

Determination of Carbon in Fly-Ash



The amount of unburned carbon in the fly-ash of coal power stations is a measure of the efficiency of energy extraction. When the maximum efficiency is reached by optimising the combustion process, the pollution emission is also reduced to a minimum. Experience has shown that this optimum condition is reached when the carbon content in the fly-ash is 2-4 % by weight.

Berthold Technologies offers a measuring system that accurately, quickly and reliably, determines the carbon content of the fly-ash. This allows the power station operator to optimize the combustion process.

In addition, the fly-ash can be used in the cement industry if the content of carbon does not exceed

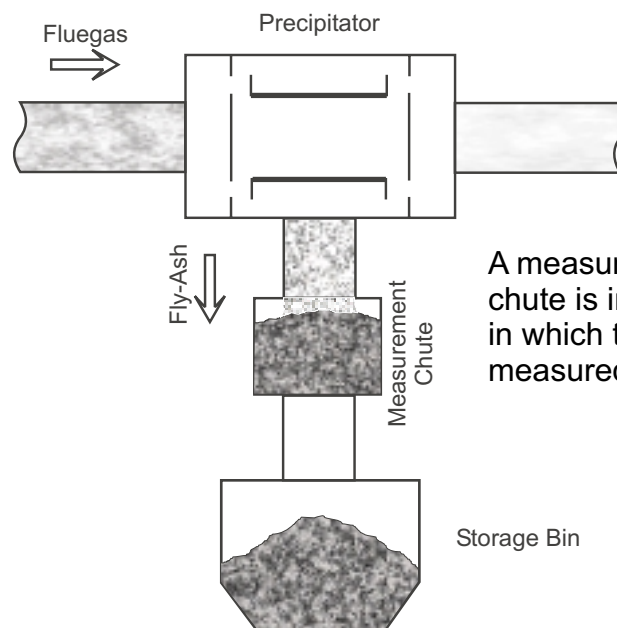
certain limits. Conversely, if the limit values are exceeded the fly ash must be disposed of at high cost.

Measuring arrangement:

The carbon content of the fly-ash is measured after the electrostatic filter. The material is periodically diverted to a measurement chute, held and analysed.

Benefits of large volume sampling with microwave transmission technology:

- Representative results due to large measurement volumes.
- This avoids a major disadvantage of pneumatic sampling systems using low volumes.
- Measurement errors due to inhomogeneity of the carbon distribution in the fly ash are negligible.
- Accurate measurement using one calibration factor for different kinds of coal.



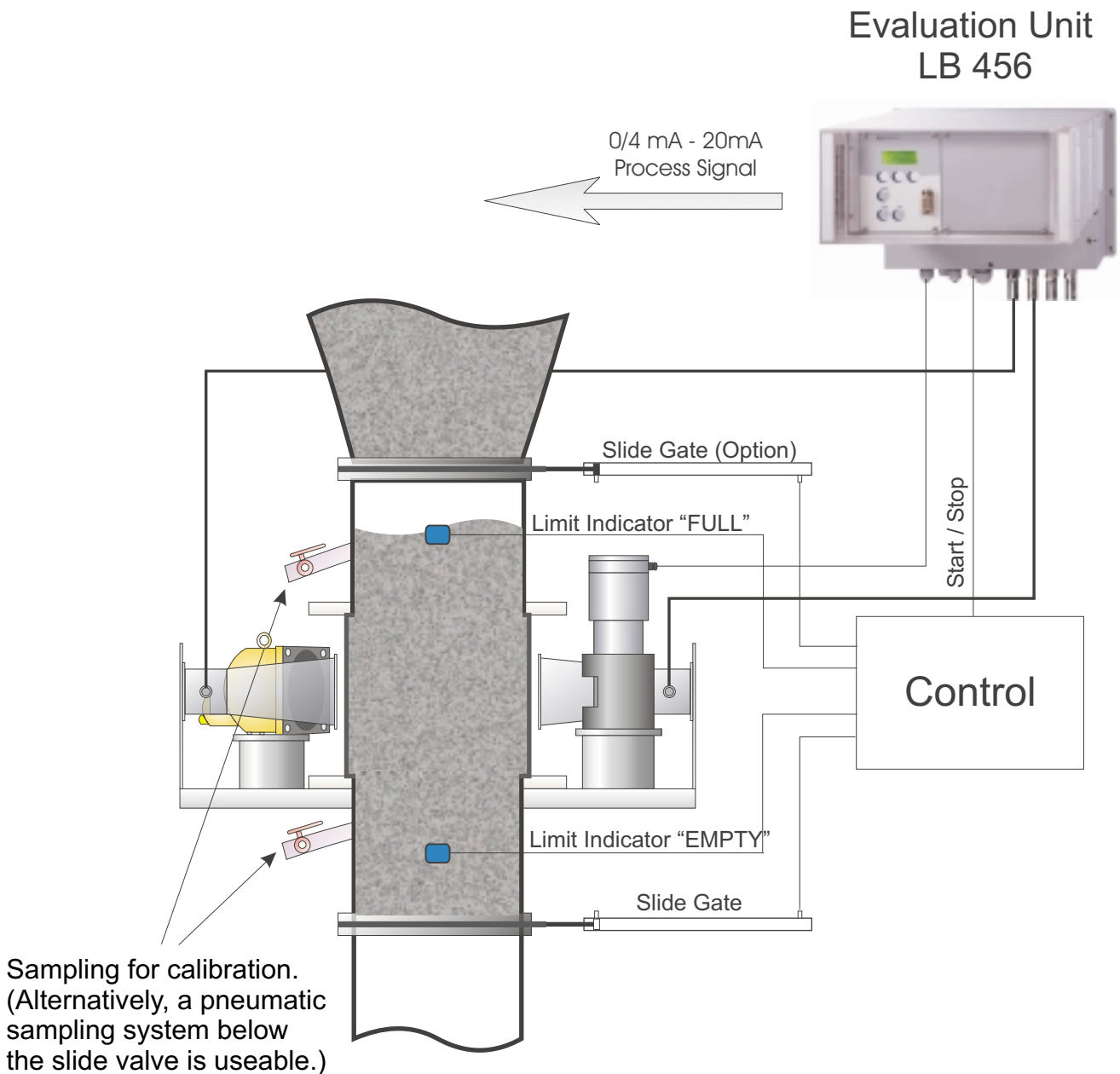
A measurement chute is installed below the E-Filter in which the total sample is held, measured and released repeatedly.

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Measurement procedure:

The fly ash is kept in the measurement chute while the lower slide gate is closed. If the limit indicator responds with "filled" the measurement may be started after a settling time of approximately 30 sec. After a measurement time of at least a further 30 sec. the lower slide valve is opened and the chute is emptied. When the limit indicator responds with "empty" the next measurement cycle can begin.

Alternatively to the limit switches, the measurement cycle may also be controlled by a time basis. The measurement is updated every 3-4 minutes.



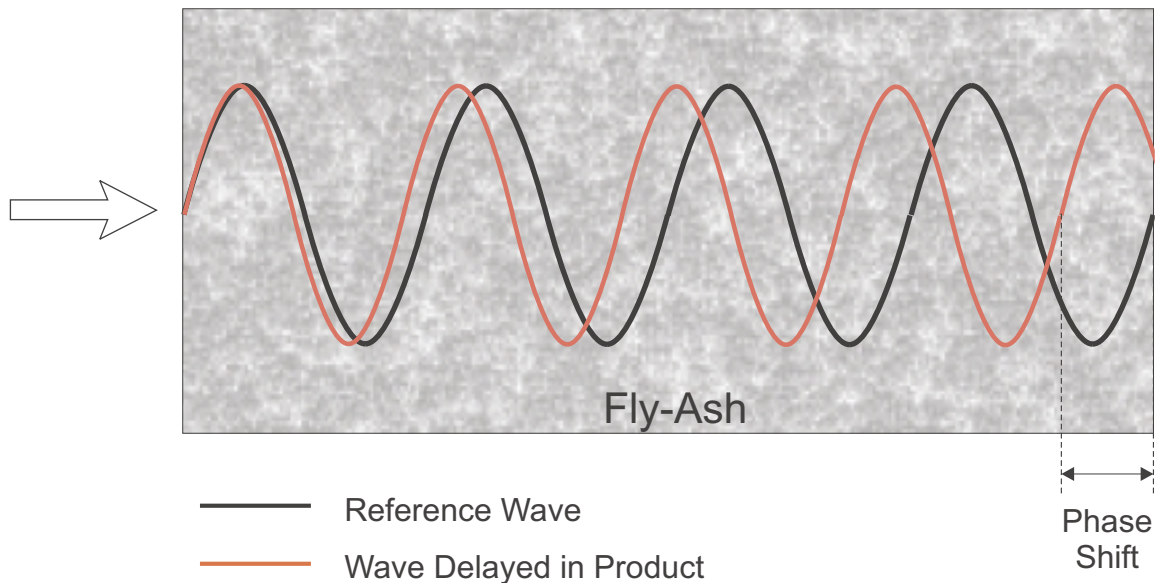
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Measuring Principle:

The unburned carbon particles are conductive and are distributed in the fly ash which is an insulator. If an alternating high frequency electromagnetic field passes through the product, the velocity of the wave is reduced due to the cyclical polarity reversals of the carbon particles occurring in the alternating field. This change in velocity causes a phase shift when compared to a reference signal at the same frequency. Using the Berthold Technologies Model LB 456, the phase shift is measured over several frequencies with corresponding plausibility check.

This results in a highly repeatable measurement and an attainable accuracy of $< \pm 0,5$ % weight fraction of carbon content, respectively ignition loss (1 Sigma)

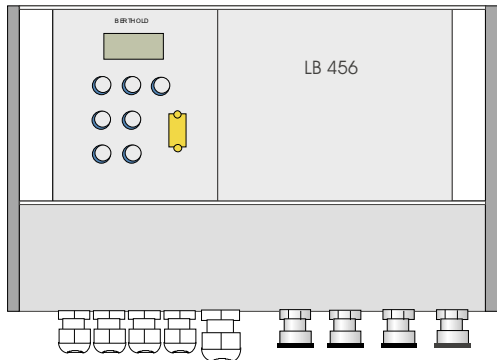
The graph shows the delay of the wave through the product compared to the reference wave. The magnitude of the phase shift is a measure of the carbon content.



All other elements in the fly ash have only negligible influence to the change in velocity of the microwave signal and therefore the phase shift depends practically only on the volume of the unburned carbon.

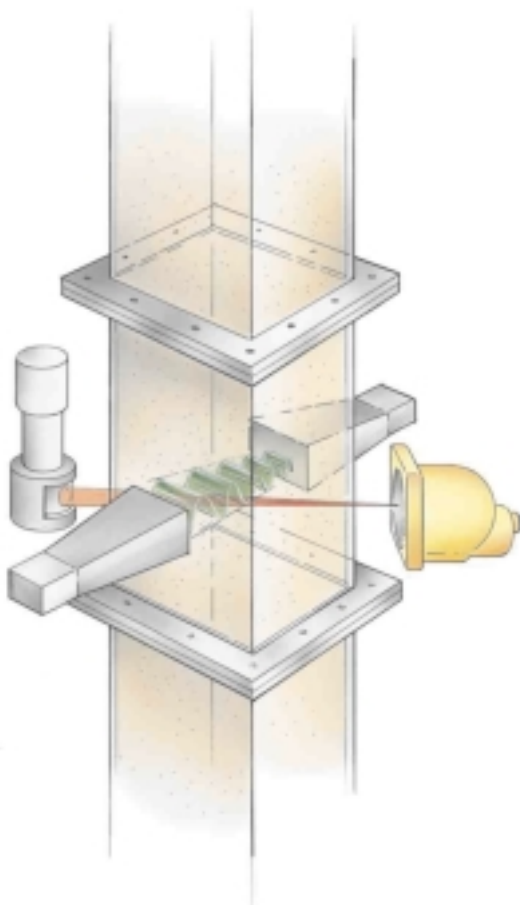
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Measurement System Components:



The evaluation unit including the microwave generator produces frequencies over a large range and directly indicates carbon content. A 0/4-20 mA-signal output is available for the process control.

The complete electronic unit is available in an ABS-plastic housing with IP 65 as standard. A stainless steel housing with IP 66 protection can also be provided on request.



Transmitter and receiving antenna made of stainless steel and window made of high temperature resistant polycarbonat ("Makrolon")

Polypropylene-measuring chute useable for product temperatures up to 100°C.

Alternatively:

PVDF-measuring chute for product temperatures up to 140°C.

Radiometric measuring path for compensation of bulk density fluctuations consisting of:

- Scintillation detector made from stainless steel with lead collimator.
- Radioactive source Cs-137 with low activity in a lead shielding.

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Total Process Solution from one Supplier:

In cooperation with M/s. DBT Automation, Lünen, Berthold Technologies offers a complete system for this application. M/s. DBT takes over the following tasks:

- Control of the product feed.
- Adaptation of the measuring chute on the feed mechanism.
- Mounting and alignment of all measurement components including electro-pneumatic slide valve, in a specially developed frame.
- Control of the whole measurement sequence.
- Installation of automatic sampling (option).



The picture shows the frame construction including all measurement components, the limit indicators and electro-pneumatic slide gate.

