HK1 Mc

Moisture Measurement of Cheese

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- Microwave measurement basics
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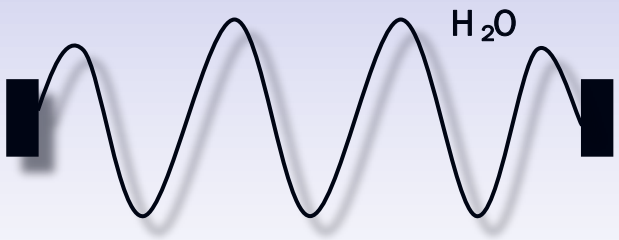
Harrer & Kassen GmbH

- Founded in 1996
- More than 25 years experience with microwave instruments
- Development, Production and sales of on-line microwave and NIR process control instruments
- Development, Production and sales of NIR laboratory instruments

Moisture measurement with microwaves

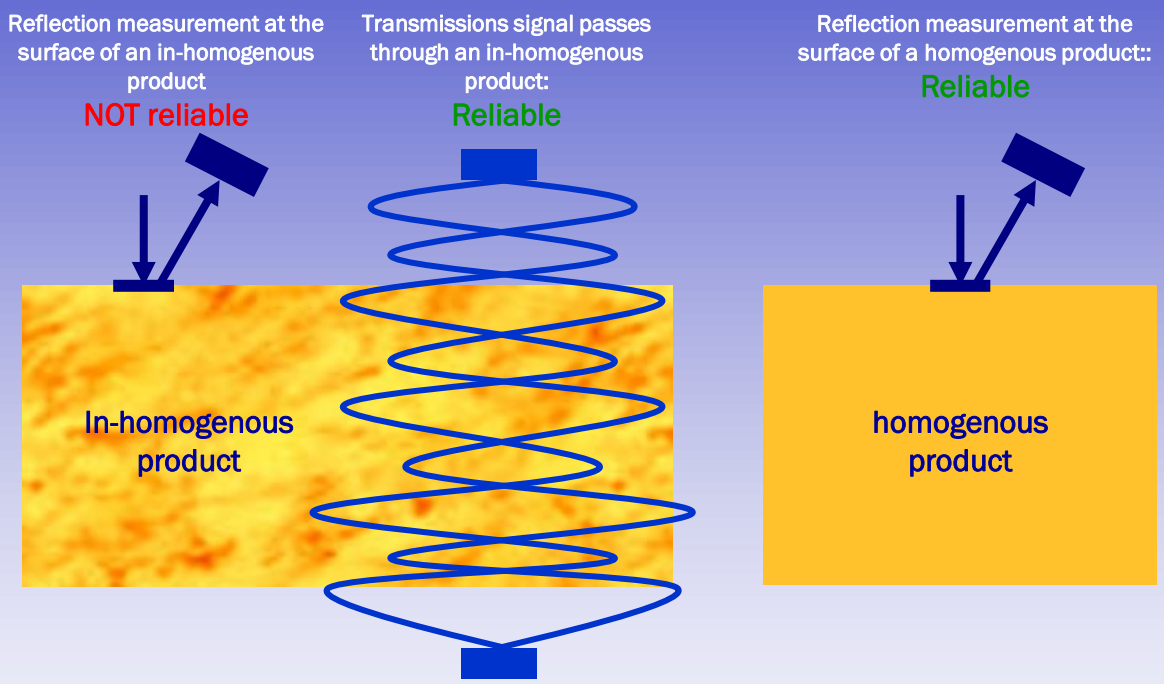
For the measurement an electromagnetic wave with very low energy is generated. This signal is coupled via an antenna into the product. Depending on the dielectric properties of the product the signal propagates in the product. After the signal has passed the product a second antenna receives the signal. Amplitude and phase shift of the received signal, related to the original signal are an expression for the water content of the product.

The microwave measurement is very stable and it has a quick response to product changes.



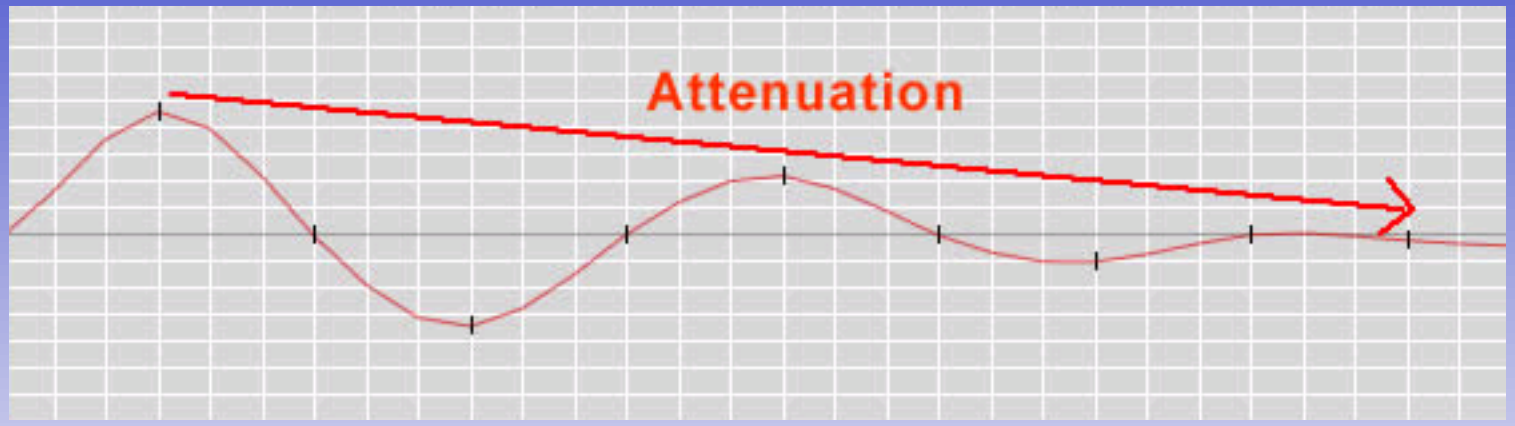
Conditions for a successful measurement:
The product contains NO SALT and there is NO METAL between the antennas!

Measurement principles for moisture measurement: Reflection / Transmission



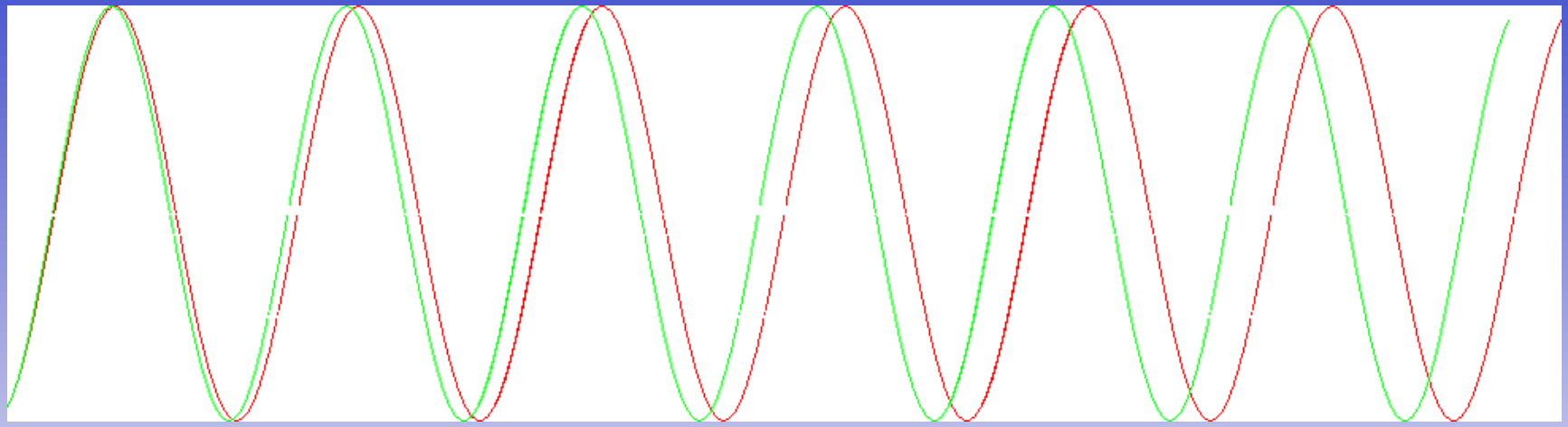
For a reliable mosture measurement of cheese blocks only the transmission measurement is suitable. Within a cheese block the moisture difference could be up to 1,5%.

Attenuation (Loss of signal power)



- - While the signal is propagating through the product the am signal amplitude decreases. It is attenuated.
- The attenuation is influenced by many different product properties.

Phase shift

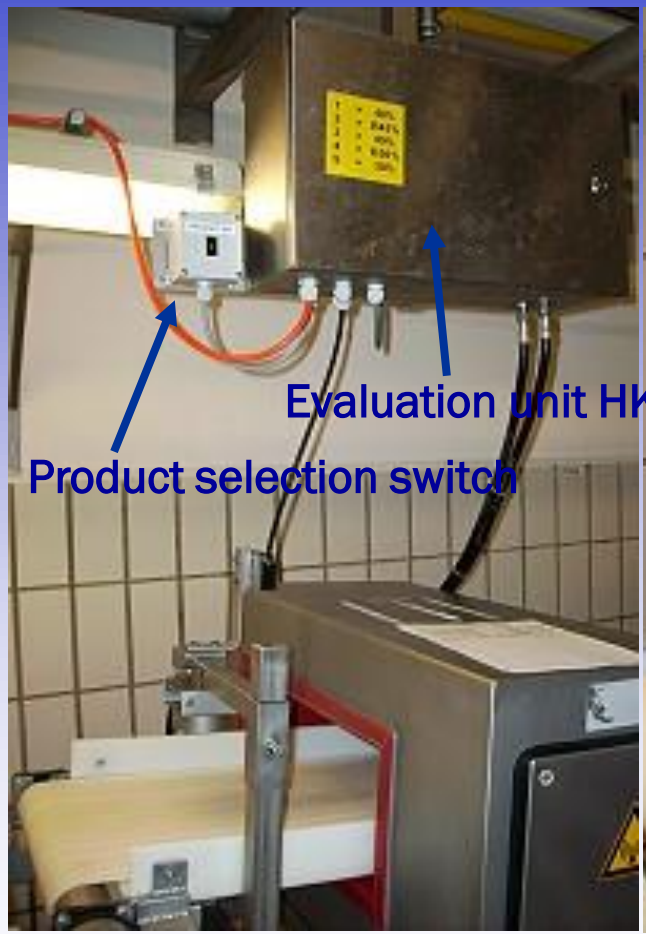


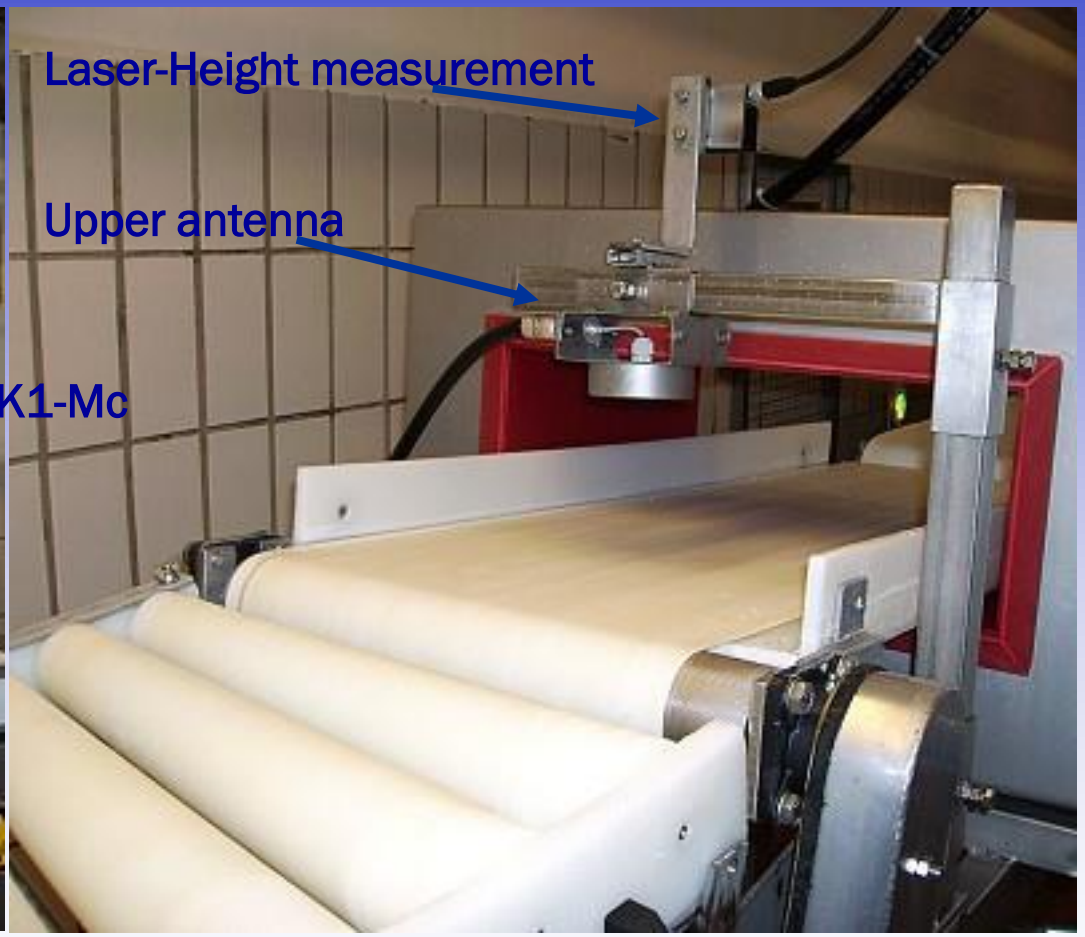
- After the signal has passed the product the phase shift related to the original signal has changed (green wave).

- The phase shift is measured in degrees and has a range from 0 to 360°

Measurement setup

HK1 Mc Installation example 1





Application: Semi hard cheese production

HK1 Mc installation example 2/3

Applikationen halbfester Schnitt-, Schnittkäseproduktion

0/4-20mA output signals

The measurement results are available as 0/4-20mA signals:

Output #1: Moisture of the actual measured cheese block.

Output #2: Averaged moisture over n cheese blocks.

Output #3: Height of the actual measured cheese block.

All measured values are also available at a serial interface (RS232 or RS485).

The HK1 Mc has two serial interfaces:

Com1: Measurement data string for PC or PLC.

Com2: For the HK Remote Key Pad or for a PC based remote control software.

The two interfaces could configured independent from each other.

Calibration

A „good“ calibration is based on „good“ laboratory values. I.e. accurate sampling and analysis of the calibration samples.

It is good to have many calibration points, but it is more important to have the calibration samples well distributed over the entire measuring

Sampling for calibration

Production

Raw data measurement HK1 Mc

Average of
10-15 measurements per block

Laboratory

Min 3 samples per block
(e.g. SEESAND Method)

Average of the particular samples.

Regression

Calibration coefficients

Calibration sheet

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% TS Cheese Calibration HK1 Mc

General Information	
Company:	Demo Company
User:	Demo User
Date:	02.12.2008
Calibration No:	1
Cheese type:	Edamer
Comment:	Block Cheese

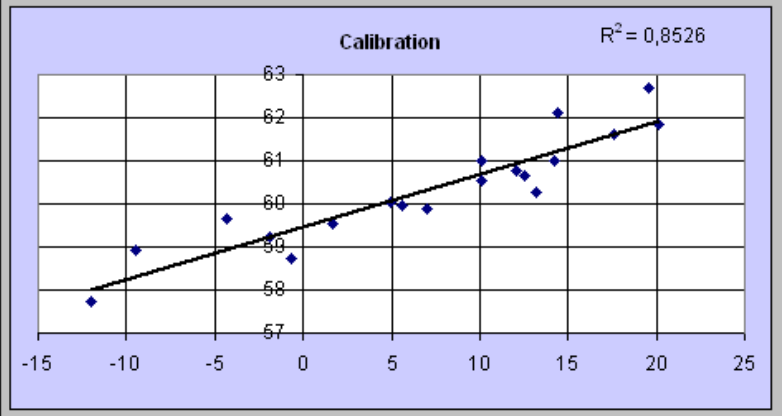
Product / System Parameter		
Beltspeed V:	0,20	m/sec
Distance D:	7,5	cm
Delay Cycles:	4	
Size of cheese:	45,0	cm
Average height of cheese:	120,00	mm
Average Lab value of cheese:	53	% TS

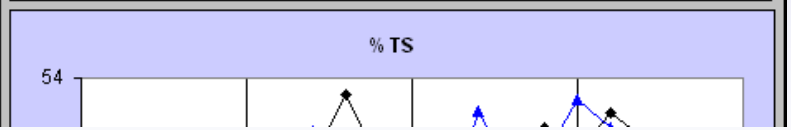
Start Calibration Parameter		
Reference measurment done:	26.11.2008	date
Reference Attenuation:	17,3	Db
Reference Phi:	208,2	PHI
Initial A0:	60,22	
Initial A1:	0,1000	
Initial Measurements per cheese:	13	

Input Calibration Data

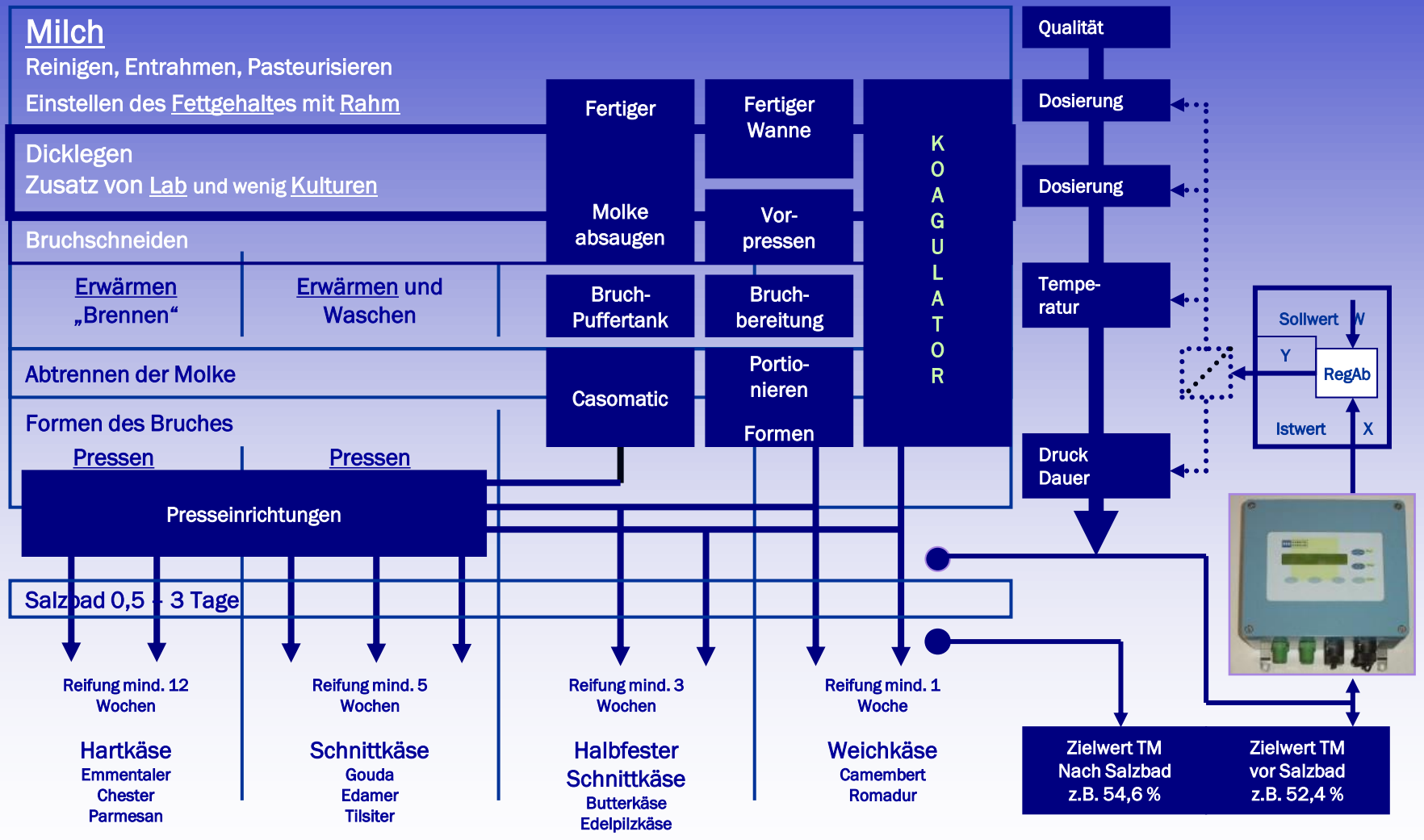
	Data From Production		Data from HK1 Mc				New Values	
Nr.	Date / Time	Lab	Height (H)	%TS (W)	A0	A1	New %TS	Deviation
1	02.12.2008 09:45	52,53	120,00	52,34	60	0,084	52,4	0,13
2	02.12.2008 10:05	52,30	119,00	52,05	60	0,084	52,18	0,12
3	02.12.2008 10:15	51,93	119,00	51,76	60	0,084	51,75	0,18
4	02.12.2008 10:20	53,16	120,00	52,84	60	0,084	53,13	0,03
5	02.12.2008 10:28	52,26	122,00	53,01	60	0,084	53	-0,74
6	02.12.2008 10:45	52,48	122,00	52,62	60	0,084	52,43	0,05
7	02.12.2008 11:08	53,18	122,00	53,31	60	0,084	53,44	-0,26
8	02.12.2008 11:10	53,83	119,00	52,81	60	0,084	53,28	0,55
9	02.12.2008 11:14	53,10	123,00	53,20	60	0,084	53,09	0,01
10	02.12.2008 11:54	51,81	122,00	52,66	60	0,084	52,49	-0,68
11	02.12.2008 12:21	52,86	119,00	52,27	60	0,084	52,5	0,36
12	02.12.2008 12:53	53,06	119,00	53,07	60	0,084	53,66	-0,60
13	02.12.2008 13:11	52,99	118,00	52,47	60	0,084	52,99	0,00
14	02.12.2008 13:19	53,48	122,00	53,14	60	0,084	53,19	0,29
15	02.12.2008 13:25	53,25	118,00	53,01	60	0,084	53,77	-0,52
16	02.12.2008 14:11	53,64	121,00	53,21	60	0,084	53,48	0,16

NEW Calibration Parameters	
A0= 59,46	A1= 0,1223
Standard Deviation= 0,39	





„Control“ of rennet cheese production



Customer benefit

Reliable moisture display for the whole production, while measuring every single cheese block.

Reliable cheese height display for the whole production, while measuring every single cheese block.

Measurement of moisture and cheese height in real time.

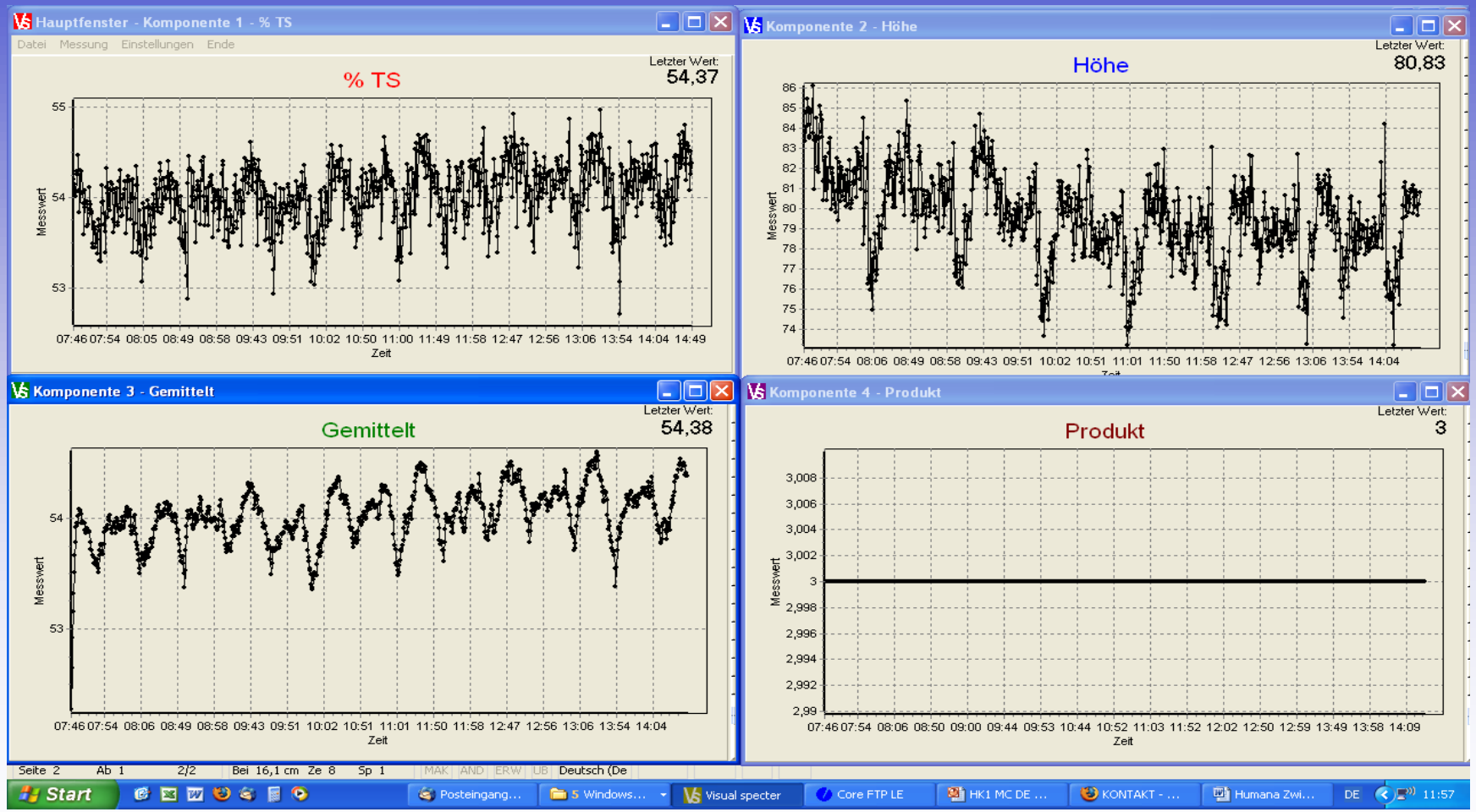
Based on the measurement results, the cheese production could be optimised.

Creation of auditable batch, production or customer oriented statistics.

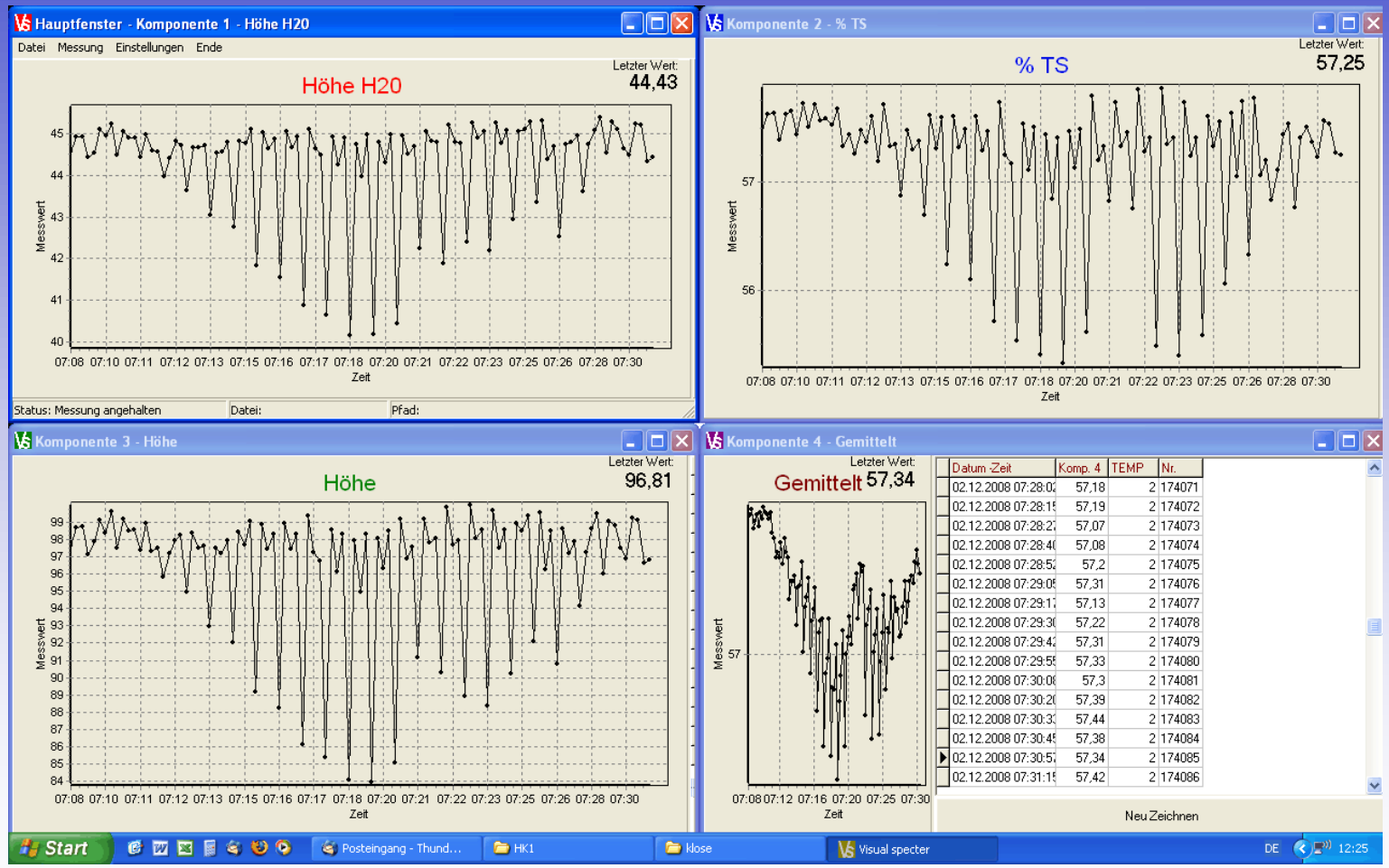
Reduction or elimination of periodic laboratory analysis for product quality control.

Raw material savings by optimising the production process.

Trend graph of a normal production batch



Trend graph showing problems at the press



Maintenance

No regular maintenance necessary

After cleaning the line, the laser should be cleaned with a soft towel.

Thank you

For your attention!

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