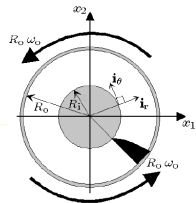


# Rheology of SCC with low binder content

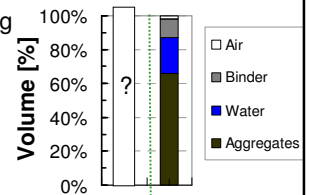


Florian V. Mueller  
Ólafur H. Wallevik  
Kolloquium in Regensburg, März 2009



## Objective

- To obtain self-compacting properties
- Similar mix-design as conventional concrete:
  - Properties of binder material ?
  - Maximum w/cm ?
  - Effect of paste volume ?



SCC CC

w/c < 0.60  
C < 350 kg/m³  
C25/30 ~ C30/37

## Materials

- Cements:
  - Rapid Portland Cement
  - Ordinary Portland Cement
- Fly ash Class F (ASTM) / V (EN)
- Limestone filler L (EN)
  - One coarse LF
  - Ground to two finer grade of Blaine-surface
- Aggregates
  - EN-Sand (for mortar)
  - Årdal (mainly cubical crushed Granite/Gneiss)
- Dispersing admixture PCE from SIKA



## Methods

- Rheological measurements in:
  - Paste, mortar and concrete
- In 5 different devices
  - Co-axial-cylinders viscometer 6 (mortar) & 5 (concrete)
  - Rheometer 4-SCC, Rheomixer (for mortar)
  - Physica MC1 for paste
- Additionally:
  - Common on-site tests (slump, slump flow, t500)

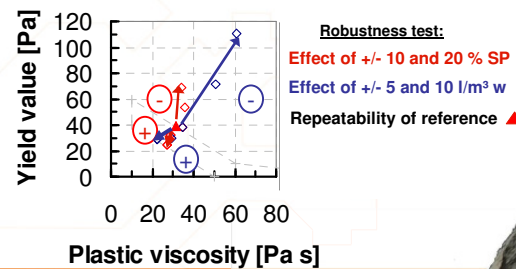


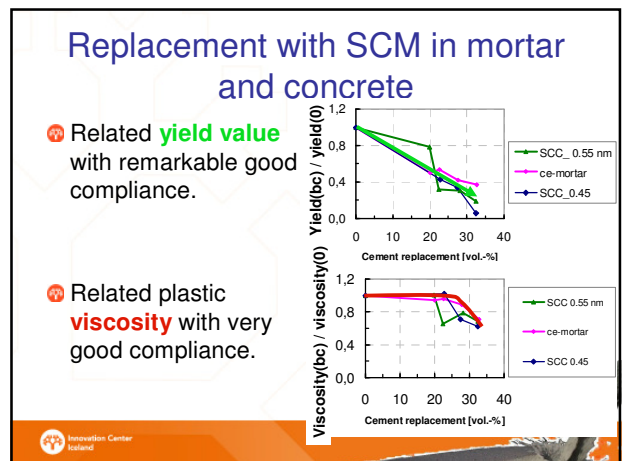
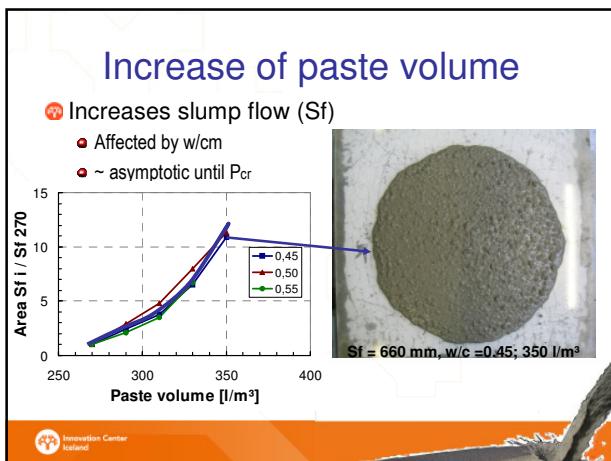
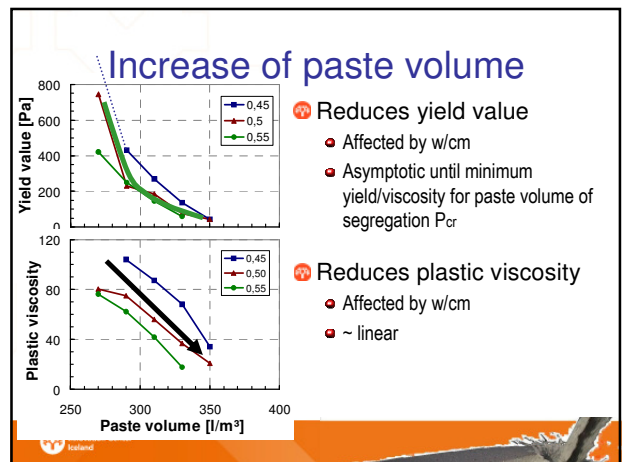
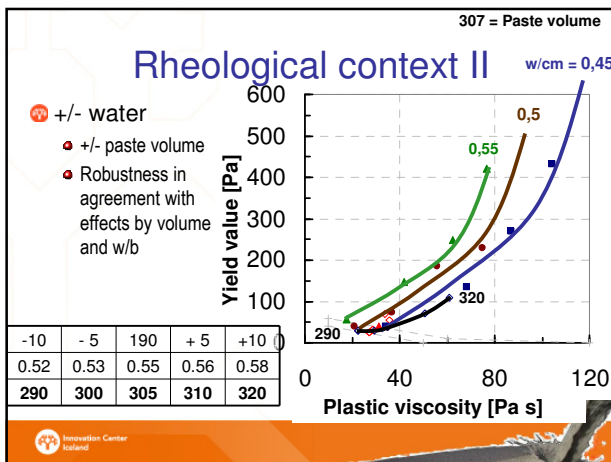
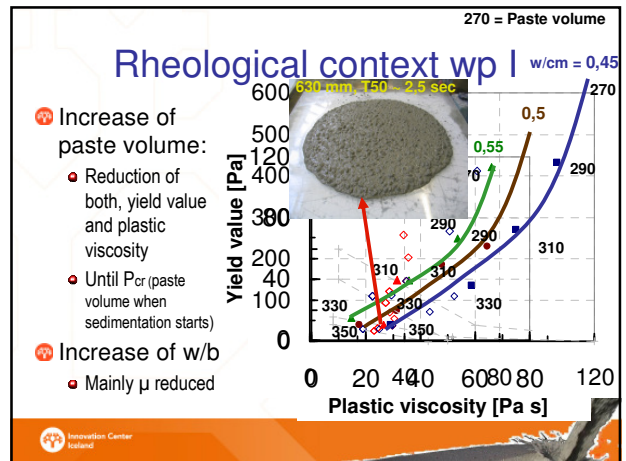
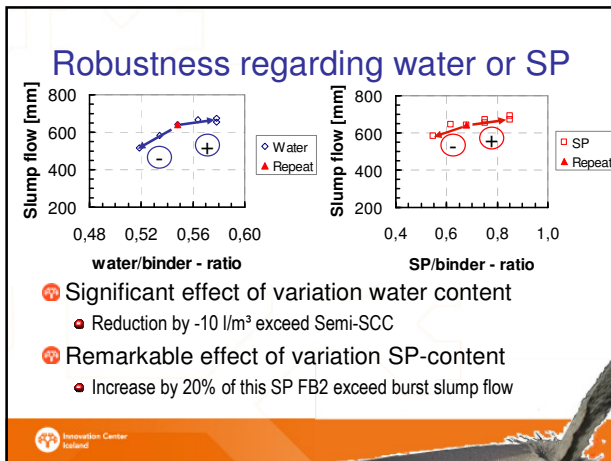
## Set-up

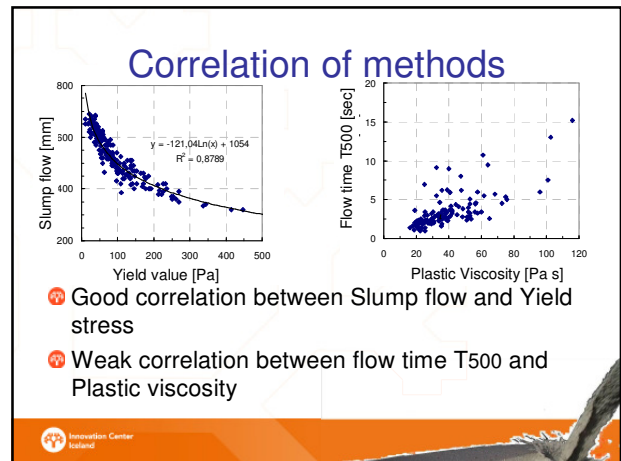
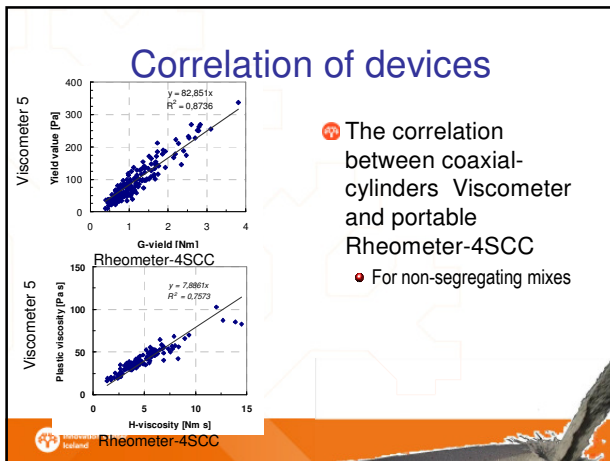
	paste 40 mixes	mortar 40 mixes	concrete 140 mixes
Work-package 1			
w/cm	0.45 / 0.5 / 0.55	0.45 / 0.5 / 0.55	0.45 / 0.5 / 0.55
cement	C1 / C4	C1 / C4	C1 / C4
paste volume	270 + 20...350 l/m³	270 + 20...350 l/m³	270 + 20...350 l/m³
c/filler			
Work-package 2			
w/cm	0.45 40 mixes		0.45 / 0.5 / 0.55
SCM	C5(x) = RPC + 20 vol.-%FA + 5/10/15 vol.-% L		
L Blaine	C6(x) = (0.5)(RPC+OPC) + 20 FA + 5/10/15 L		
	C6(x3) = (0.5)(RPC+OPC) + 20 FA + 5/10/15 L		

## Robustness of low-binder SCC

- 345 kg/m³ binder content (RPC, FA, L) with w/b= 0.55







- ## Conclusions
- Good correlation between devices.
    - Good correlation for mortar and concrete devices
    - Good correlation between yield value and Slump flow
    - Weak correlation between viscosity and T500
  - Good correlation between mortar and concrete.
    - Contrary results in paste
  - Paste volume affects rheology
    - ✓ Increase of volume → reduction of yield value and viscosity (w/c=const.)
  - Fly ash V
    - Reduces yield value and can maintain viscosity (cement dependent)
  - Limestone filler L
    - Reduces yield value and can maintain viscosity (cement and Blaine dependent)

**www.rheo.is**


**Innovation Center  
Iceland**

RILEM + Nordic Rheology Committee NRC  
 workshops and conferences  
 "Rheology of cementitious suspensions"  
 17.-20. August 2009