36. Hofer Vliesstage

New possibilities für measuring nonwovens through advanced x-ray technology

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Concepts of the x-ray reflection sensor

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1) measurement of x-ray absorption in reflection

- Basis weight measurement of thick and thin, lightweight materials, e.g., unbonded nonwoven, foam, membrane materials, organic coatings on metal foils in reflection
- Basis weight range: ~ 10 to 2000 g/m^2
- Thickness up to ~ 50 mm (maximum measuring gap is 60 mm)

2) Combined measurement of x-ray absorption in reflection and x-ray backscattering

- Reduced material dependences
- Total basis weight and content measurement of composite materials, e.g., paper, paper board, glass fibre nonwoven, with a single sensor
- Basis weight range: ~ 10 to 15000 g/m^2
- Thickness up to ~ 25 mm (maximum measuring gap is 30 mm)

Concept 1): x-ray reflection sensor developed for measuring unbonded nonwoven

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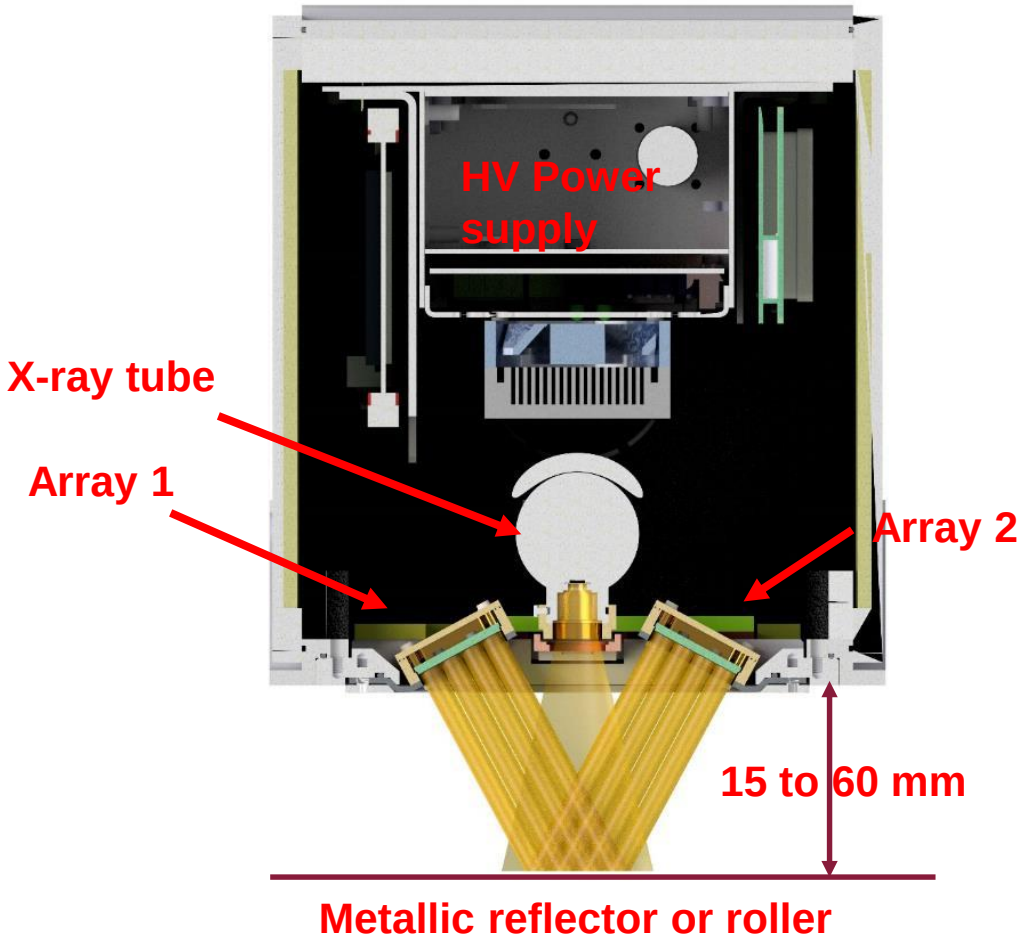
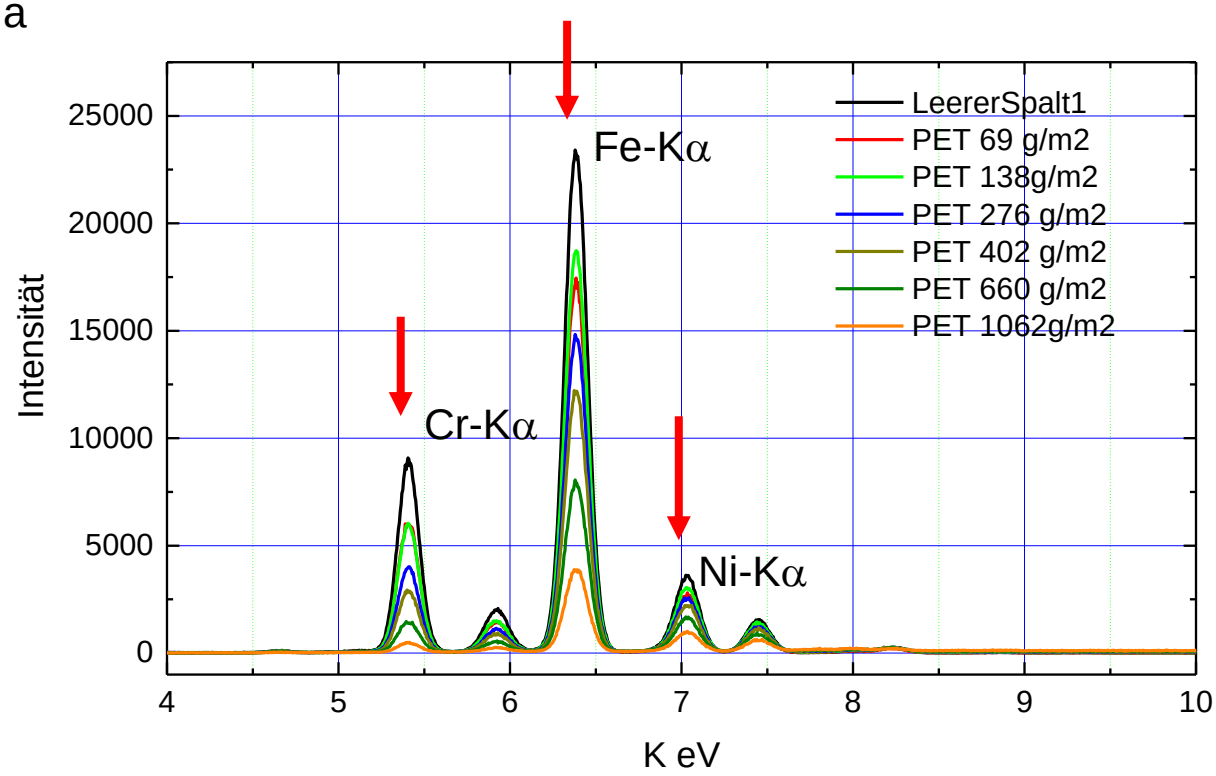
- X-ray tube with 20 KeV excites x-ray florescence in a stainless-steel reflector
- 2 detector arrays are measuring the x-ray fluorescence from the reflector
- The unbonded nonwoven runs between the reflector and the sensor housing and attenuates the x-ray fluorescence i.e., x-ray absorption is measured
- Possible measuring distance is 15, 30 and 60 mm



Test of the concept 1) with PET film samples

- X-ray tube voltage: 20 keV
- Energy resolved measurement is done with a x-ray spectrometer
- XRF-lines of the stainless-steel reflector can be seen
- PET samples up to ~ 1000 g/m^2 are placed in the measuring gap.
- The PET attenuates the lines strongly

X- ray fluorescence of a stainless steel reflector attenuated by PET



Test of the concept 1): comparison with x-ray transmission

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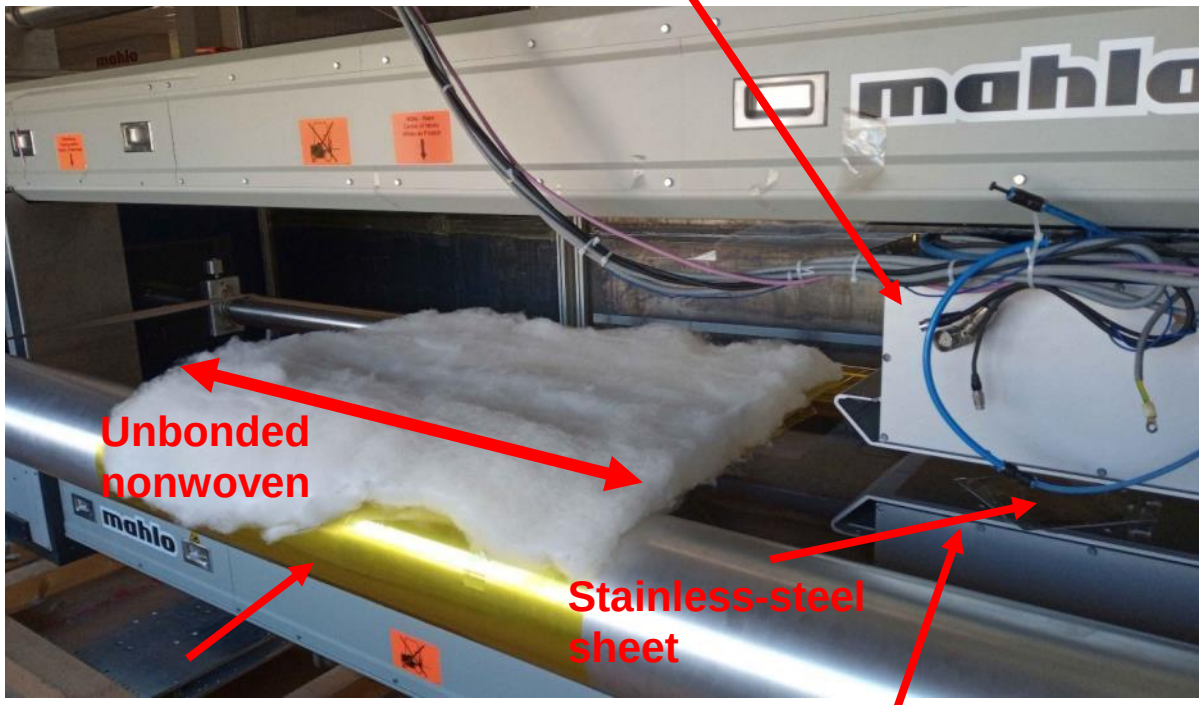
Test procedure

- Reference measurement with a standard x-ray transmission sensor
- Stainless-steel plate is put in
- The unbonded nonwoven is measured in reflection at the same line



Test of the concept 1): comparison of the cross profiles

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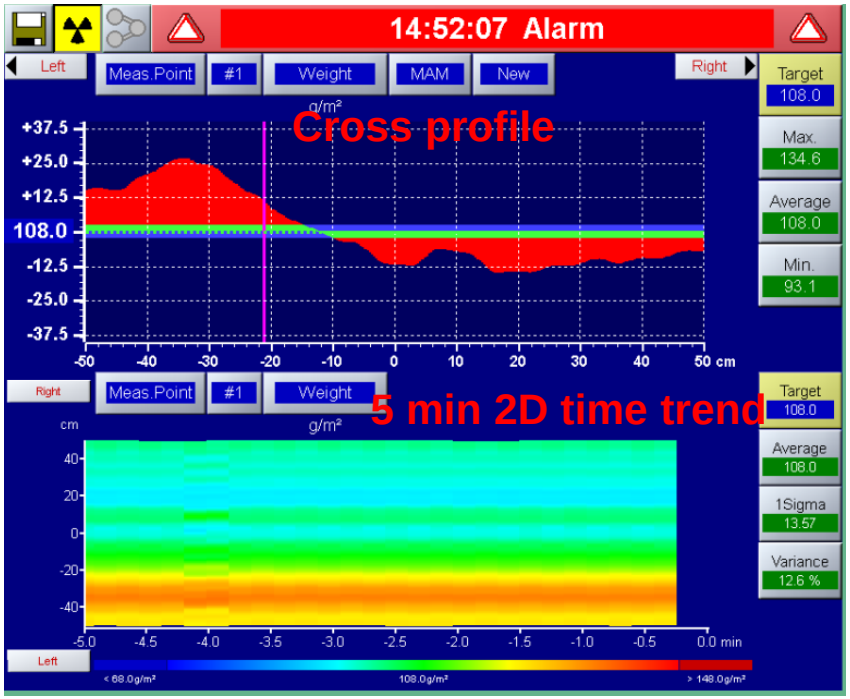
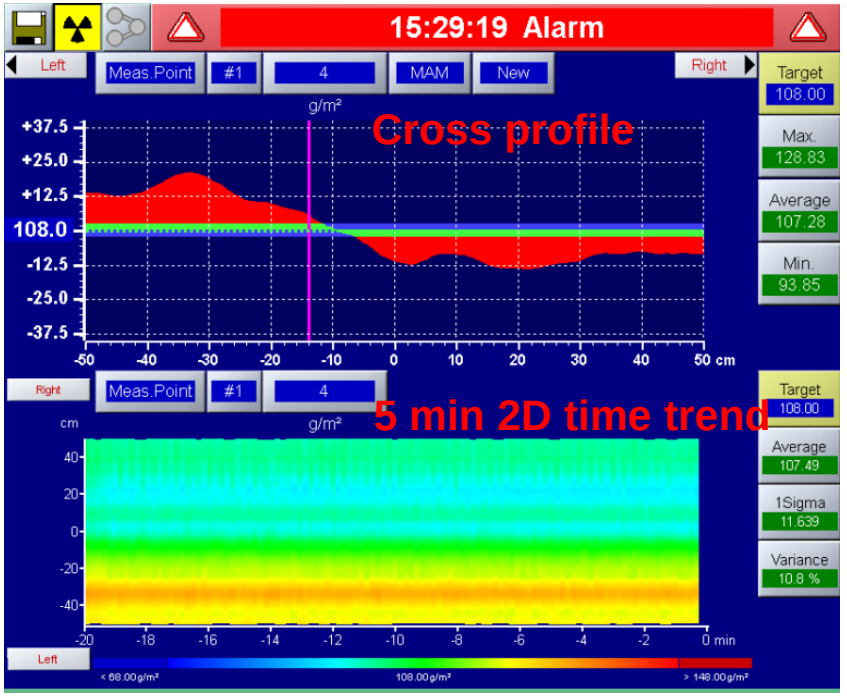
FMX-T: X-ray transmission sensor



MMX: X-ray reflection sensor

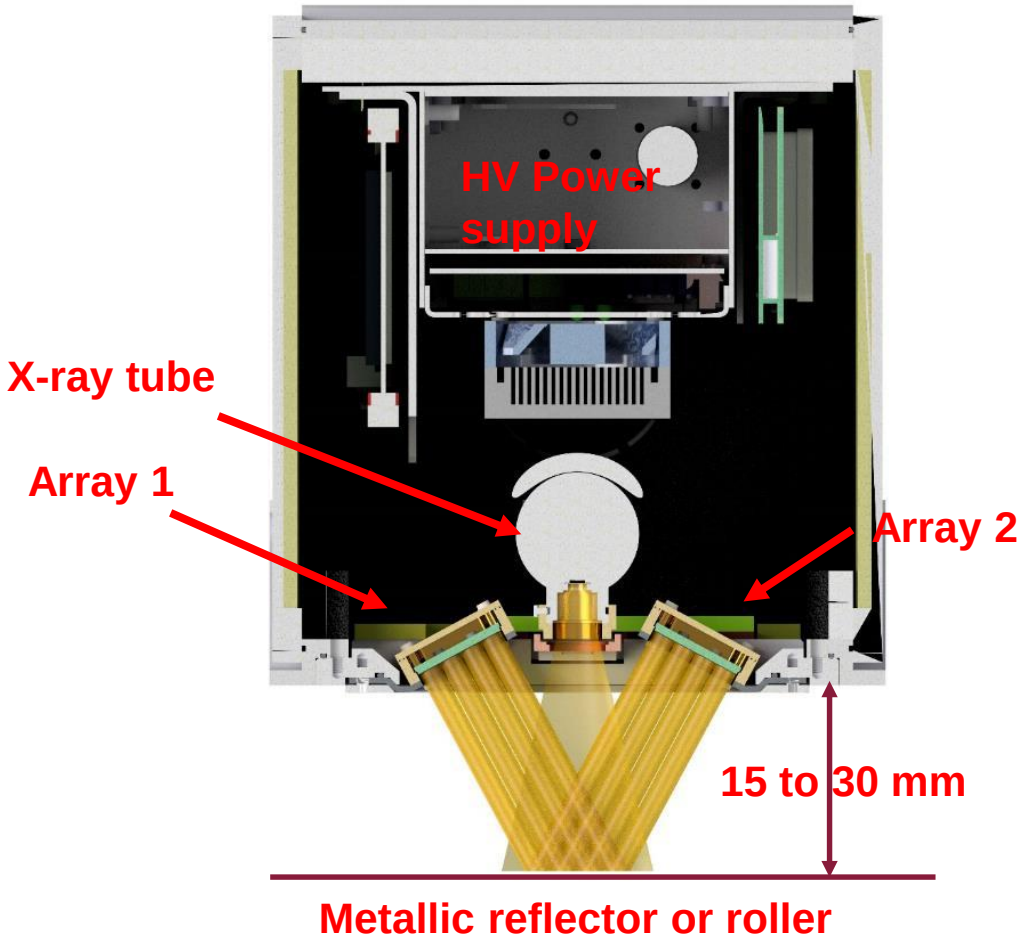


1. Reference measurement with a standard x-ray transmission sensor
2. The nonwoven is measured with the reflection test sensor at the same line

⇒ The cross profiles are comparable, i.e. the concept is working

Concept 2): combined x-ray backscattering/ x-ray absorption

- Combined measurement reduces material dependence strongly and makes it possible to measure components
- Higher X-ray tube voltage of ~50 KeV needed for x-ray backscattering
- Array 1 measures the backscattering (XRF from the reflector is filtered out)
- Array 2 measures the XRF from the reflector (as before)
- Possible measuring distance is 15 and 30 mm



Test for measurement of total basis weight and LOI of glass fibre nonwoven

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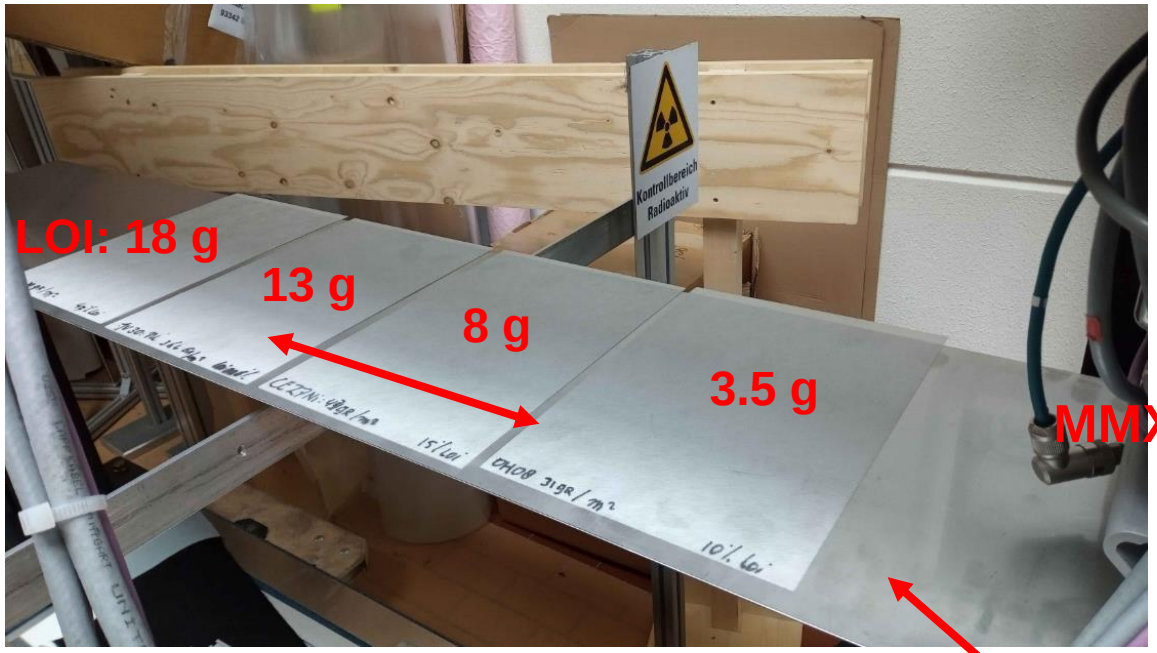
Test is done on glass fibre nonwoven samples with decreasing LOI from left to right and total basis weight around 40 g/m^2

The Al-PET calibrations are used:

- Glass has similar absorption as Al
- Binder has similar absorption as PET



Cross profiles of the glass fibre nonwoven

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Measurement:

Total basis weight, fibre content and binder (= LOI, loss of ignition)

The stepwise decrease of the LOI can be seen