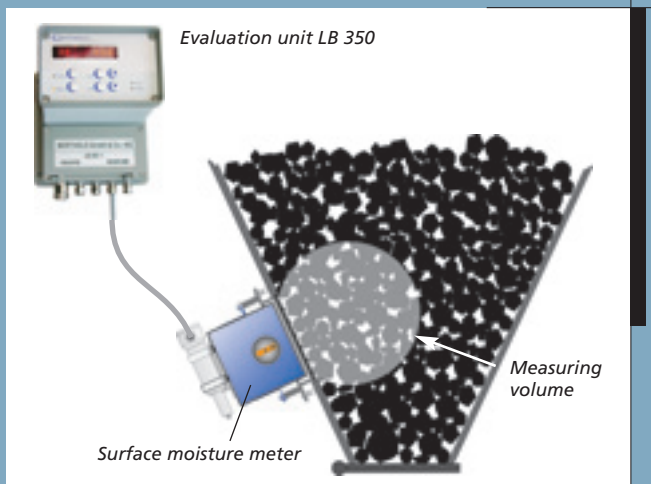
The surface moisture probe LB 7410 is mounted directly on the tank. The steel wall of the tank should not be thicker than 20 mm so measurement sensitivity is sufficient.

Benefits

lockable shielding

■

superior measuring sensitivity when using the mounting frame



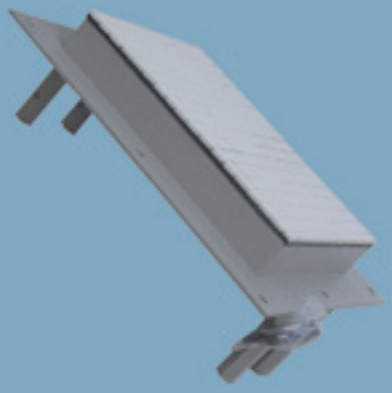
Surface moisture measurement

Mounting frame

A mounting frame is sometimes recommended because it:

- provides accurate measured values, since the measuring signal is not reduced by the tank wall
- allows fast mounting, since the holding device for the moisture measurement is integrated into the mounting frame
- offers a long service life due to a wear-resistant ceramics surface

The mounting frame has to be installed in a opening prepared in the tank wall.



After an operating time of several years, a broken wire in the integrated conductor loop indicates that the ceramics surface is worn down.

Bulk Density Compensation

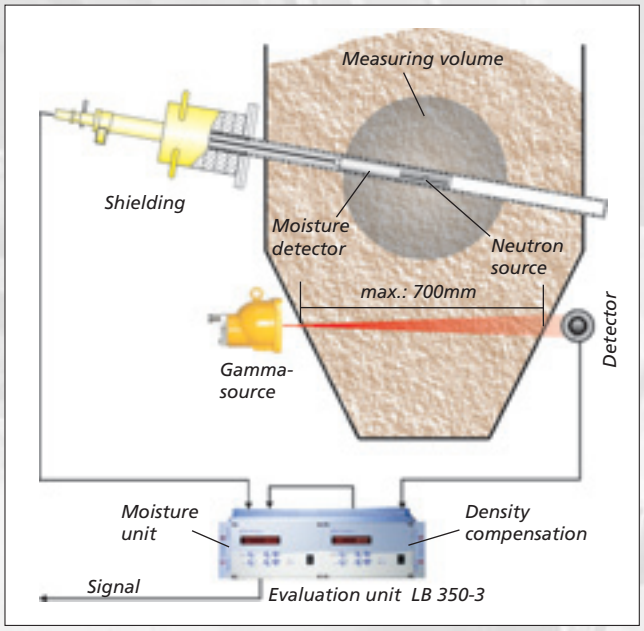
Bulk density compensation increases the accuracy of the moisture measurement if the bulk density of the product is fluctuating.
Bulk density compensation consists of a scintillation detector and a shielded Gamma radiation source. An additional measuring amplifier determines the bulk density in order to compensate for the moisture measurement.

Depending on the measurement path through the tank, different measuring systems should be used to measure the bulk density:

- transmission measurement
- backscatter measurement

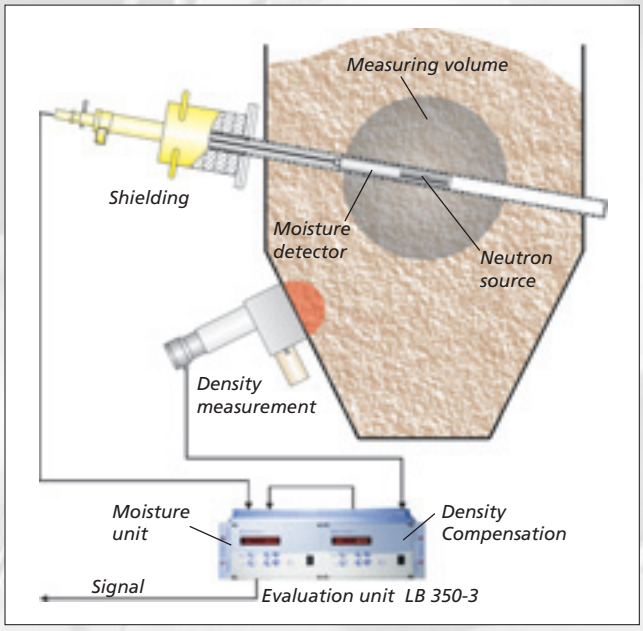
Transmission Measurement

Radiation emitted by a Gamma source is attenuated as it passes through matter. If the bulk density changes, the attenuation changes as well.
A transmission measurement is possible only with transmission paths of max. 700 mm; however, compared with a backscatter measurement it offers a decisive advantage: the indication is more representative, since a larger measuring volume can be covered.



Backscatter Measurement

Radiation emitted by a Gamma source is backscattered by the product being measured. The intensity of the backscattered radiation is an indication of the bulk density.
If a surface probe is used instead of a bunker probe, then the backscatter measurement can simply be installed into the mounting frame.



Radiation Protection

The controlled area of 3.700 MBq neutron radiation sources ends in air (dose rate > 3 µSv/h) already in a distance of 80 cm from the source. For most applications, the controlled area is within the vessel's dimensions and is not accessible, which minimises radiation protection efforts.

Technical Data LB 350

Evaluation unit LB 350

Design	LB 350-1: aluminum wall housg. IP 54 weight approx. 10 kg LB 350-2: 19" rack 3HE weight approx. 14 kg LB 350-3: 19" rack 3HE accommodating 2 channels for mois- ture density compensation weight approx . 19 kg
Mains	AC voltage: 250/230/125/24VAC +10% to -15%, 47-65Hz DC voltage: 24VDC (18 - 36VDC)
Power consumption	max. 25 VA
Operating temp	0 ... +50°C (273 ... 323 K)
Storage temperature	-40 ... + 70°C (233 ... 343 K)
Analog output	Moisture signal 0/4 - 20mA, isolated, load: max. 500 Ohm
Detector connection	7 - wire Supply (+/- 15V DC) and pulse line on separate wires
Digital input	"Hold" signal by external contact closing
Digital output	3 relay contacts for: - collective fault message - limit value max - limit value min Load: Max. 250VAC / 2A non-inductive
Parameters	set up via code numbers
Operation	by means of 6 push buttons
Display	max. 5 digits

BERTHOLD TECHNOLOGIES reserves the right to implement technical improvements and/or design changes without prior notice.

Detectors: General Data

Counter tube	^{3}He counter tube automatic drift stabilisation
Operating temp.	-20 ... +50°C (253 ... 323 K)
Storage temperature	-40 ... +70°C (233 ... 343 K)
Housing	made of stainless steel
Cable	7 x 1.5 mm^2, shielded max. cable length: 1400 m

Moisture Bunker Probe LB 6666

Types	LB 6666-1 3.7GBq (100 mCi) AmBe LB 6666-2 11.1GBq (300 mCi) AmBe
Protection class	IP 65

Moisture Bunker Probe LB 6669

Types	Counter tube and preampl. separate LB 6669-1 3.7GBq (100 mCi) AmBe LB 6669-2 11.1GBq (300 mCi) AmBe
Preamplifier	LB 2018
Protection class	IP 65

Surface Moisture Measurement LB 7410

LB 7410-13	Lockable surface neutron shielding with 2 counter tubes Housing made of stainless steel Weight: approx. 50 kg
LB 7410-14	same as LB 7410-11 but with pneu- matic shutter, weight: approx. 55 kg
LB 7410-44	fire-proof version, weight: appr.90 kg
LB 7410-55	same as LB 7410-44, but with pneu- matic shutter, weight: approx. 95 kg
Source for LB 7410	3,7GBq (100 mCi) AmBe 11,1GBq (300 mCi) AmBe

Density Compensation for Transmission

Detector	Sz5 D1 50/50 Scintillation counter, crystal 50x50
Source	Cs-137 or Co-60 (depending on application)
Shielding	LB 7440 or LB 7442

Density Compensation for Backscattering

Detector	SZ AR 1 44/5 Scintillation counter, crystal 44x5
Source	Cs-137, 1.11 GBq (30 mCi)
Backscatter chamber	Lockable shielding with housing made of stainless steel

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