Die Frischbetonprüfung
Selbstverdichtender Betone direkt im Mischer

The assessment of Self-Compacting Concrete in a Mixer
Current Situation

Problems during production of SCC

- Dosing accuracy at the concrete plant
- Moisture content of (fine) aggregates
- Change in properties of constitutive materials
  (grading curve, super plasticizer etc.)

- deviation of fresh concrete properties
Current Situation

Target

- Evaluation of the flowability and the rheological properties of SCC automatically, directly after the mixing process has been finished
Current Situation

Control of the flowability of SCC during production

- Mixing energy

![Graph showing torque during mixing](image-url)
Current Situation

Control of the flowability of SCC during production

- Mixing energy
  Evaluation with Bingham-Model

![Graph showing mixing energy and Bingham model equation](attachment:image.png)

**Problem:** Not exact enough for SSC
Conception

Target

- Evaluation of the flowability and the rheological properties of SCC automatically, directly after the mixing process has been finished
- At the end of the mixing process a rheometer immerses into the concrete and starts the measurement
- At this time a correction of the mixture is still possible, before it is filled into the truck
The concrete rheometer RheoCT

Florian Fleischmann, Wolfgang Kusterle
The concrete rheometer RheoCT
The concrete rheometer RheoCT

Shearrate [s⁻¹]

Shearstress [Pa]

\[ f(x) = -0.02x + 68.88 \]

\[ R^2 = 0.96 \]
The concrete rheometer RheoCT

Measuring-time [s]

Speed [1/min]

Shearstress [Pa]

Strain[°]
The concrete rheometer RheoCT

**Concrete**

<table>
<thead>
<tr>
<th></th>
<th>B2.1</th>
<th>B2.3</th>
<th>B2.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>kg/m³</td>
<td>177, 7</td>
<td>192, 7</td>
</tr>
<tr>
<td>Slump Flow</td>
<td>mm</td>
<td>630</td>
<td>790</td>
</tr>
<tr>
<td>V-Funnel Time</td>
<td>sec</td>
<td>11,1</td>
<td>6,3</td>
</tr>
<tr>
<td>Sedimentation</td>
<td></td>
<td>no</td>
<td>no</td>
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</table>

**Shear Stress [Pa]**

- $f(x) = -0.01x + 34.69$
- $f(x) = -0.02x + 69.25$
- $f(x) = -0.06x + 180.82$

**Graph**

- Sherrate [s⁻¹]
- Shear Stress [Pa]

---

**Table**

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<tr>
<td>B2.3</td>
<td>187, 9</td>
<td>790</td>
<td>6,3</td>
<td>no</td>
</tr>
<tr>
<td>B2.4</td>
<td>192, 7</td>
<td>830</td>
<td>4,8</td>
<td>yes</td>
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The concrete rheometer RheoCT

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Control of the water-content

![Graph showing the relationship between water content and V-Funnel time and viscosity.](graph.png)
Control of the water-content

- Slump Flow
- Dynamic Yield Stress
- Bingham Yield Stress
Implementation in the mixer
Control of the water-content

- Slump Flow
- Dynamic Yield Stress

Water [kg/m³] vs. Slump Flow [mm] vs. Dynamic Yield Stress [Pa]
Control of the water-content

- Slump Flow [mm]
- Yield Stress [Pa]

Water [kg/m³]

Setzfließmaß | Slump Flow
Dynamische Fließgrenze | Dynamic Yield Stress

Example values:
- Water content 2 kg/m³
- Slump Flow 750 mm
- Yield Stress 40 Pa
Conclusion

- Concrete rheometer for use in a concrete plant
- Rheological Values
- Quality control
- Fast test results
- More uniform SCC
- Less wastage
- Financial success
Thank you
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im Mischer

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Florian Fleischmann, Wolfgang Kusterle
Current Situation

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Current Situation

Control of the flowability of SCC during production

- Mixing energy

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<table>
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<tr>
<th>Time [sec]</th>
<th>Torque during mixing [Nm]</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>120</td>
<td>100</td>
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Current Situation

Control of the flowability of SCC during production

- Mixing energy

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Evaluation with Bingham-Model

Problem: Not exact enough for SSC
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Shearrate \( [s^{-1}] \)

\[ f(x) = -0.02x + 68.88 \]

\( R^2 = 0.96 \)

Measuring-time \( [s] \)

\[ 0 \quad 10 \quad 20 \quad 30 \quad 40 \quad 50 \quad 60 \]

\[ 0 \quad 0.5 \quad 1 \quad 1.5 \quad 2 \quad 2.5 \]

The graph shows the relationship between the shearrate and the measuring-time with a linear equation. The correlation coefficient \( R^2 \) indicates a strong correlation with a value of 0.96.
The concrete rheometer RheoCT

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0,8
1
1,2
1,4
1,6
1,8
2
2,2

0,05
0,1
0,15
0,2
0,25
0,3

Measuring-time [s]

S
p
e
e
[1/mi]

0
60
120
180
240
300
360

0
20
40
60
80
100
120
140

Strain [°]

S
h
e
a
r
s
tr
es
s
P
a

Entspricht einer Scherrate von 0,03 1/s
### Concrete Rheometer RheoCT

Florian Fleischmann, Wolfgang Kusterle

#### Shear Rate [s⁻¹]

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- Equation 1: \( f(x) = -0.01x + 34.69 \)
- Equation 2: \( f(x) = -0.02x + 69.25 \)
- Equation 3: \( f(x) = -0.06x + 180.82 \)
The concrete rheometer RheoCT

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0 1000 2000 3000 4000 5000 6000 7000 8000

B2.1 B2.3 B2.4

Strain [°]

S h e a r s t r e s s [P a]

Concrete B2.1 B2.3 B2.4

Water kg/m³ 177,7 187,9 192,7

Slump Flow mm 630 790 830

V-Funnel Time sec 11,1 6,3 4,8

Sedimentation no no yes

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Control of the water-content

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Control of the water-content

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Control of the water-content

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Water [kg/m³]

Setzfließmaß
Dynamische Fließgrenze

Slump Flow
Dynamic Yield
Stress

Yield Stress [P]
Conclusions

- Concrete rheometer for use in a concrete plant
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