MEASUREMENT HEAD MMR-9

Measurement of Moisture

Water, Cellulose, Polymers and other organic substances show in the infrared radiation region strong absorption bands.
Therefore at certain frequencies the radiated light as it passes through material becommes intense attenuated in the infrared region (700…7000 nm) .
While at other frequencies the light penetration way is characterized by declination and distortion from its straight path , at the afforementioned frequencies the power absorption is a direct measure of the water (watermass in gr/m2) which is contained in the material.
In fact the moisture measurement relies on that physical property of water to absorb at certain infrared frequencies.
These dependencies are depicted in Fig. G.13.1.

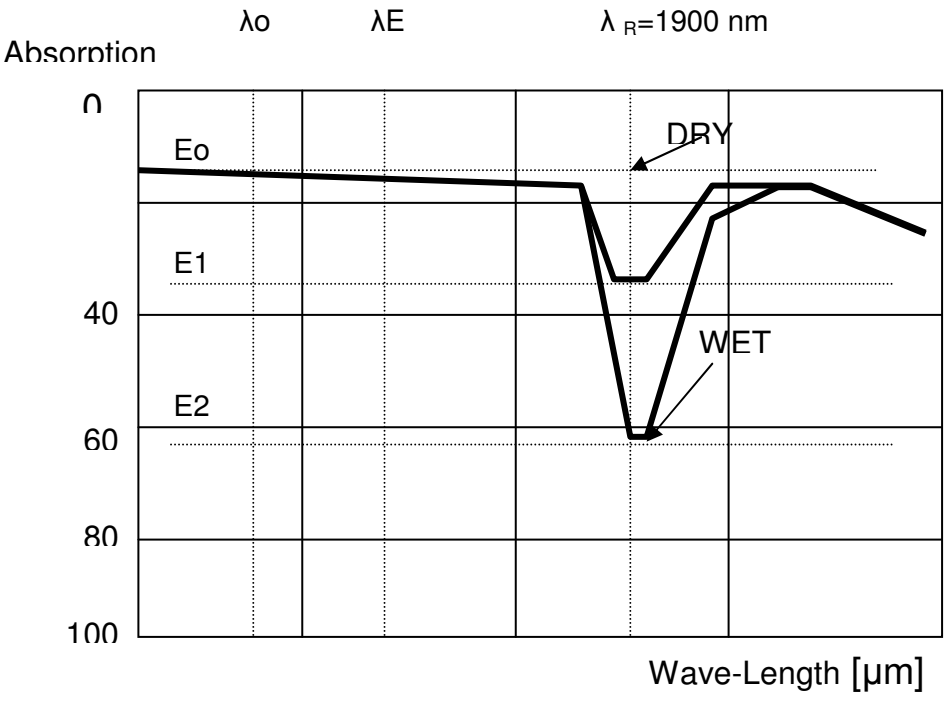


Fig. G.13.1: Absorption Spectrum in Infrared Region

G.13

For the determination of water content (moisture), the attenuation at the wave lengt λo/Eo must be measured (nearby zero attenuation) and compared with the attenuation at wave-length λ_R/E2, where the attenuation is caused by the moisture content in material (gr/m2).

The ratio of these two measurements is the parameter which corresponds to the existing moisture.

The measurement through the aforementioned method -whereby two wave lengths are used- is realized in practice by means of two proper filters which are integrated into the gauge. These method also known as two filter method lacks in many cases in accuracy and preassumes a relatively constant composition of material.

In order to enhance measurement accuracy META relies on the three channel method, which consists in the use of one filter more at a wave length λE.
The three channel method enables the use of a fixed basis of measurement (two points line) making the measurement unaffected by disturbances in material caused by color- , gloss-changes or the presence of other disturbing agents (loads) in material.

MMR-9 : Head Configuration

On a rotating disc are integrated the necessary nerrow band filter.
The filter are selected in dependence of the certain application .
These filter are high sensitive devices allowing only the pass of that part of light radiation which becommes absorbed wenn interferes with water.

A source of light emmits "white" light containing all frequencies.
The radiation penetrates the material and follows the physical rules of defraction attenuation and reflection.
One part of emmited light after its reflection on surface and in material will be backscattered, passes the corresponding filter, and will be collected by means of concav lens at a photosensitiv device.
The filters allow only the pass-through of the infrared region which corresponds to the bands of interest. Water absorbs at the wave length about 1900 nm.
The rest of radiation can not pass through the narrow band filter and never reach the photosensitiv device and in that manner gets disclosed from measurement.
The collected light energy on the photosensitiv device results in an electrical current which after amplification is tranfered as measuring signal to the processor unit for further processing.
The data processing per se , i.e. the algorithmic evaluation for indication and control takes place in the electronic processor.

The scheme of the measuring head operating in reflection method is depicted in Fig. G.13.2.

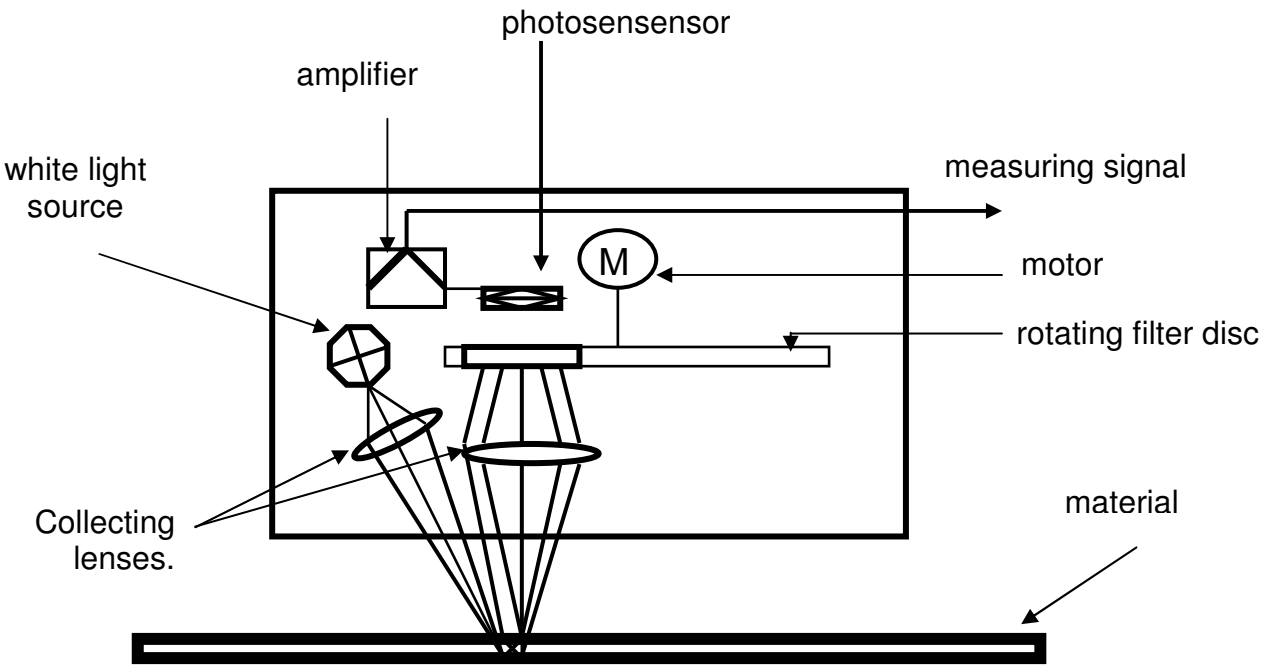
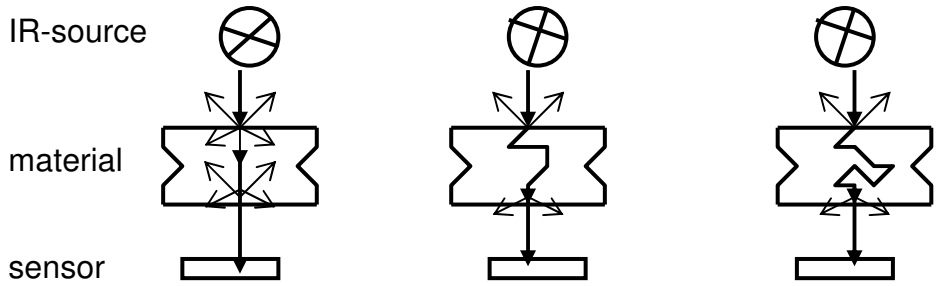


Fig. G.13.2: Gauge Optical Elements

Negativ impact on measurement caused by inhomogenities in composition and quality of material

In a clear medium the real path of light is directly corresponding to the thickness of the medium (e.g. glas).
In paper or similar opac material -mainly due to different origins of fibres, variation in fibre length but also the presence of inhomogenities in the composition- cause difraction phenomena disturbing the straight path of light.
Thus the path of light is extended and therefore appears further attenuated resulting in that way in an apparent moisture content which is slightly greater than the real existing water.

This phenomenon is called P.E.R.-Effect (Path Extension Ratio) and is roughly illustrated in Fig.G13.3.



α) homogen material

β) less homogen material

γ) inhomogen material

Fig. G13.3: Disturbances of the light path in different media

The moisture is calculated by the most gauge producers according to the following relationship. :

$$\%H2O = (M_{H2O} / M_{O}) * 100\ \%$$

M_{H2O} = the mass (quantity) of water

M_{O} = the total mass (basis weight) of the measured material

In the META's 3 channel method the losses due to PER Effect are taken into consideration and the following relationship is applied :

$$\%H2O = [(M_{H2O} * C_{PER}) / M_{O}] * 100\ \%$$

C_{PER} = the compensating factor for the losses due to PER.

This relationship yields accurate results.