

Fresh Concrete Properties Described By Oscillation Measurements

Tests with the new rheometer *Viskomat XL*

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Our Products



- CDF- and Slab-Tester
- Shrinkage testing equipment
- Viskometers
- Maturity Measurement
- Special Applications

Schleibinger in Buchbach, Germany

Buchbach / Obb.

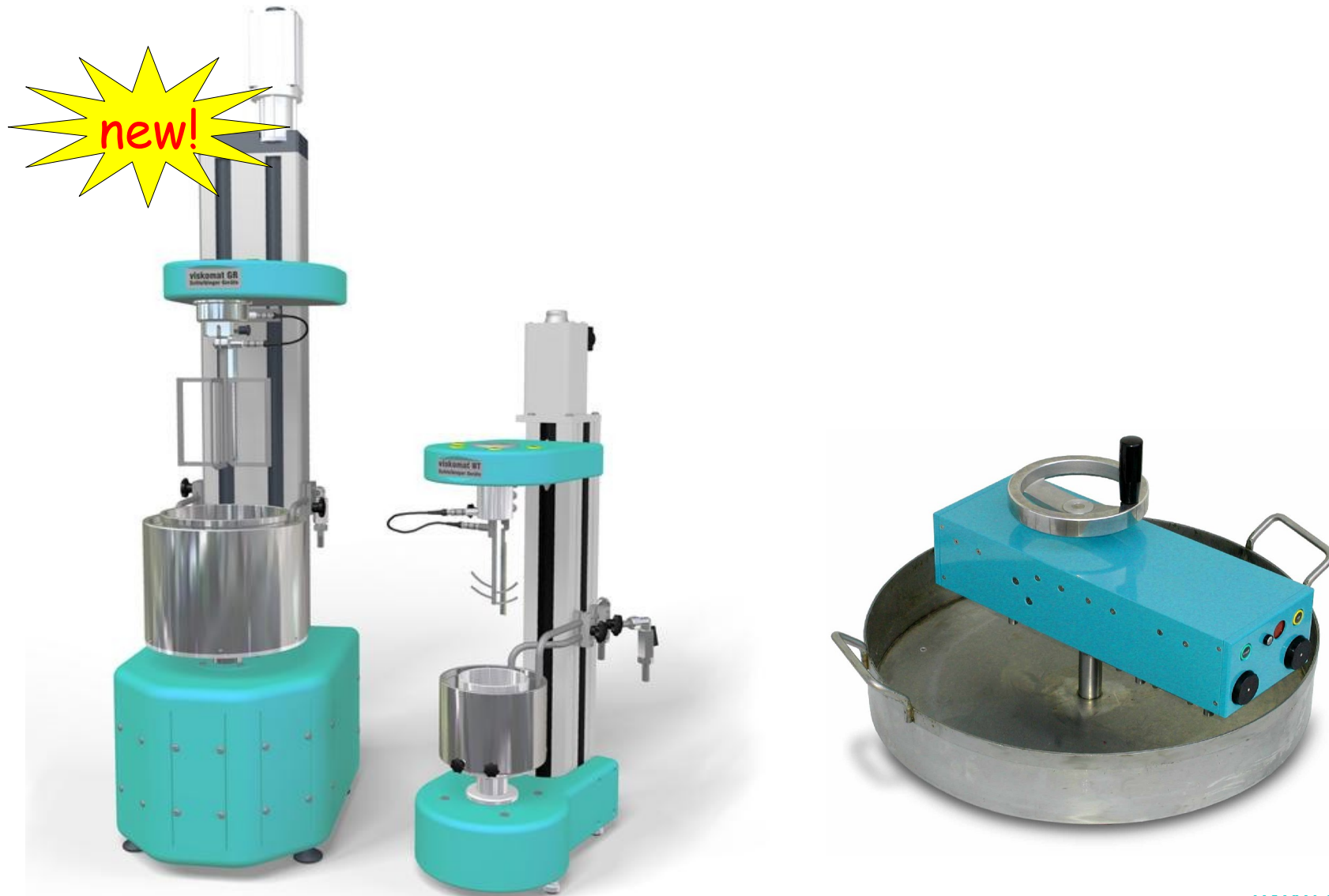


30 km east of the Munich
airport

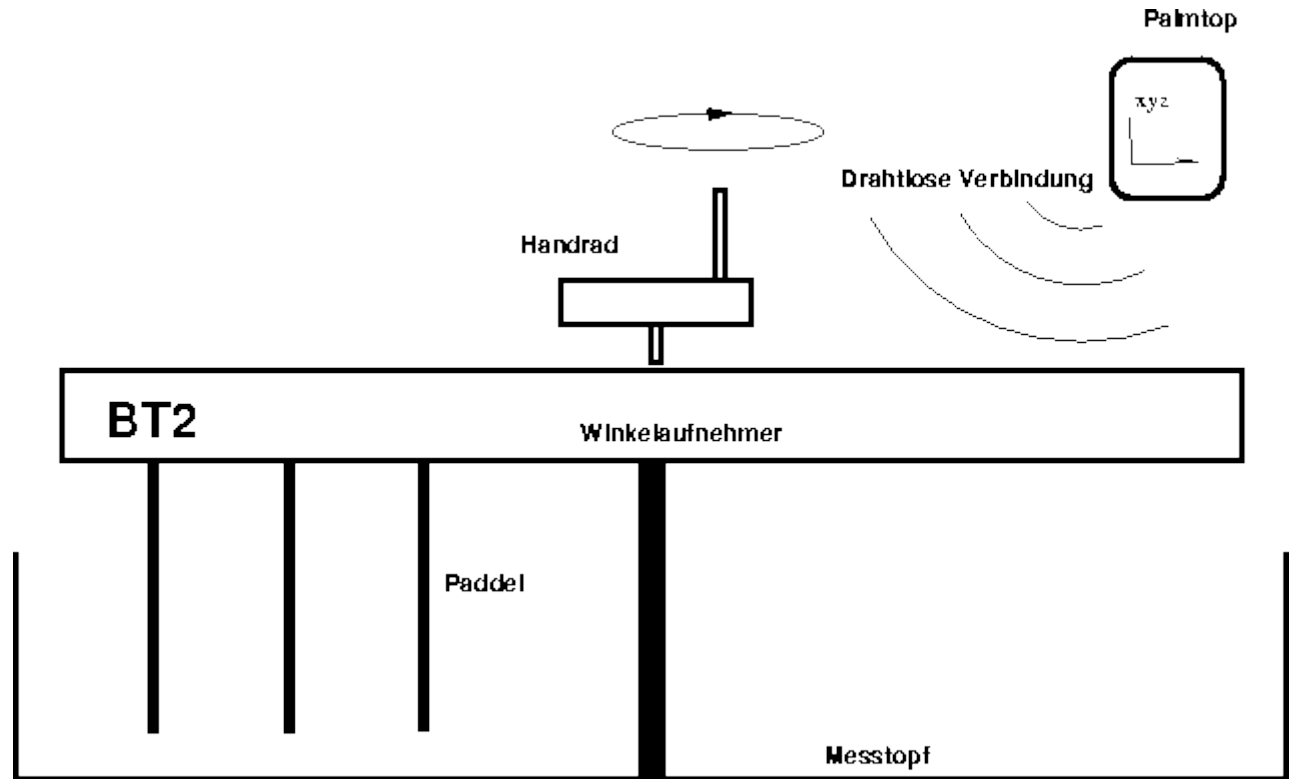
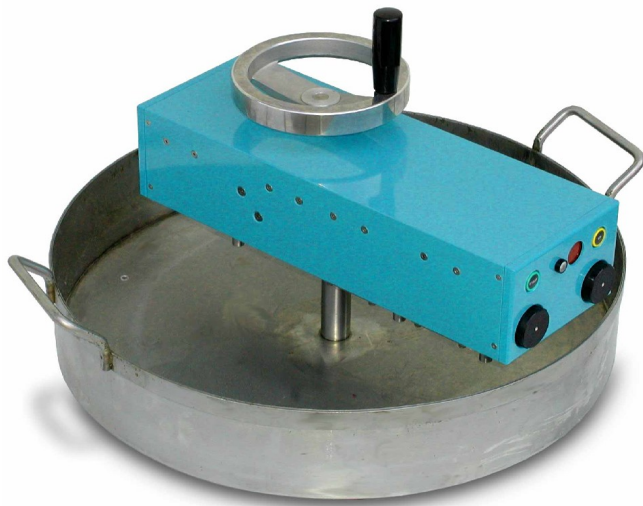
Some of our customers..



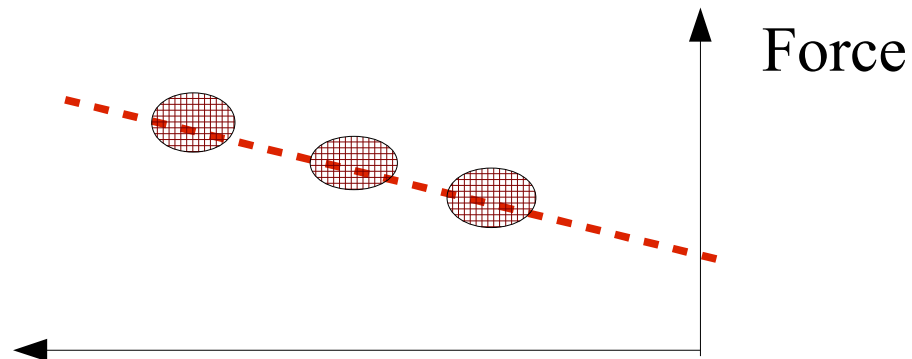
Viskomat XL – Viskomat NT - BT2



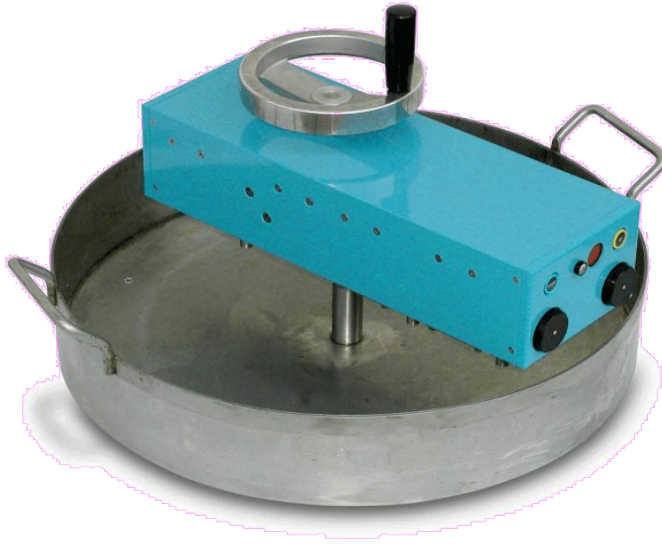
Concrete Rheometer BT2



Speed



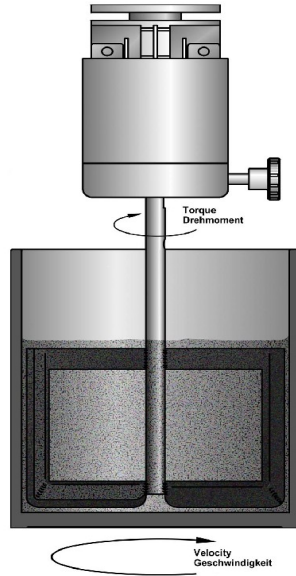
BT2



Concrete Tester

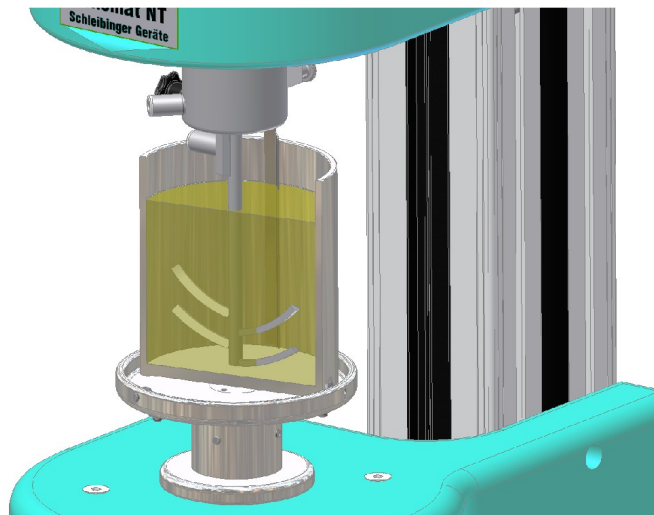
- **Relative Measurement**
- **No Segregation**
- **Very fast test!**

Viskomat a Couette Type Rheometer



A vessel is rotating and the force on the probe is measured

Mostly mixer type probes are used



- **Relative Results**
- **Relative Flowcurves**
- **Long Test Time Possible**

Different Probes

Absolute Values:

Coaxial Cylinder



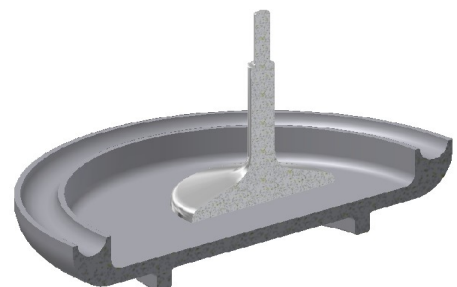
Plate Cone

Double Gap (Basket Probe)
acc. To Prof. Vogel

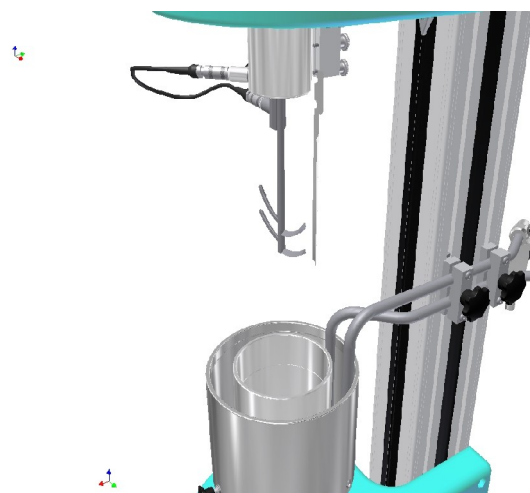


Relative Values:

Plate-Plate



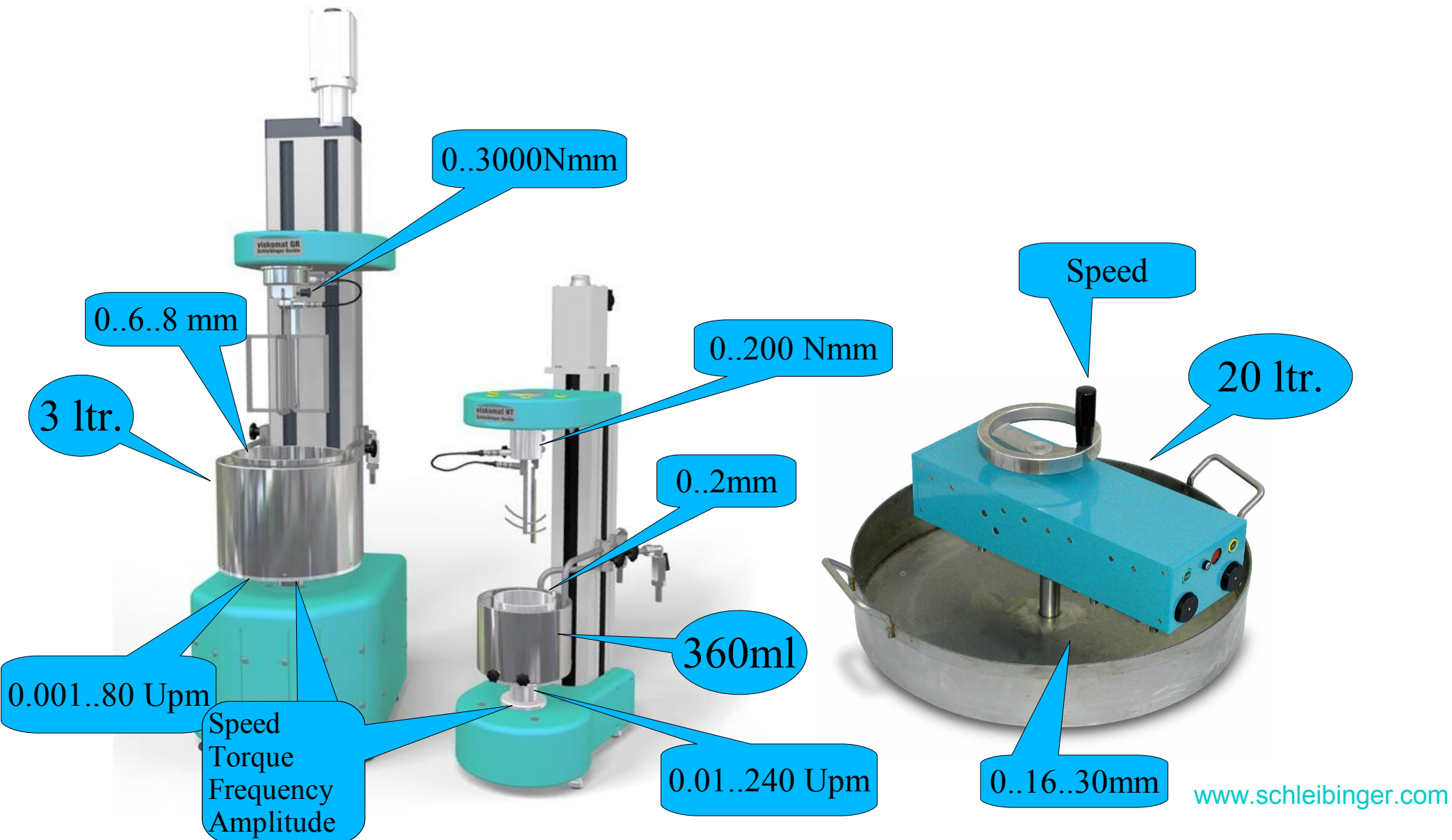
Mixer Formed Probes



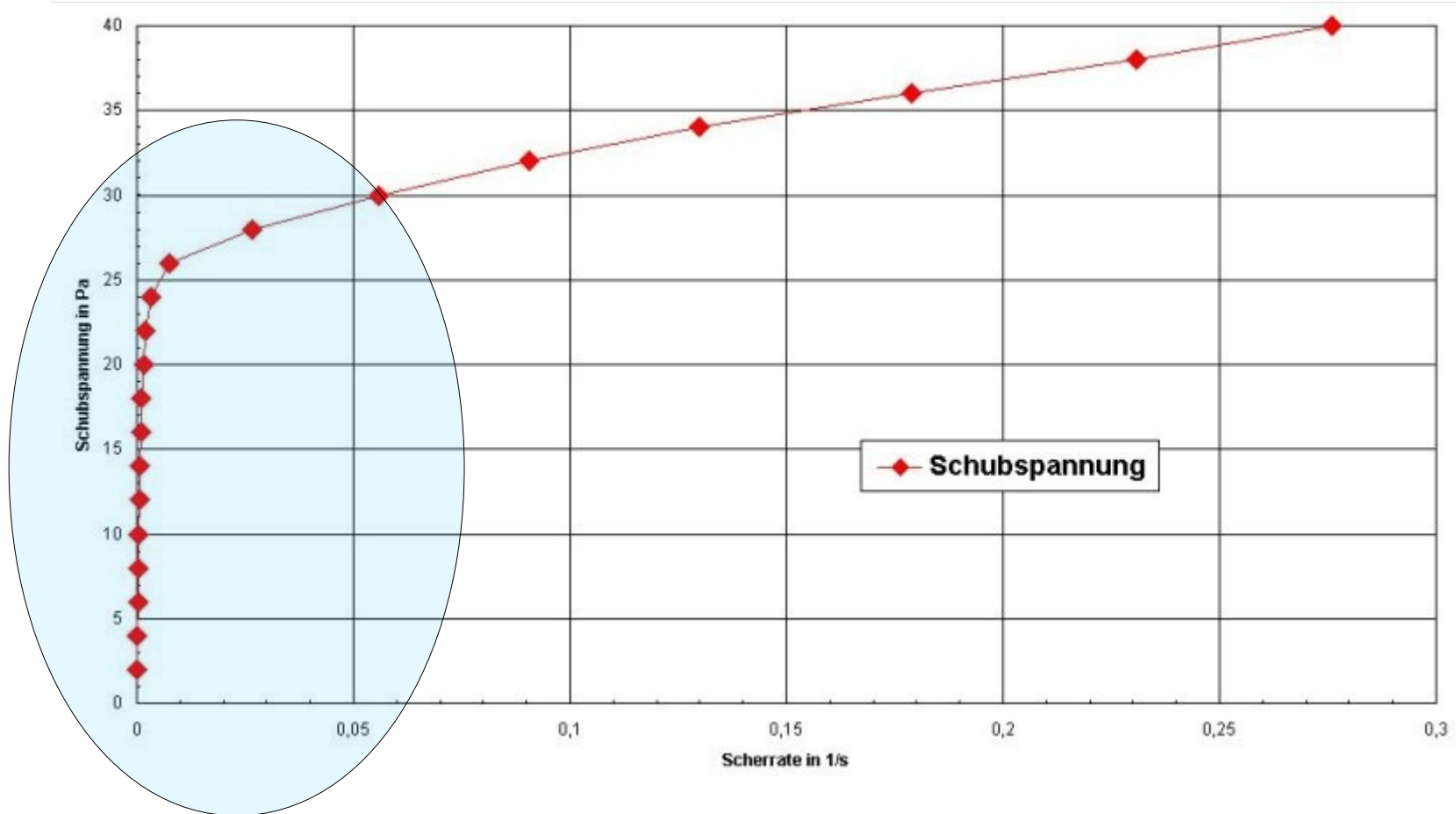
Ball Probe



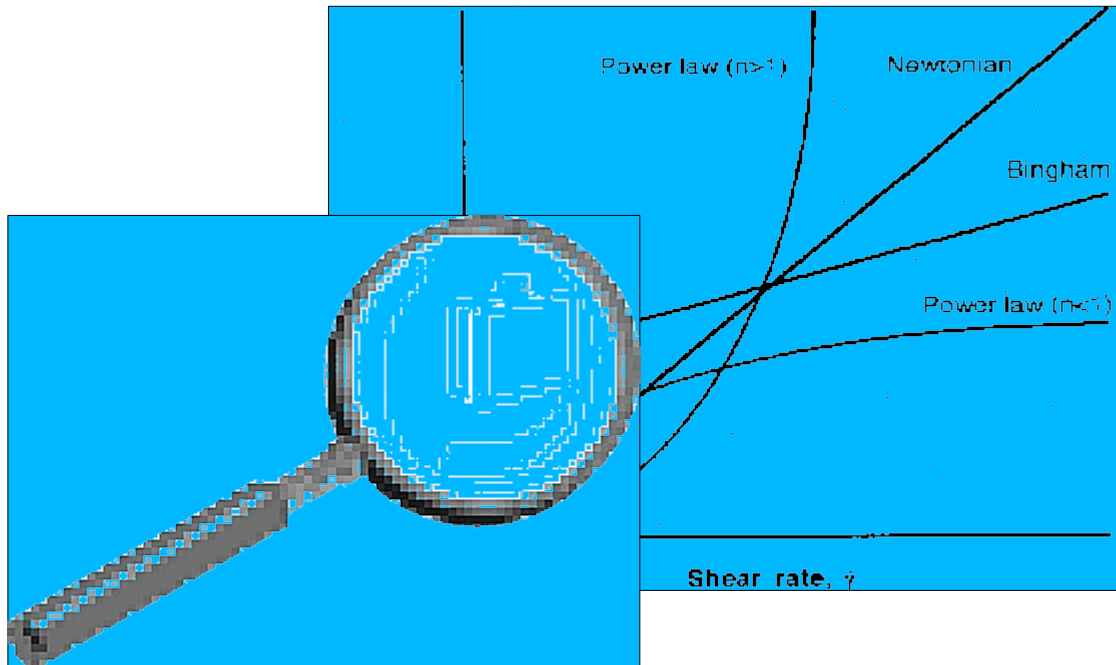
Viskomat XL – Viskomat NT - BT2



The white spot on the concrete rheology map!



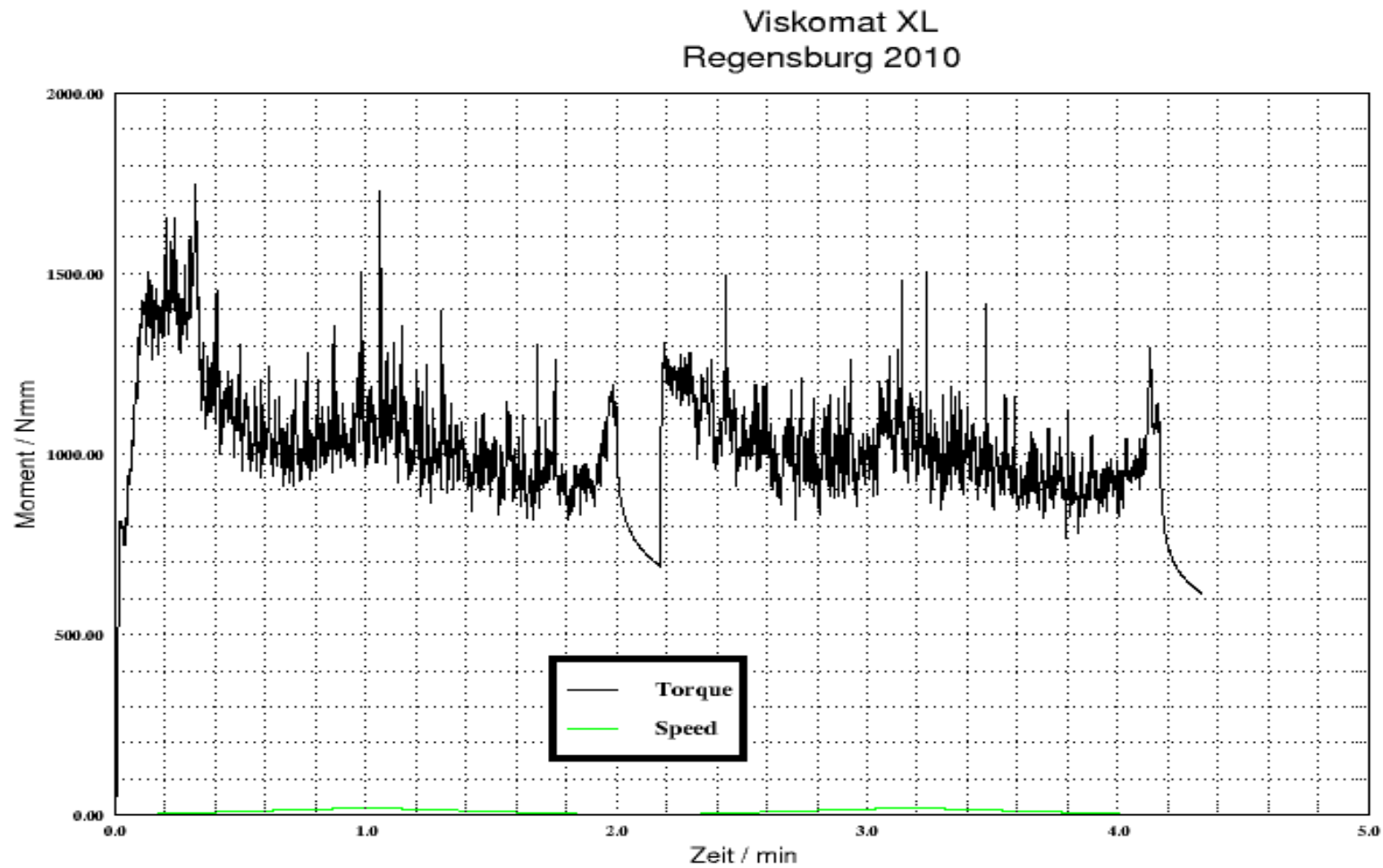
What happens at yield point ?



The yield value of screed ?

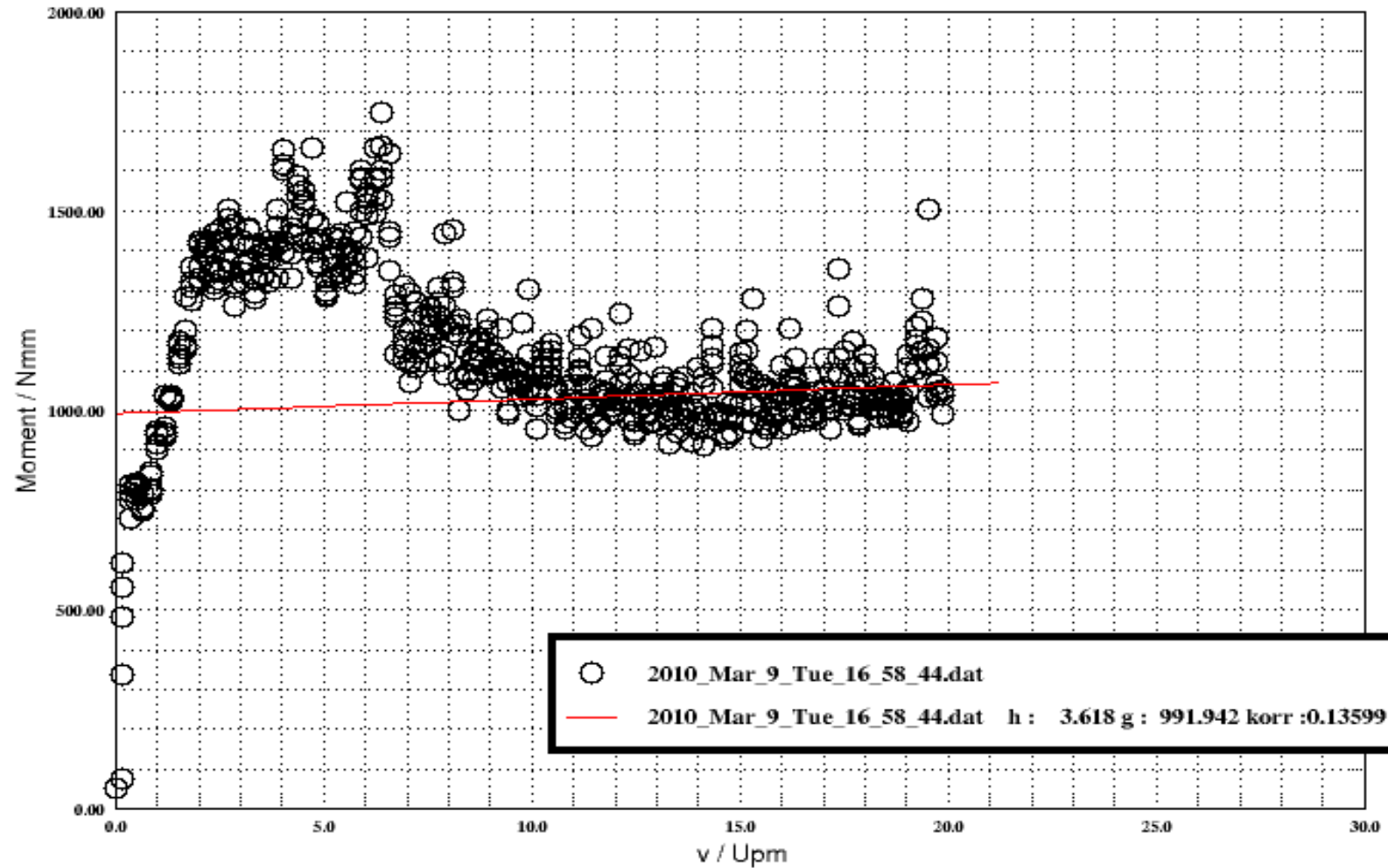


Torque vs. Time

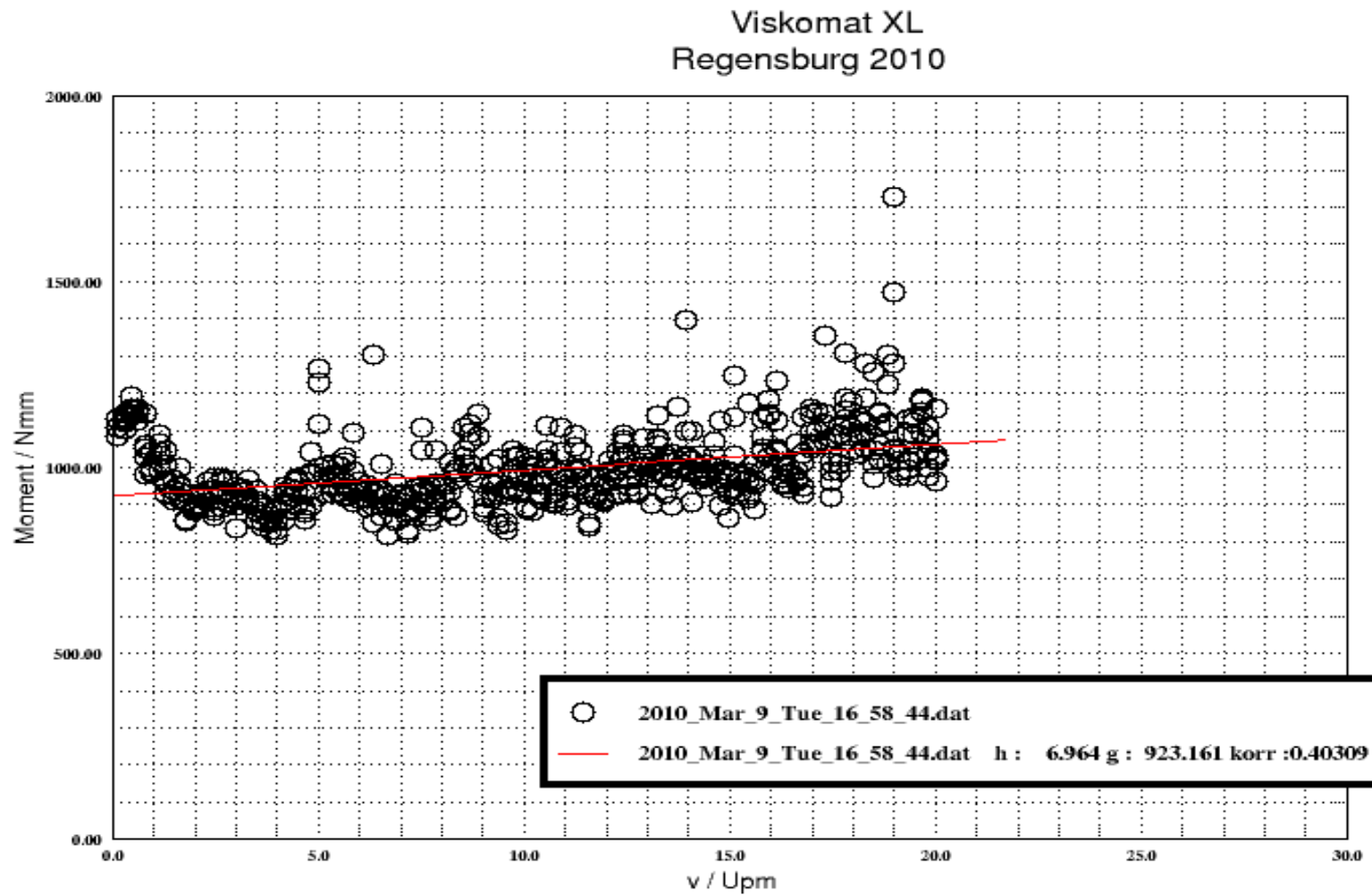


Flowcurve Screed

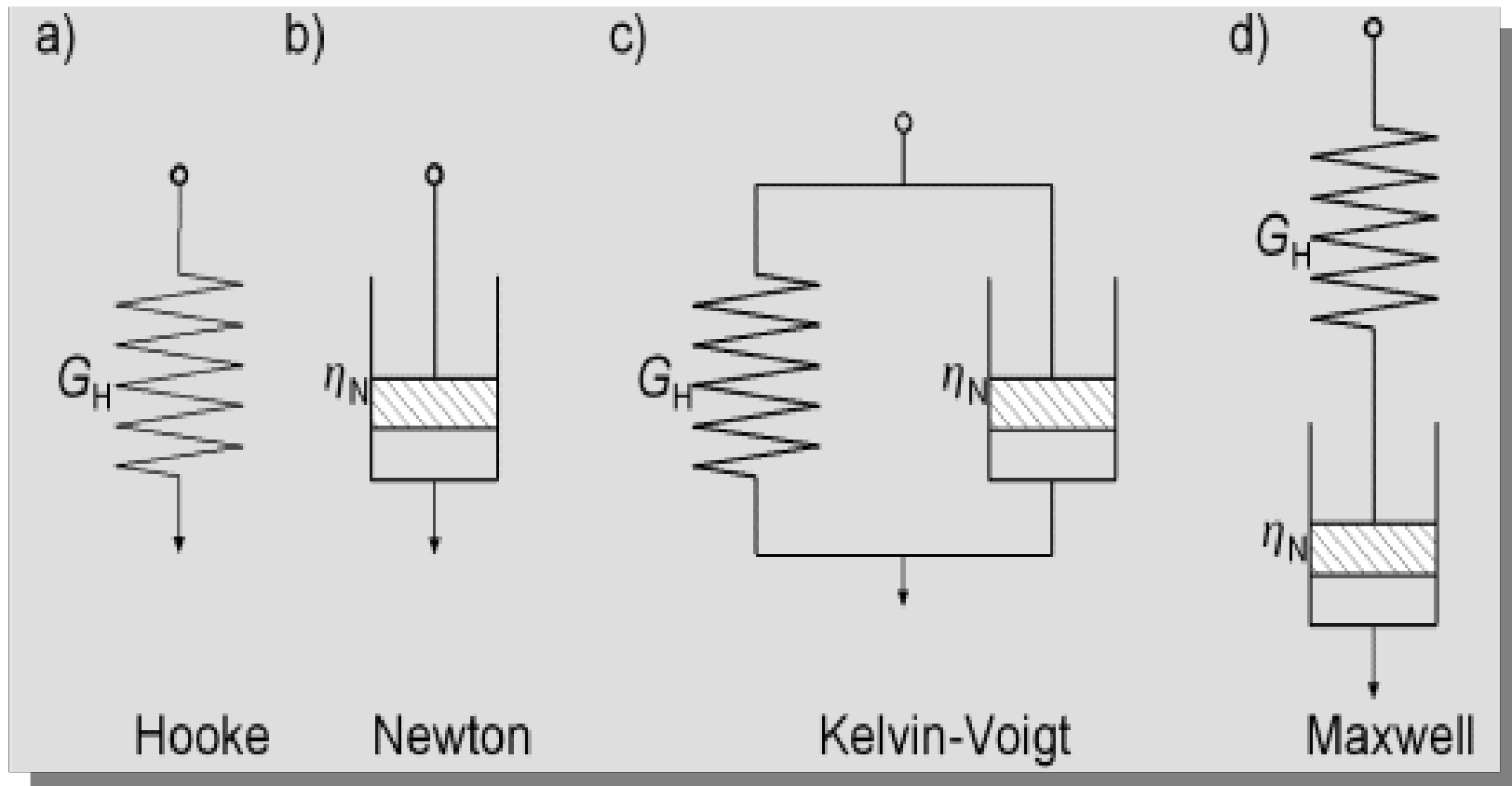
Viskomat XL
Regensburg 2010



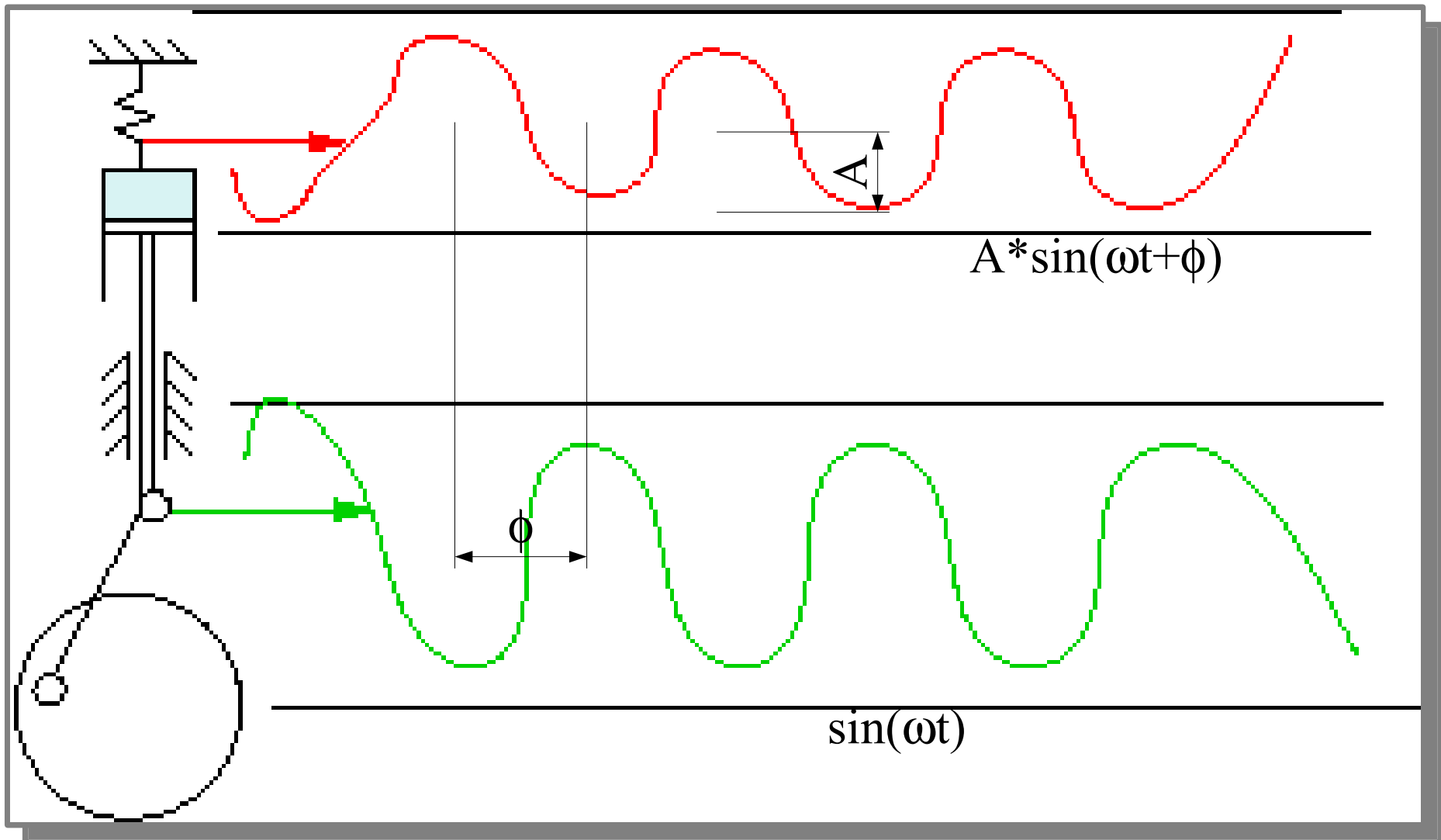
Downgoing Slope



Modells



Simulation



Some Mathematics

Erregung :

$$\sin(\omega t)$$

Ausgang:

$$A \sin(\omega t + \varphi) = G' \cos(\omega t) + G'' \sin(\omega t)$$

mit: dem Betrag:

$$|G^*| = \sqrt{G'^2 + G''^2};$$

und dem Verlustwinkel :

$$\varphi = \arctan\left(\frac{G''}{G'}\right);$$

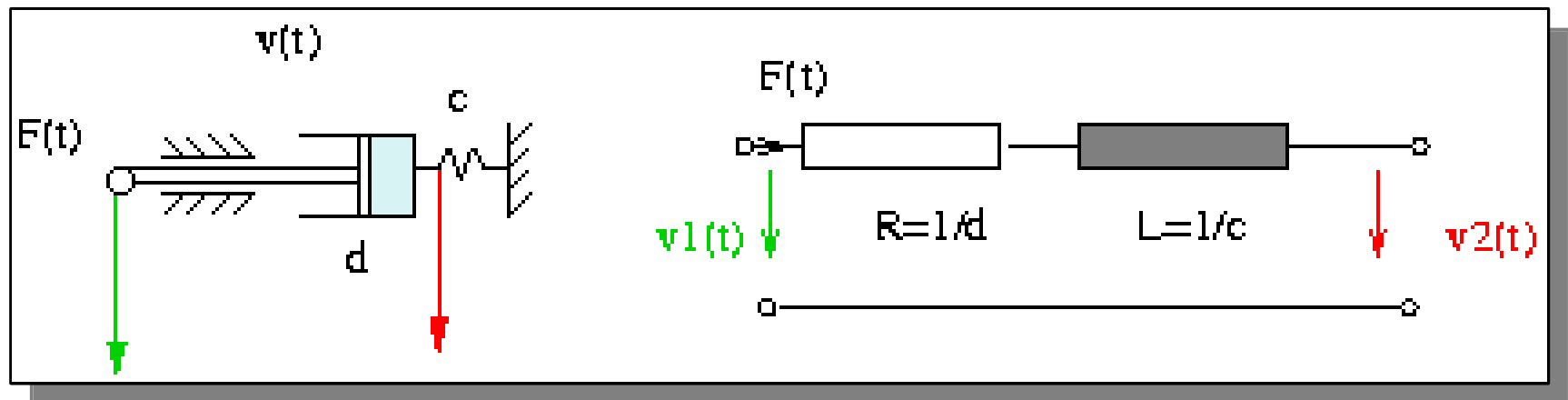
Übergang zur komplexen Schreibweise:

$$G^* = G' \cos(\omega t) + iG'' \sin(\omega t);$$

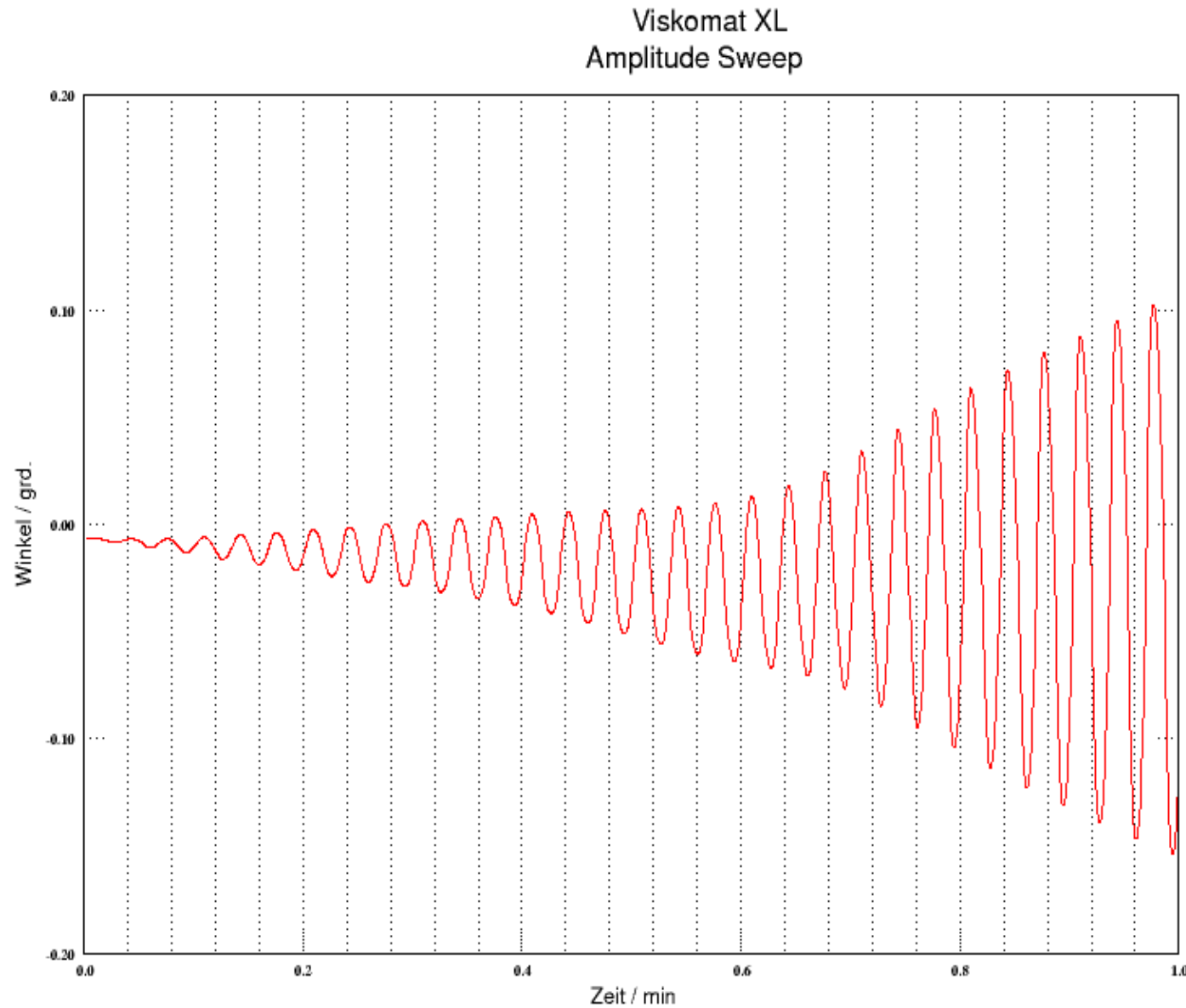
Storage Modulus

Loss Modulus

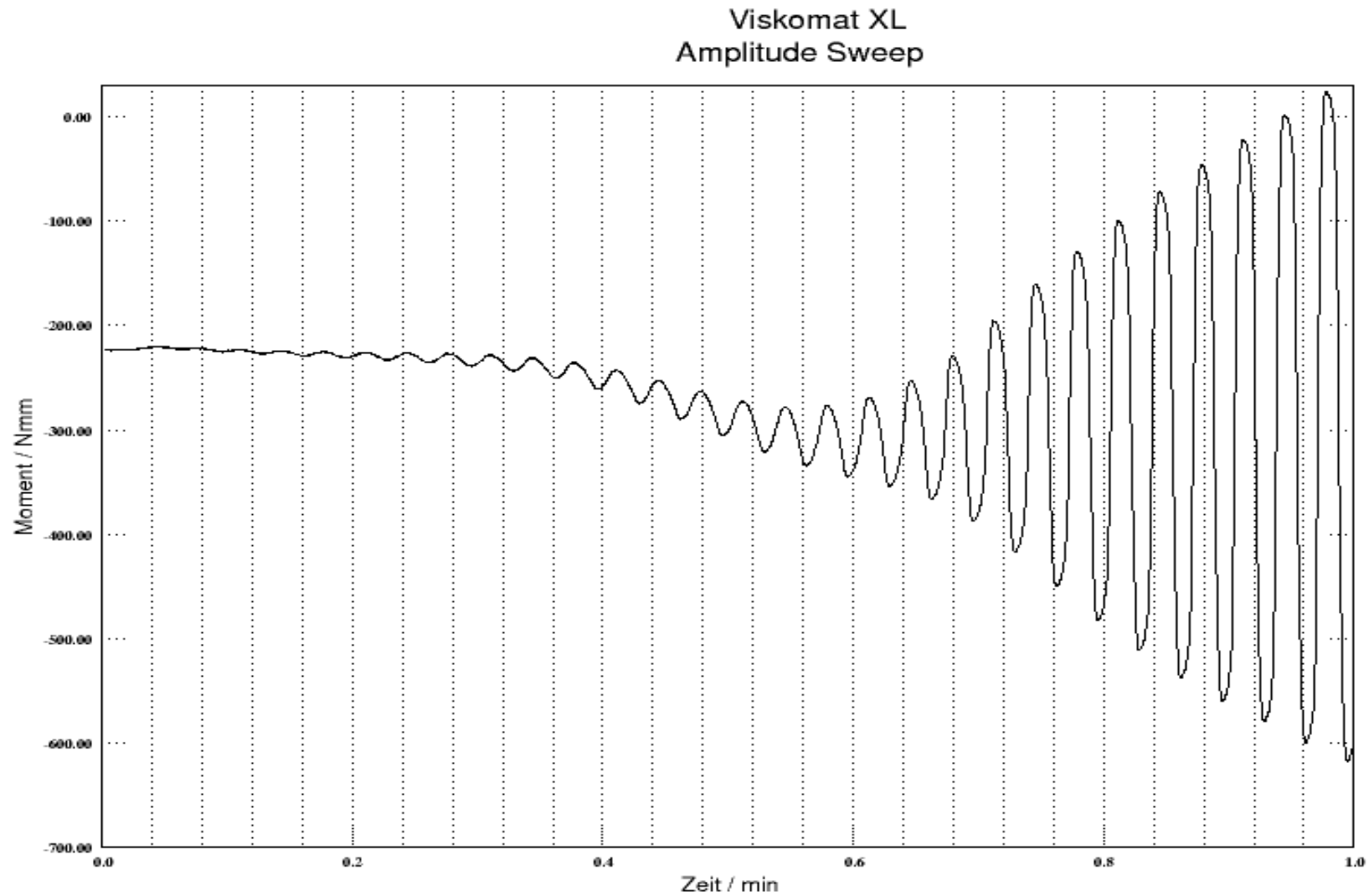
Analog Modells



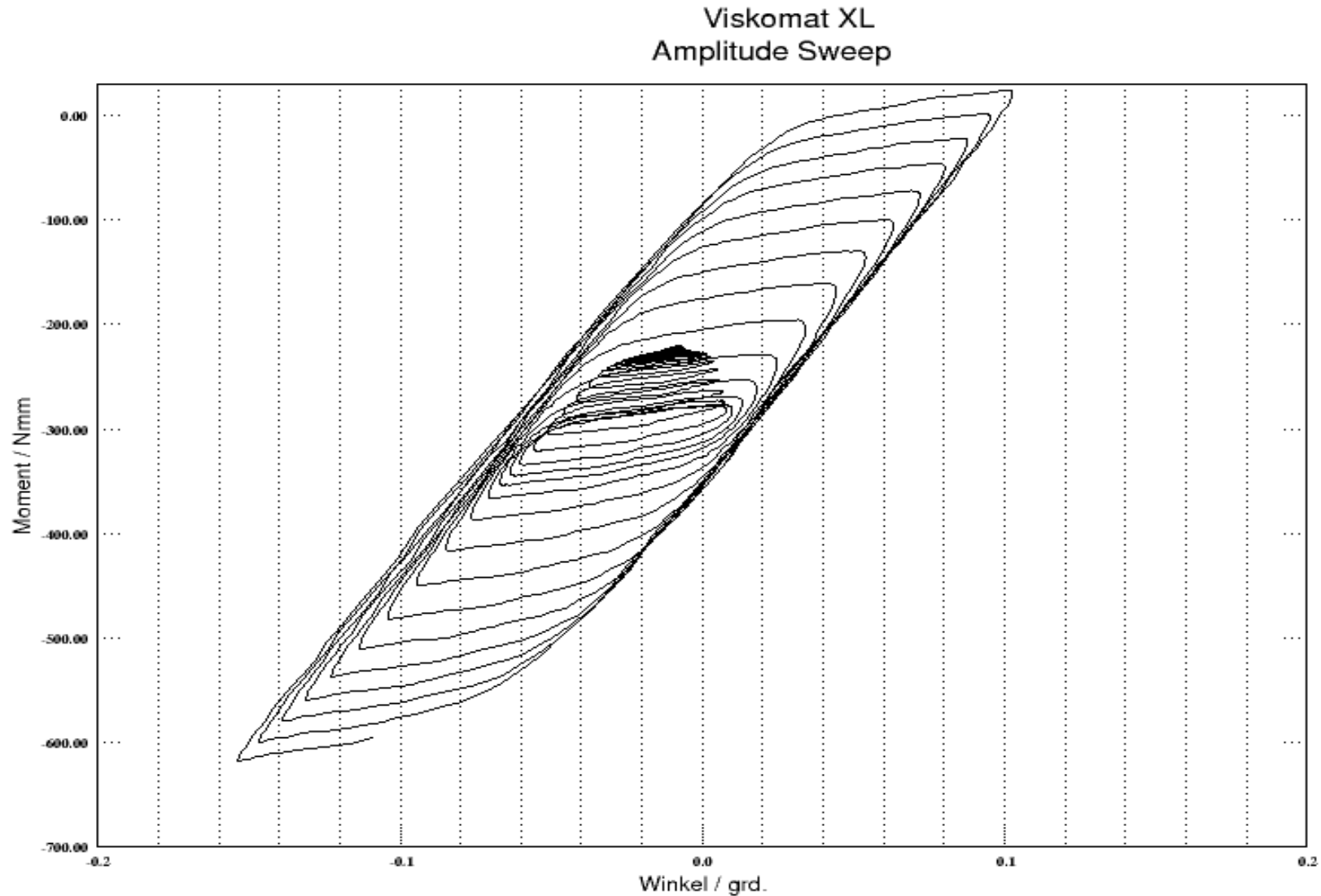
Angle over Time



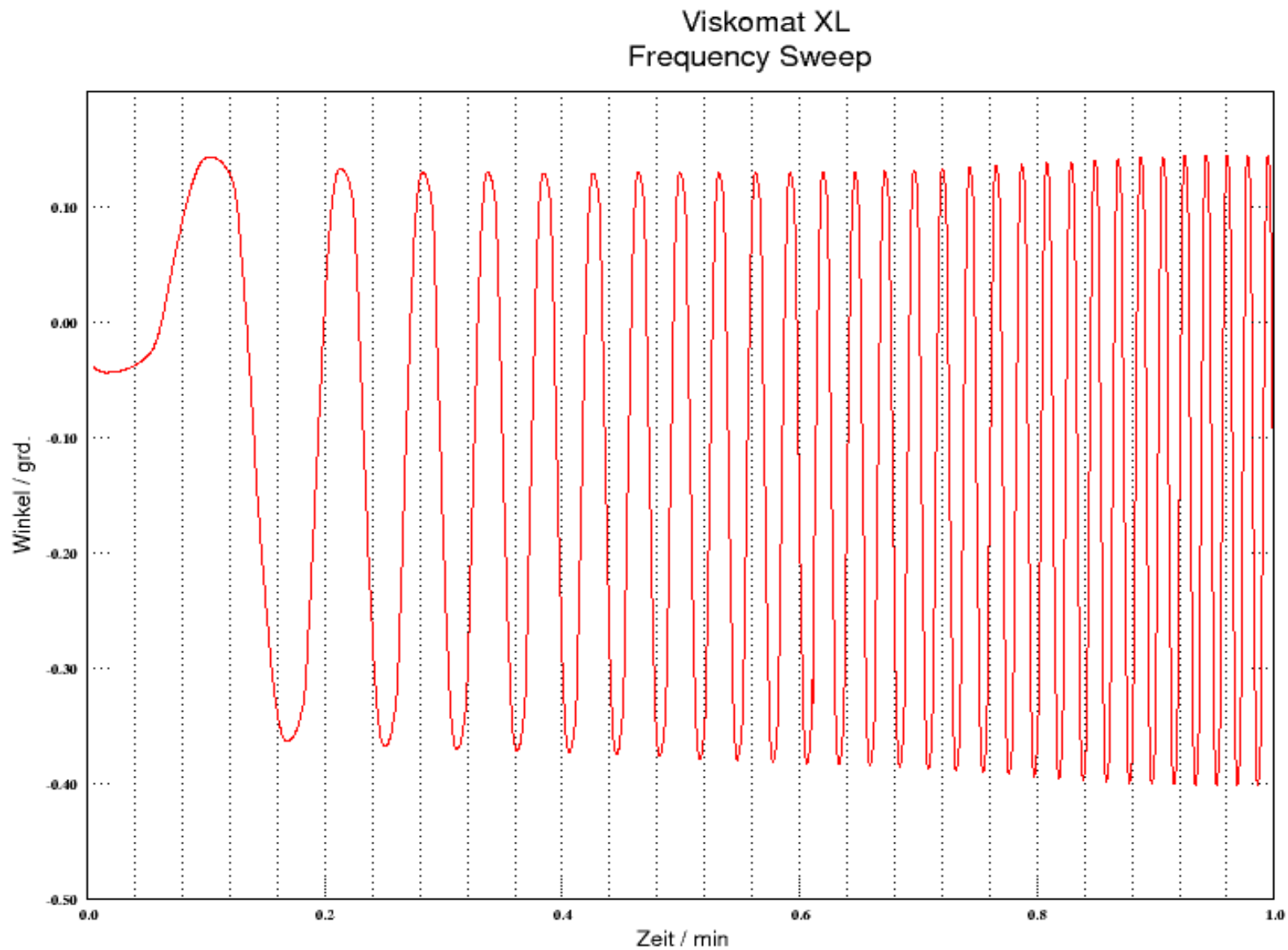
Torque over Time



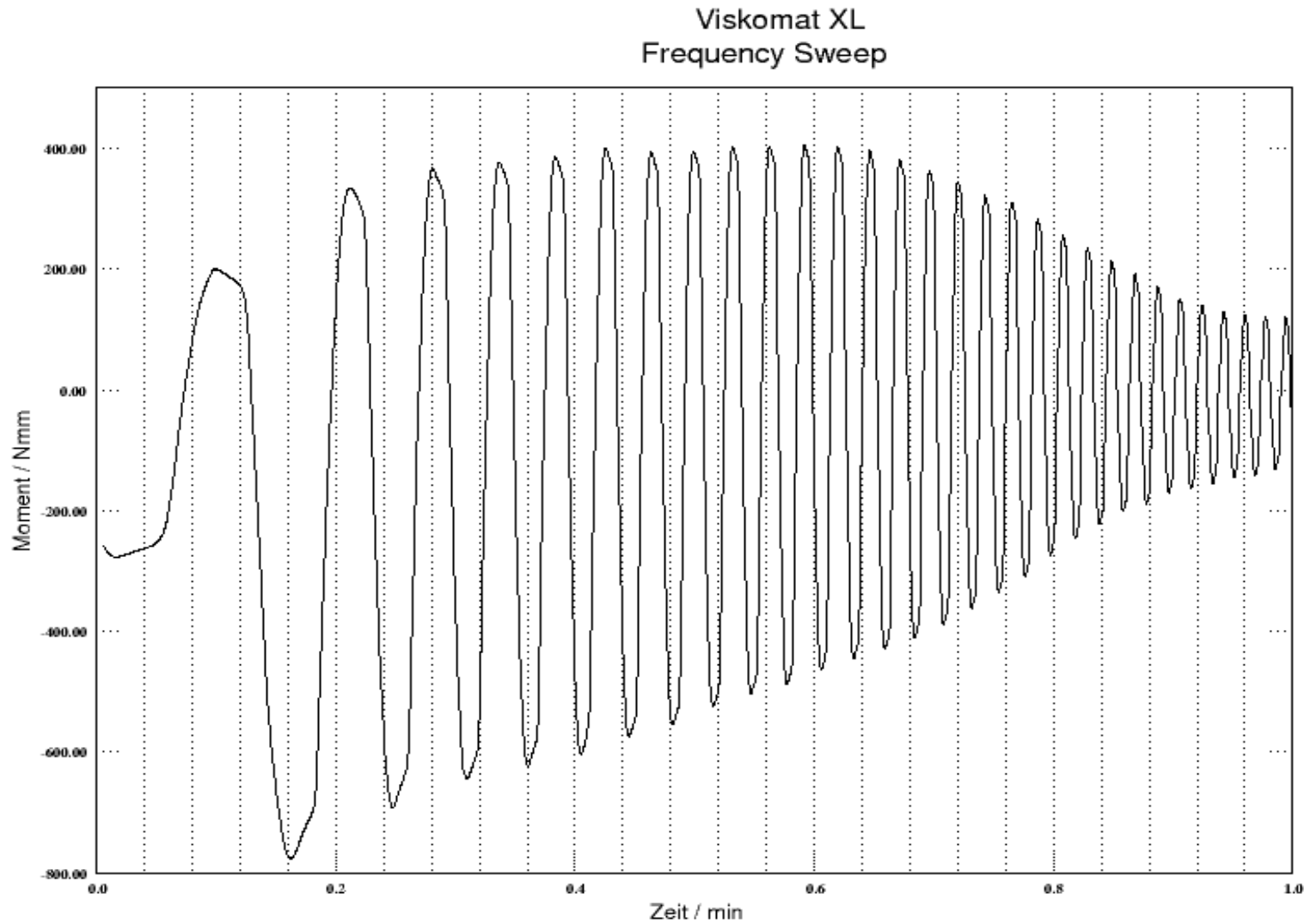
Lissajous curve, Torque over Angle



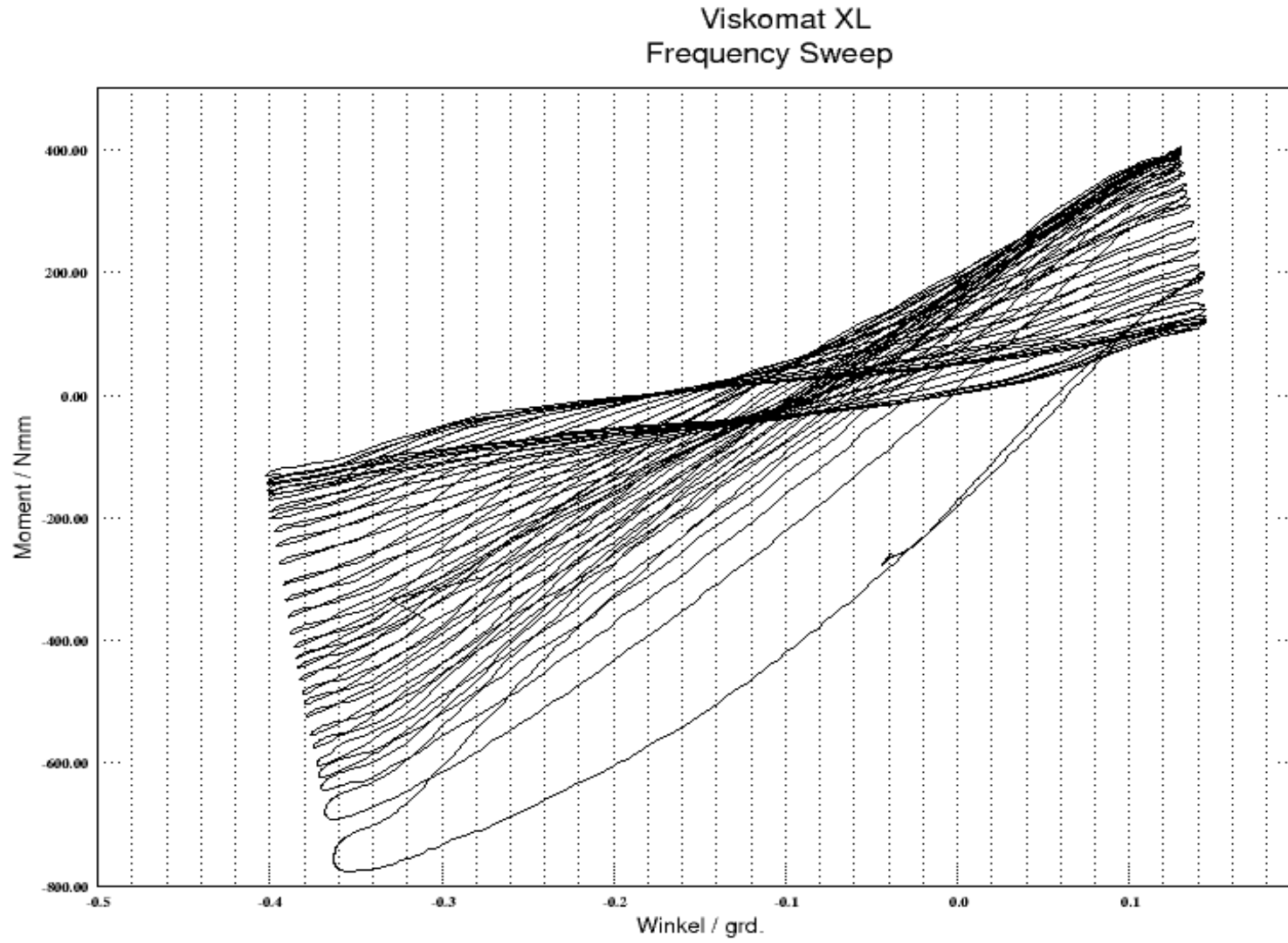
Angle vs. Time



Torque over Time



Lissayous Plot, Frequency Sweep



Oscillating Test: Signal

- Measuring the torque amplitude depending on the signal or input amplitude
- Measuring the phase angle between the signal amplitude and the torque or resulting amplitude
- Calculating the storage modulus G' and the loss modulus G'' or the complex modulus G^*

What is G' and G'' ?

- Elastic or Hook's body =>
torque is phase is according to the deflection =>
storage modulus $G' \neq 0$,
loss modulus $G'' = 0$
a spring stores energy
- Plastic or Newtonian body =>
torque follows deflection, phase angle 90° , torque
maximum at maximum speed at the zero crossing
point, deflection = 0 =>
storage modulus $G' = 0$
loss modulus $G'' \neq 0$
oil dissipates energy

Summary

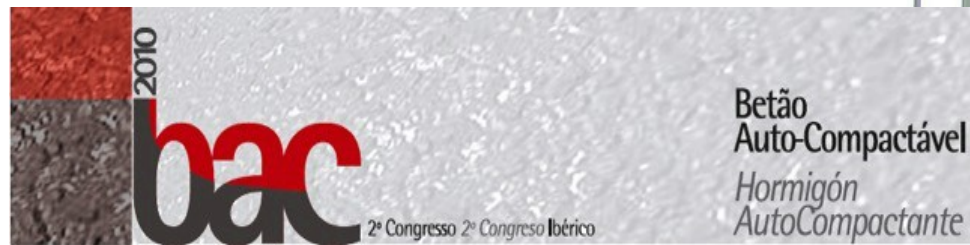
- The Viskomat XL ist the first concrete rheometer working also at very low speeds.
- The Viskomat XL may run with a shear stress controlled mode.
- The Viskomat XL is the first oscillating concrete rheometer on the market.
-its up to you to use this new tool ;-)

Cui bono ?

What's the use anyhow!

- „We never will need more the 90 measurement values over time.“
- „I don't believe that a two point test make sense at all!“
- „I see all this effects with the spread table test“

Meet Schleibinger again..



GDCh
GESELLSCHAFT
DEUTSCHER CHEMIKER
Bauchemietagung
Dortmund

HOCHSCHULE
REGENSBURG
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OF APPLIED
SCIENCES

 **AERC 2010 in Göteborg**

NRS



ESR



**20. Rheology Conference March, 09..10, 2010
in Regensburg, Germany**

SCC 2010

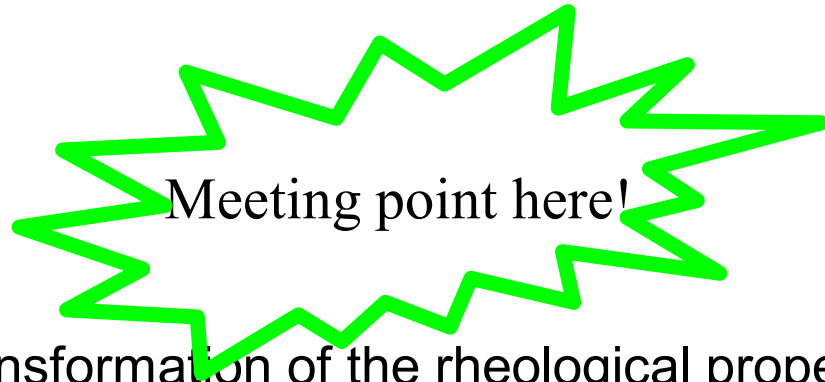
26-29 September 2010 - Montreal, Canada

**6th International RILEM Symposium on Self-Compacting Concrete
4th North American Conference on the Design and Use of SCC**



**UNIVERSITÉ DE
SHERBROOKE**

Workshop Thursday 11.03, 09:00..12:00



- Transformation of the rheological properties of concrete by the influence of energetically modified water and colloidal mixing technique.
Dipl.-Ing. (FH) Holger Reinecke et al. , FML Concretec GmbH, Herborn, Germany
- Introduction to Rheological Measurement Techniques
Dipl.-Ing. Oliver Teubert et. al., Schleibinger Geräte, Buchbach, Germany
- A new instrument to measure the pumpability of fresh concrete;
a practical demonstration"
Dipl.-Ing. Knut Kasten, Putzmeister Concrete Pumps GmbH, Aichtal, Germany
- *After the workshop you may have lunch at the cafeteria*

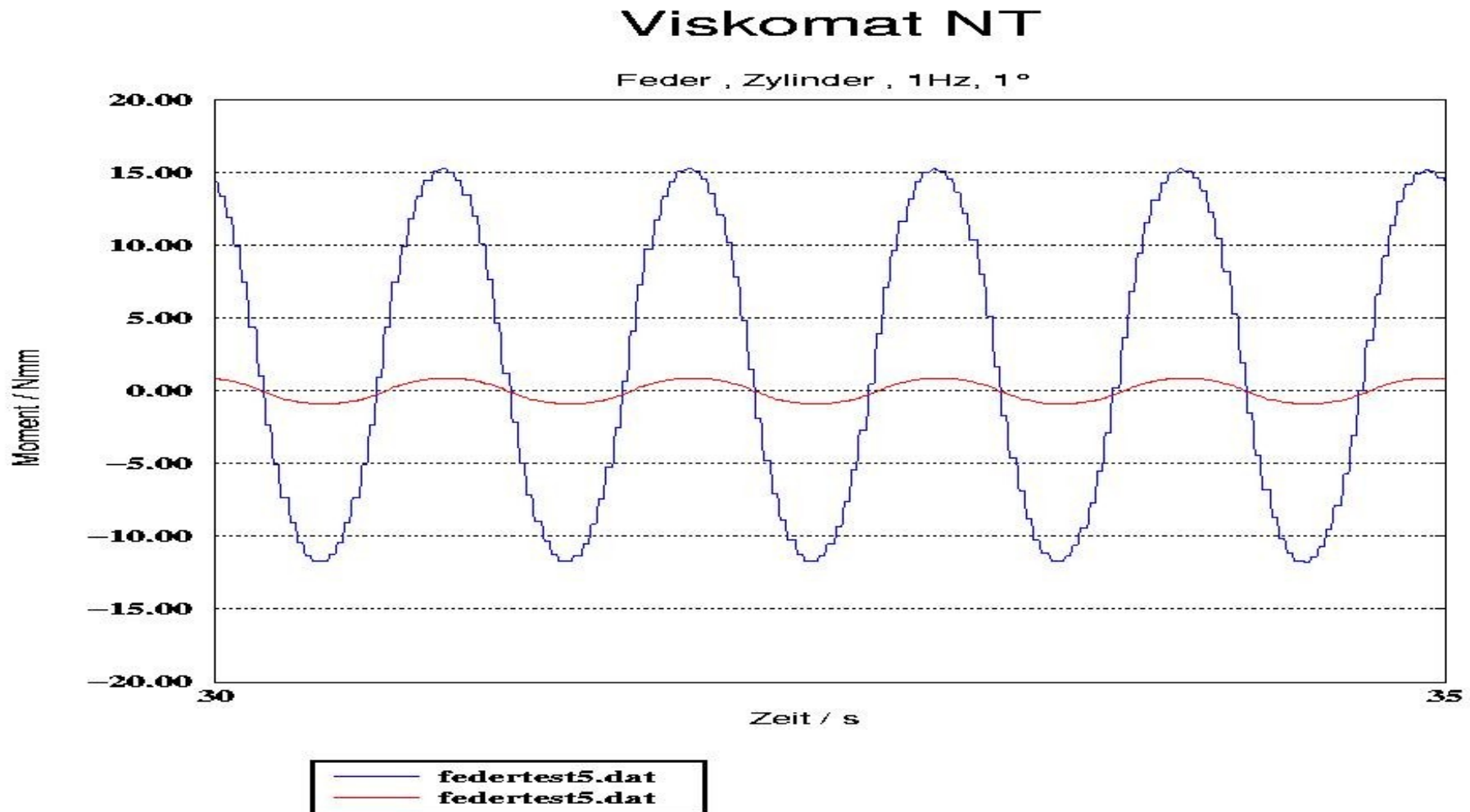
This evening 7pm..??



What are we measuring?

- G' and G'' as a function of time (setting)
- G' and G'' as a function of the amplitude
- G' and G'' as a function of the frequency

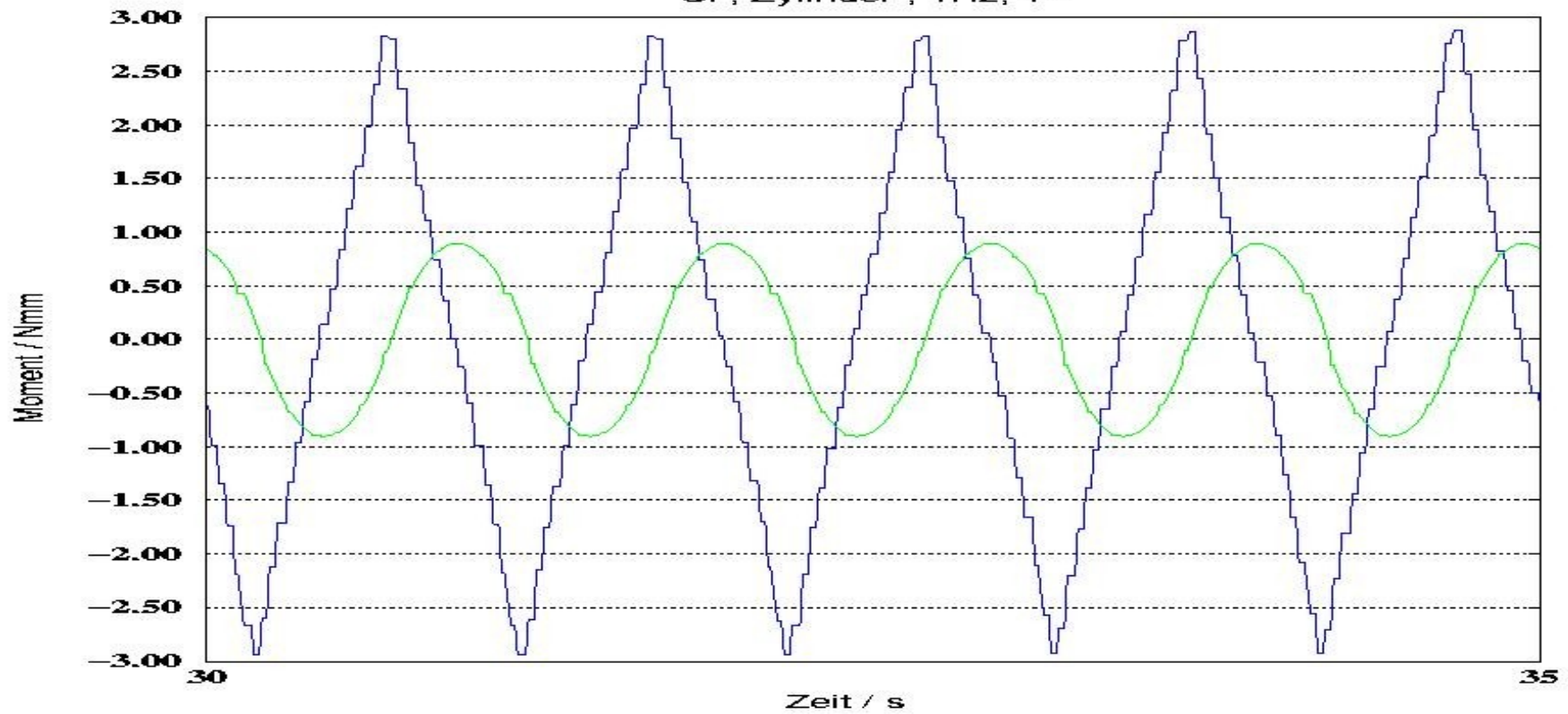
Torsionsfeder



Ölmessung

Viskomat NT

Öl , Zylinder , 1Hz, 1°



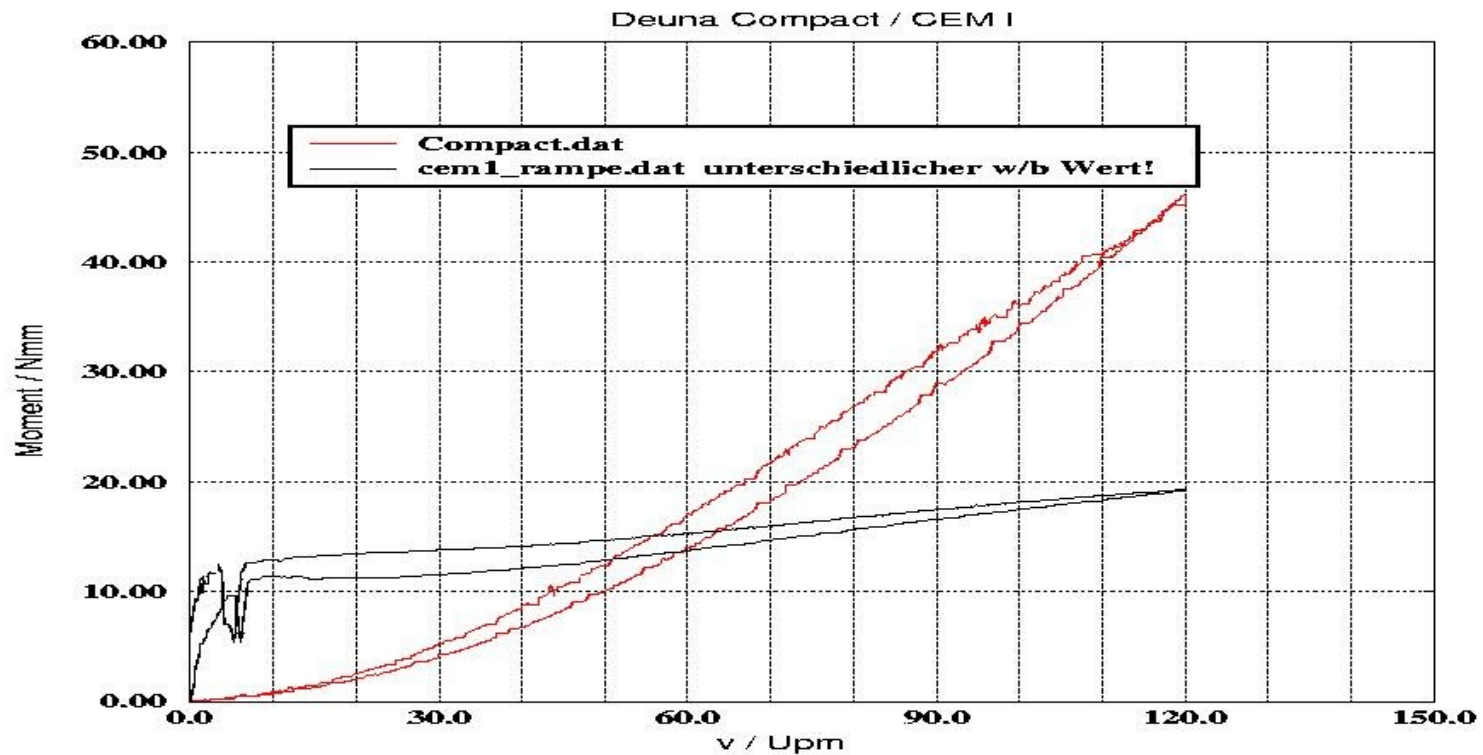
— oeltest3.dat
— oeltest3.dat

Oszillatorische Messung: Anregung

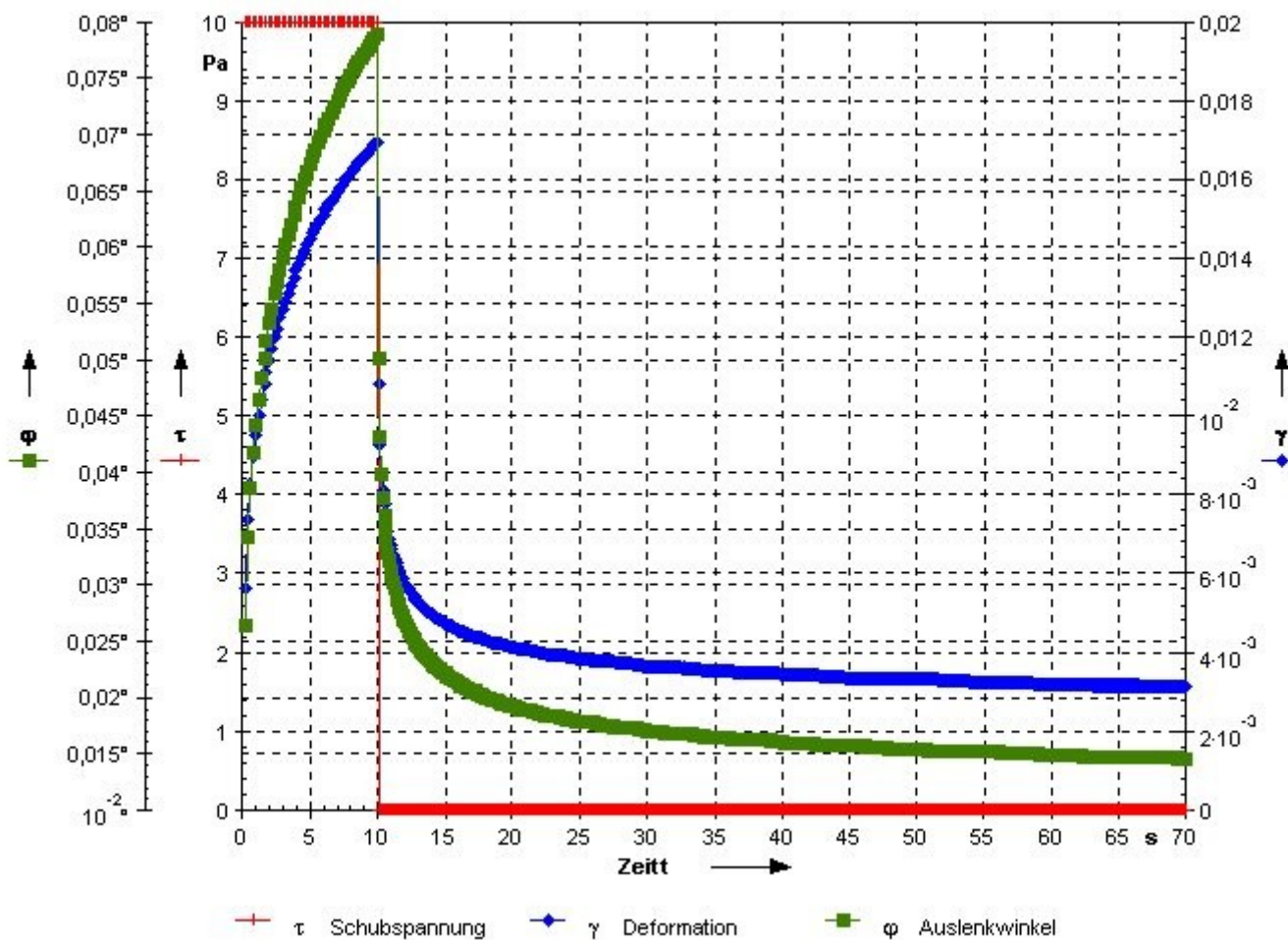
- Messung im elastischen Bereich, „unterhalb“ der Fließgrenze
- Sinusförmige Anregung = Motorbewegung
- Amplitude $0,01^\circ \dots 5,0^\circ$
- Frequenz $0,01 \text{ Hz} \dots 5 \text{ Hz}$
- Zeitlicher Anstieg der Amplitude = Amplituden-Sweep
- Zeitlicher Anstieg der Frequenz = Frequenz-Sweep

SCC Mortar

Schleibinger Viskomat Schulung 2001

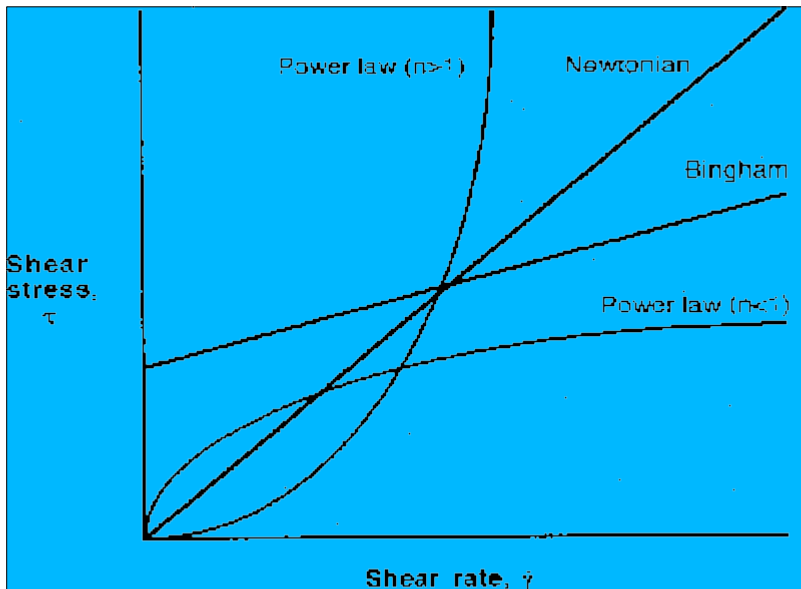


Creep Test



Flowcurves

Abbildung nach Banfill u. Hornung 1992



$$\tau_0 = 0 \wedge n = 1 \Rightarrow \textit{Newton}$$

$$n = 1 \Rightarrow \textit{Bingham}$$

else Bulkley Herschel \vee other power laws

$$\tau = \tau_0 + \eta_0 \cdot \dot{\gamma}^n$$