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Influence on the pumpability of concrete and its possibilities to ascertain

Einflüsse auf die Pumpfähigkeit von Betonen und deren Beurteilungsmöglichkeiten

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Pumping in the concreting process

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	Responsibility
❑ Mixing	Mixing plant
▼	
❑ Transportation	Mixing plant
▼	
❑ Pumping 	Pumping service provider
▼	
❑ Formwork	Site manager
▼	
❑ Properties of hardened concrete	Mixing plant

What ist pumpability?

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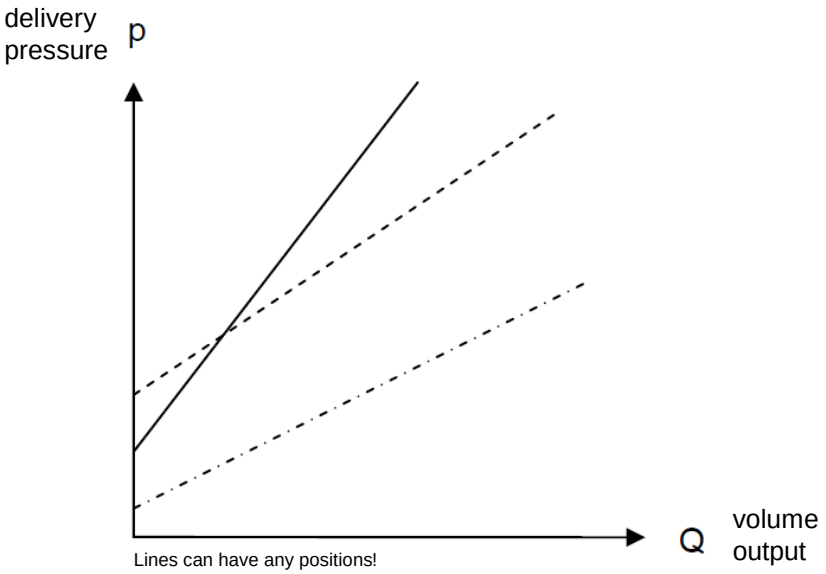

Pumpability of concrete

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Own definition:

With known

- ❑ **geometry of pipe**
- ❑ **pumping height**
- ❑ **volume output**
- ❑ **and an allowed maximum pressure**

conveying concrete through pipes is possible

At this point there is no standardization of pumpability !

Influence on pumpability

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- Aggregate / shape
- Grading curve
- Cement and w/c- respectively w/b-ratio
- Admixtures
- Supplementary cementitous materials

Pumping of concrete with PCE

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- Workability is more constant so there is a more evenly pumping behaviour
- In spite of high slump flow (SCC) pumping resistance can be very high
- A bad mix design (e.g. too much plasticiser) can produce segregation or blockages during a pumping brake
- Stickiness can produce higher cleaning effort
- More pumping resistance means more wear
- Higher pumping pressure produces higher energy costs

Methods of evaluation and its problems (1)

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- **Evaluation of pumpablility by mix design or consistency**
  - Evaluation more and more difficult

- **Calculation of pipe resistance by slump or spread**
  - In spite of high slump or spread concrete more and more has a bad pumpability. Different mix designs with the same slump or spread can have a very different pressure need.

Methods of evaluation and its problems (2)

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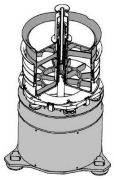
- **Pumping test**
  - Pumping tests give exact values but produce a lot of costs

- **Measurements with rheometers at universities (e.g. LCPC)**
  - Measuring with rheometers is mostly complicated respectively not useable for calculation of pumping pressure



Effort to evaluate the flow resistance of concrete in pipelines

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A new method for evaluation is necessary!

Bingham media

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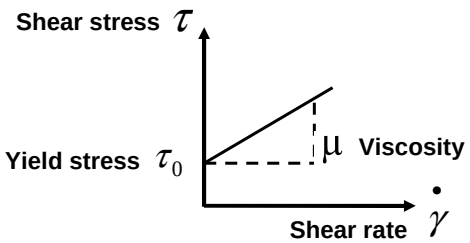
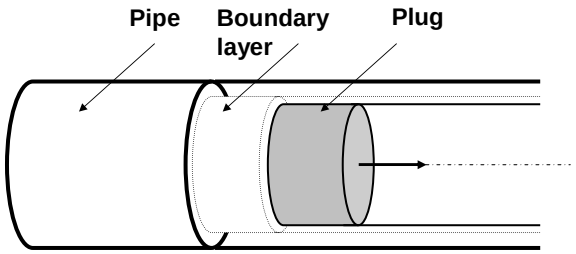
$$\tau = \tau_0 + \mu \dot{\gamma}$$





New device - prototype

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Measuring with Sliding Pipe Rheometer (SLIPER)

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Measuring examples

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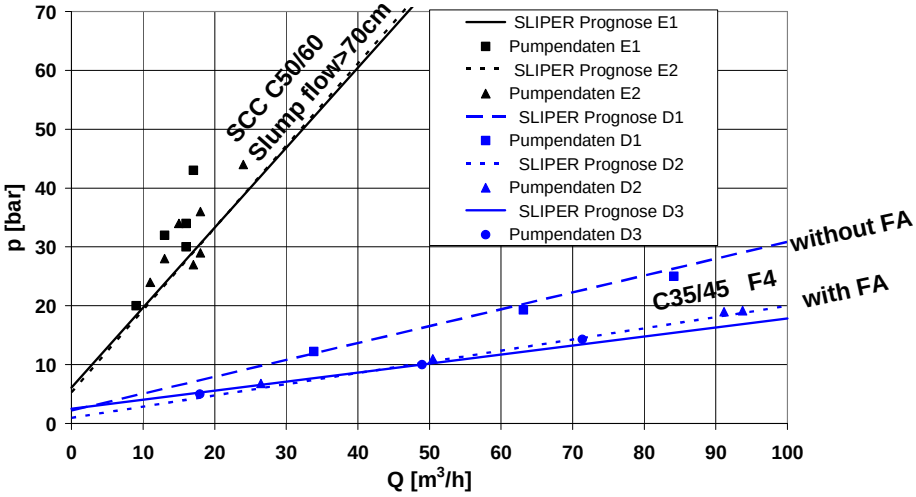
Measurments with rheometer and forecast compared to measurements of delivery line pressure



Conclusions

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- ❑ **Spread or slump is not useful to evaluate pumpability anymore**
- ❑ **Little changes in mix design can have a large effect on pumpabiltiy**
- ❑ **For developing new mix designs the pumpability can be shown for a lot of concrete mixes in laboratory by SLIPER**
- ❑ **Only to play safe in very special cases make a pumping test**

SLIDING PIPE RHEOMETER
by K. Kasten