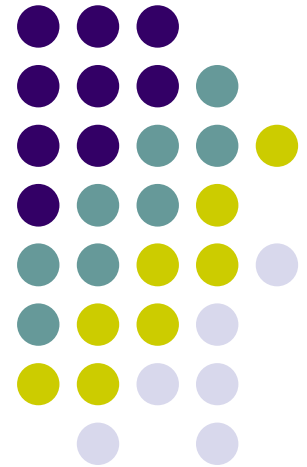


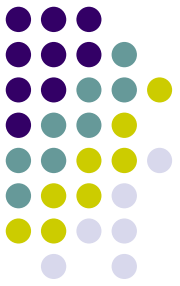
The effect of temperature on rheology of cement paste and of fresh self compacting concrete

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Introduction



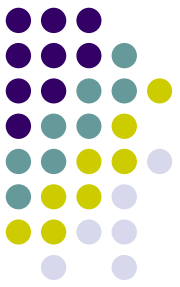
Temperature considerably influences rheological properties of fresh concrete

Changes in temperature may lead to loss of self-compacting properties and make very difficult to cast concrete properly

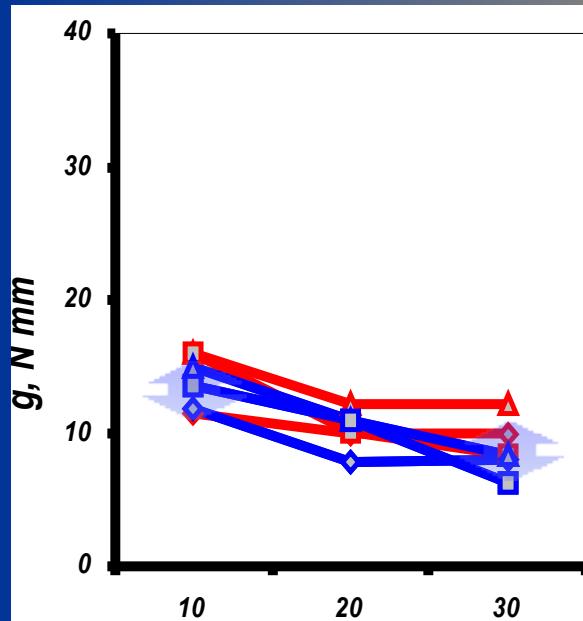
Temperature must be taken into account during SCC mixture designing and development

Only limited systematical data on influence of temperature on rheological properties of fresh self-compacting concrete are available

Temperature and rheology of mixes with different cement – SP system



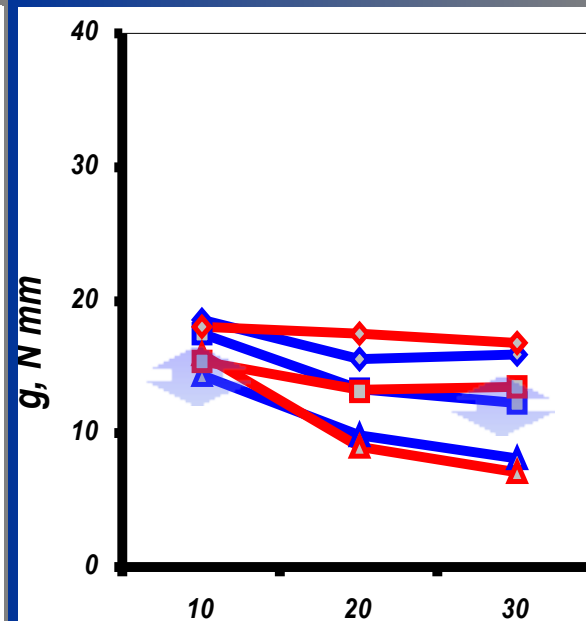
$C_3A - 2\%$



TEMPERATURE, °C

10 min ◆ PE1 ▲ PE3 ■ PC
 60 min ◆ PE1 ▲ PE3 ■ PC

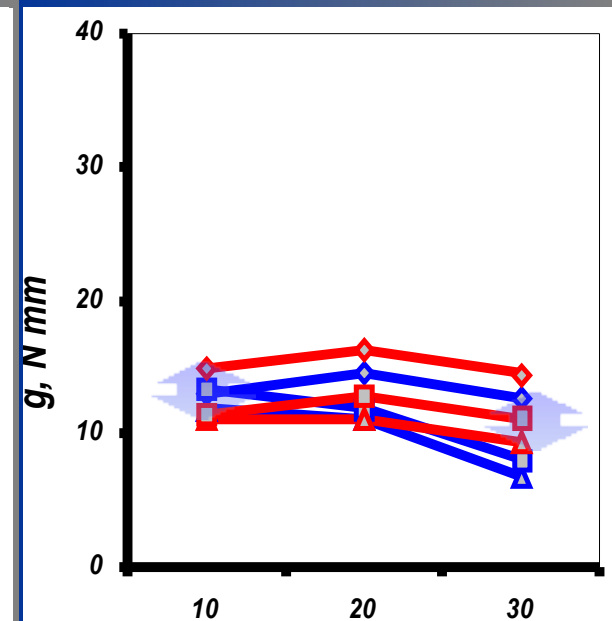
$S_{wc} - 320 m^2/kg$



TEMPERATURE, °C

10 min ◆ PE1 ▲ PE3 ■ PC
 60 min ◆ PE1 ▲ PE3 ■ PC

$Na_2O_e - 0,3\%$

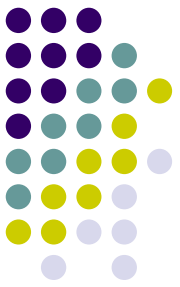


TEMPERATURE, °C

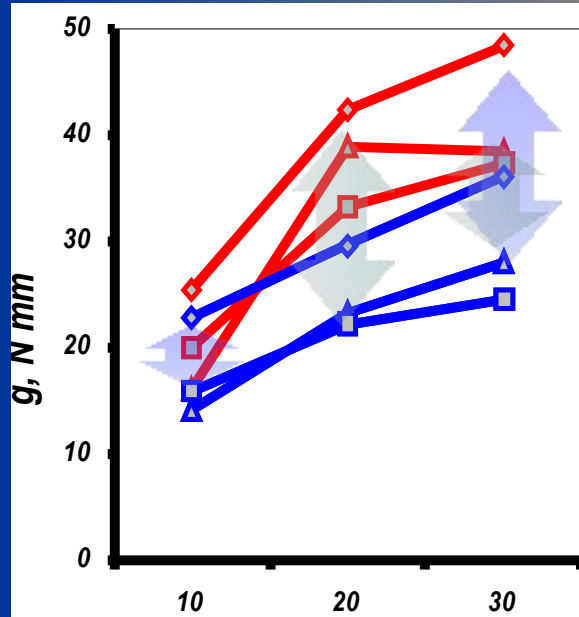
10 min ◆ PE1 ▲ PE3 ■ PC
 60 min ◆ PE1 ▲ PE3 ■ PC

Yield value g

Temperature and rheology of mixes with different cement – SP system



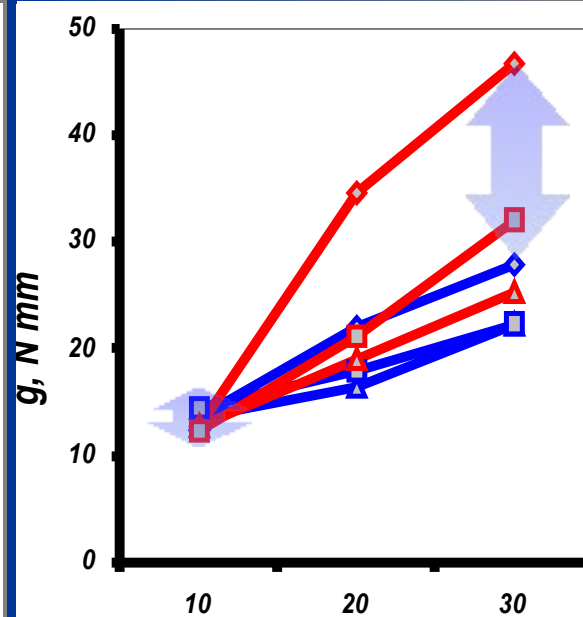
$C_3A - 12\%$



TEMPERATURE, °C

10 min ◆ PE1 ▲ PE3 ■ PC
 60 min ◆ PE1 ▲ PE3 ■ PC

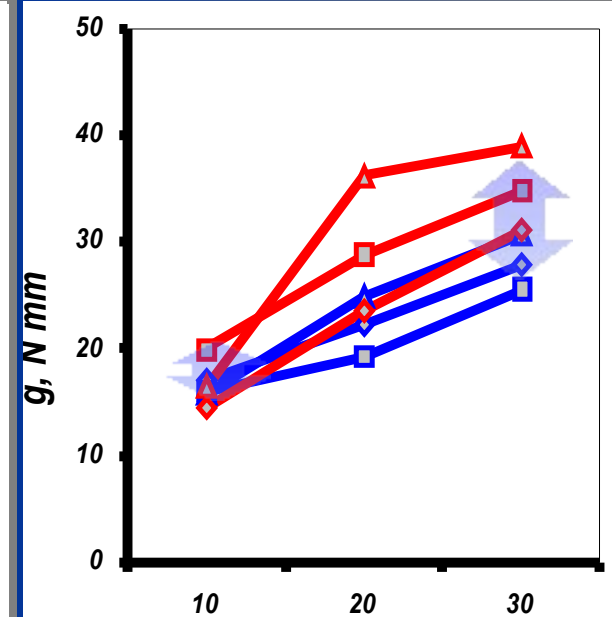
$S_{wc} - 420 m^2/kg$



TEMPERATURE, °C

10 min ◆ PE1 ▲ PE3 ■ PC
 60 min ◆ PE1 ▲ PE3 ■ PC

$Na_2O_e - 1,1\%$

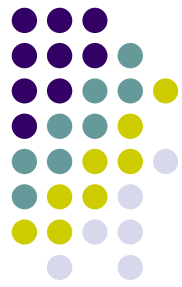


TEMPERATURE, °C

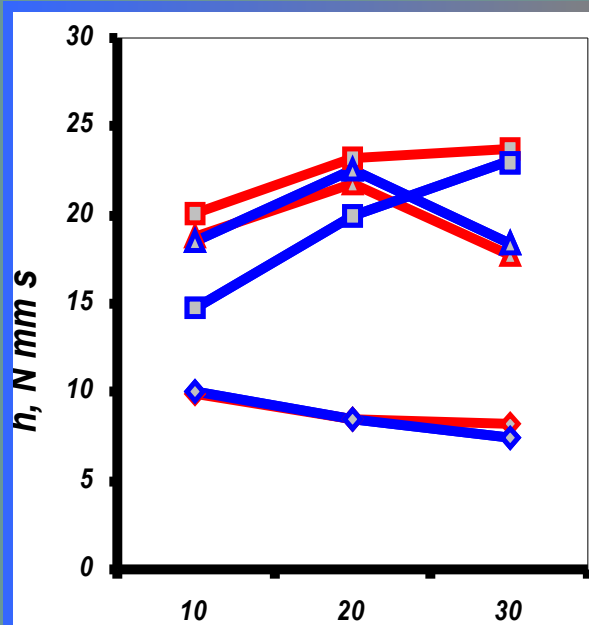
10 min ◆ PE1 ▲ PE3 ■ PC
 60 min ◆ PE1 ▲ PE3 ■ PC

Yield value g

Temperature and rheology of mixes with different cement – SP system

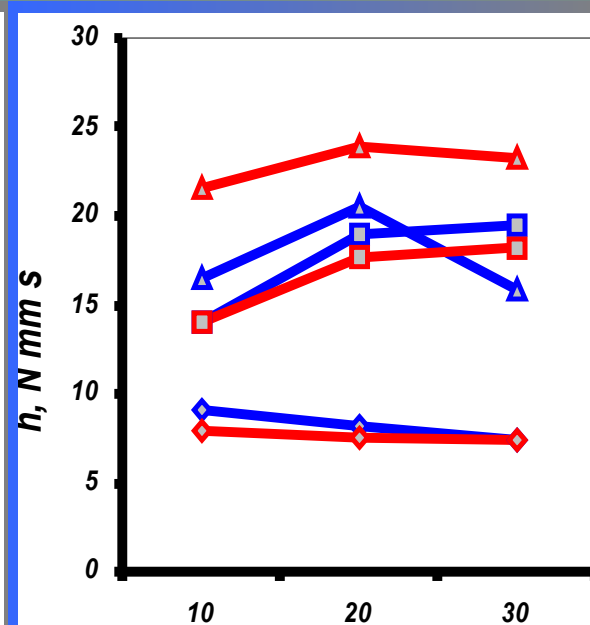


$C_3A - 2\div 12\%$



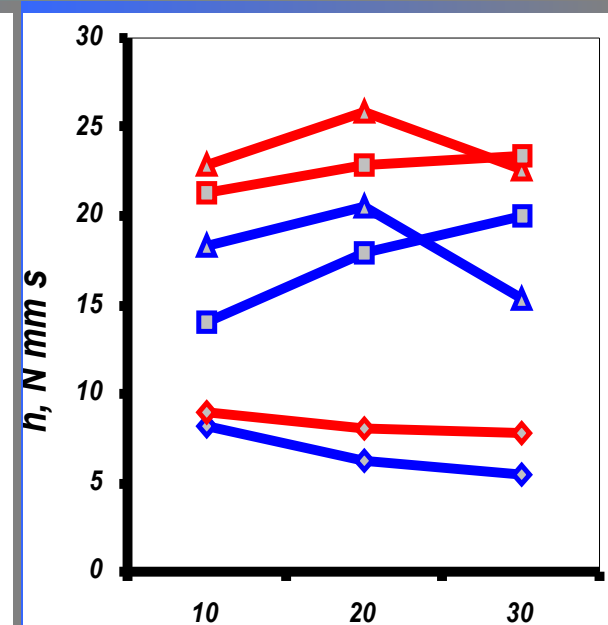
C_3A TEMPERATURE, °C
 2% PE1 PE3 PC
 12% PE1 PE3 PC

$Na_2O_e - 0,30\div 1,1\%$



Na_2O_e TEMPERATURE, °C
 0,3% PE1 PE3 PC
 1,1% PE1 PE3 PC

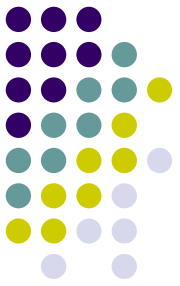
$S_{wc} - 320\div 420 m^2/kg$



S_{wc} TEMPERATURE, °C
 320 m^2/kg PE1 PE3 PC
 420 m^2/kg PE1 PE3 PC

Plastic viscosity h

Introduction

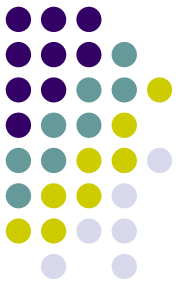


Changes in rheological properties of mixtures with temperature show ambiguous trends.

It is difficult to predict changes in rheological properties of SCC mixture caused by changes in temperature.

Influence of temperature on compatibility of cement and superplasticizer system and on rheological properties of fresh concrete should be experimentally established during mixture designing and development.

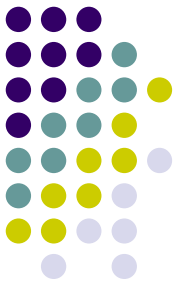
Introduction



Testing compatibility of cement and superplasticizer system and self-compacting mixture designing and development → cement paste rheology.

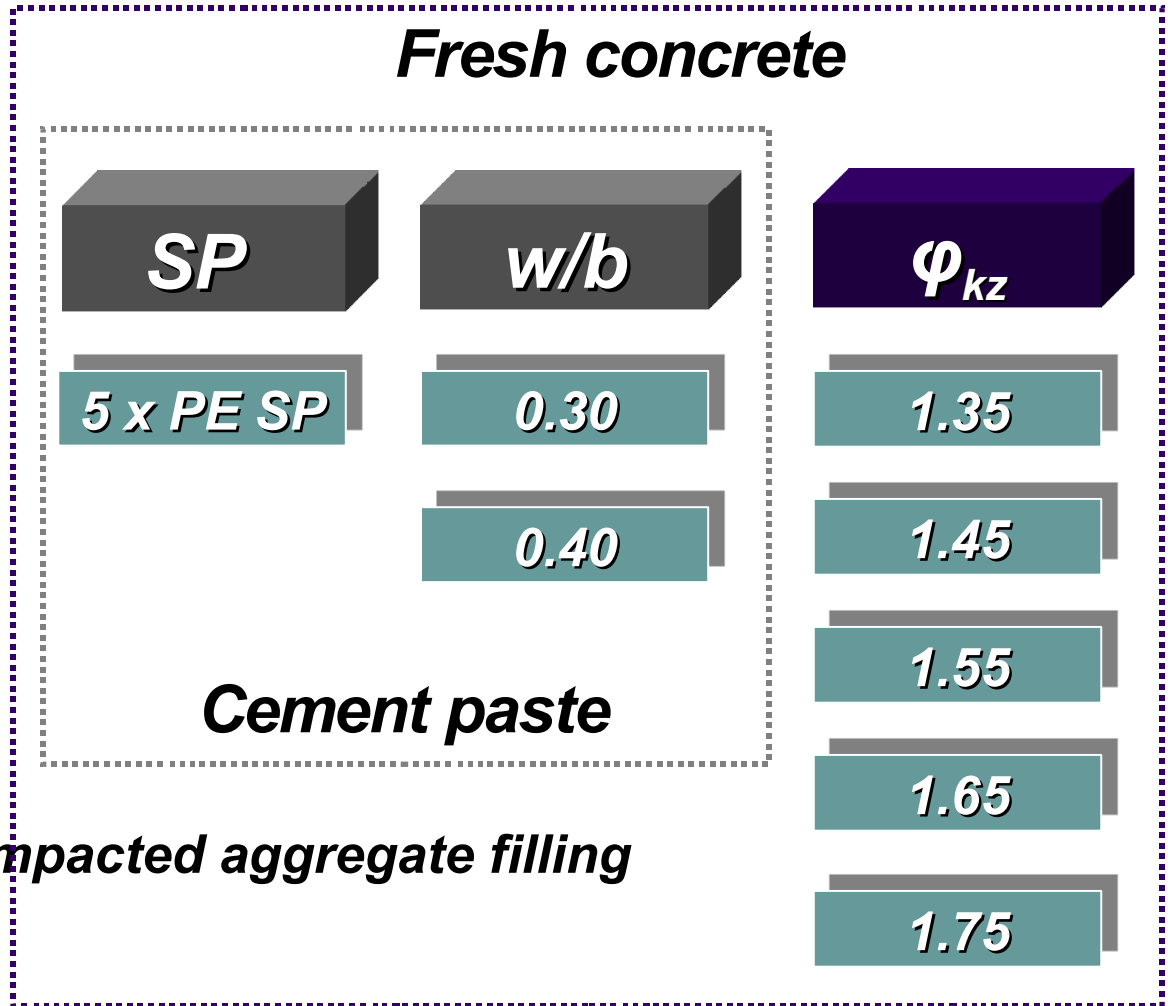
Obtained relationships of influence of different technological factors on rheological properties of cement paste, mortar and fresh concrete not always are unequivocal

Does temperature changes similarly rheological properties of cement paste and self-compacting mixture?



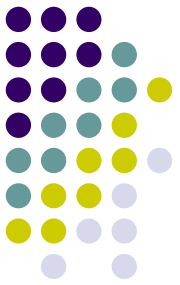
Testing program

Temperature
10, 20, 30°C



φ_{kz} → factor of uncompacted aggregate filling by cement paste

Materials and proportions

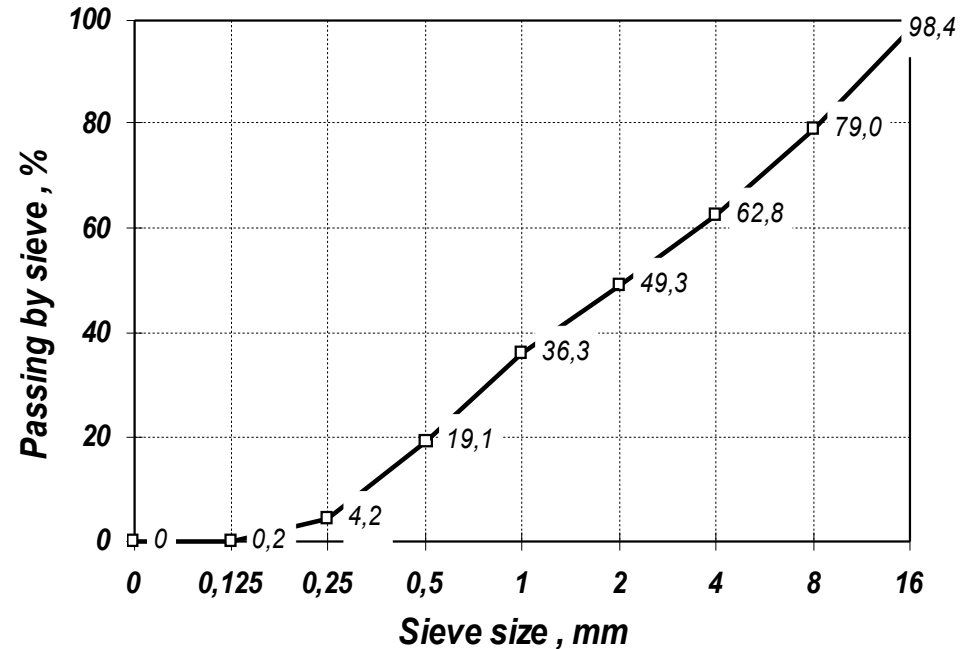


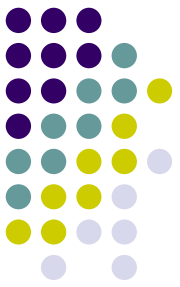
**Cement II/B-S +
limestone powder**
480 – 650 kg/m³

Cement paste volume
330 – 380 dm/m³

Coarse aggregate
0 – 16 mm

w/b = 0,30 – 0,40
SP = 1 – 0.7%





Testing method

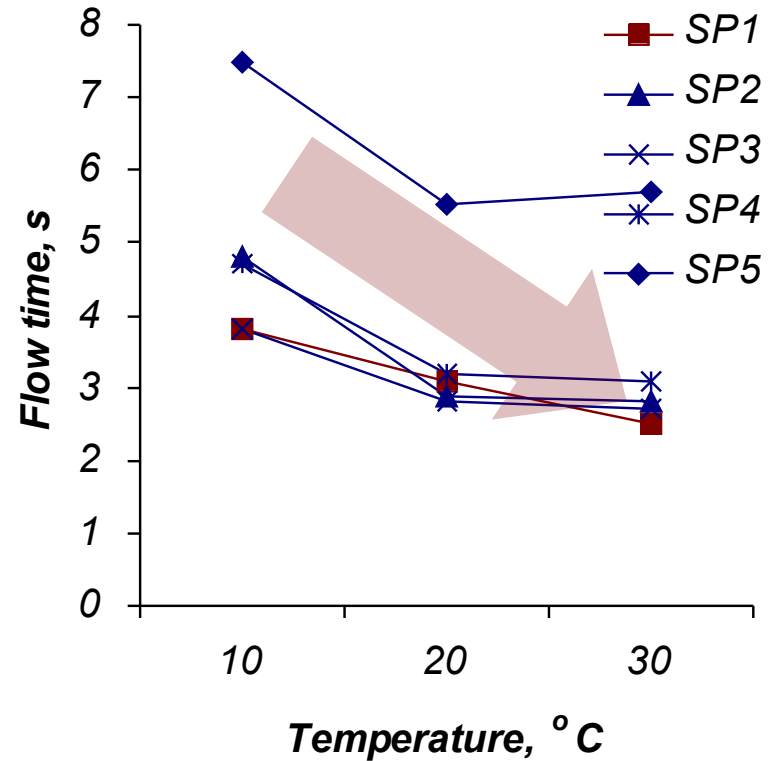
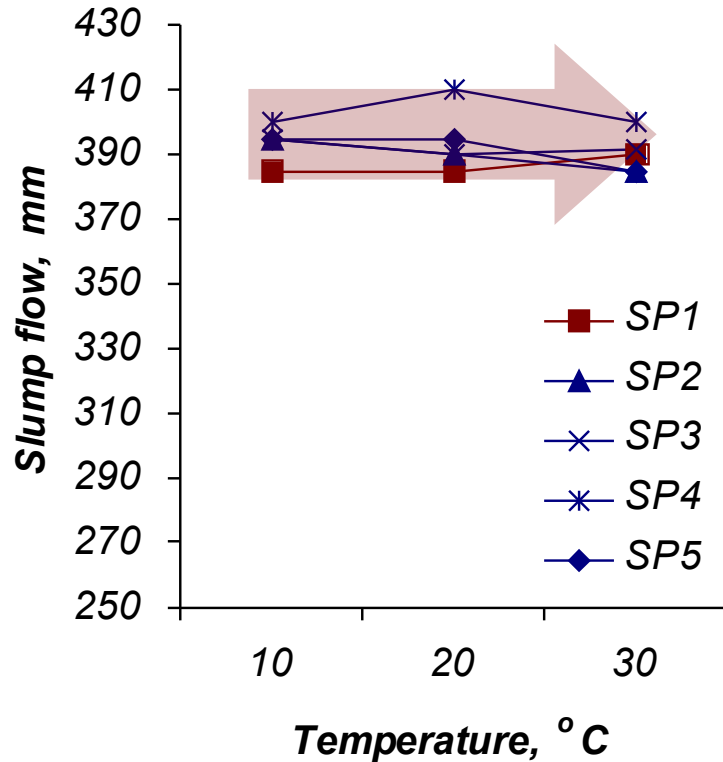
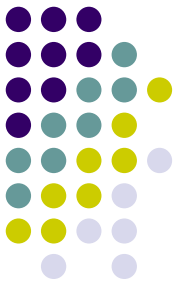
Cement paste and fresh concrete mixture exhibit the Bingham viscoplastic behaviour →

***rheological parameters:
yield value and plastic
viscosity***



Flow test

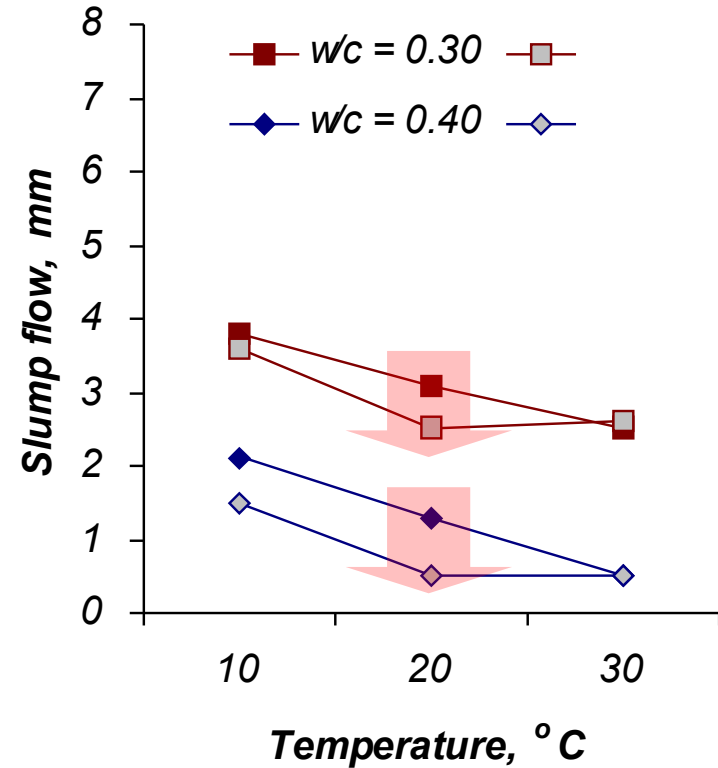
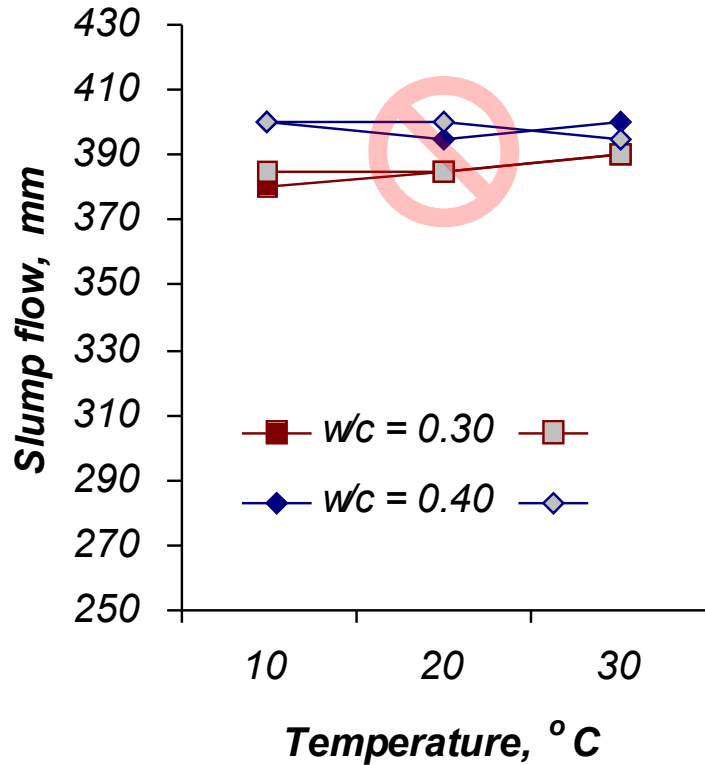
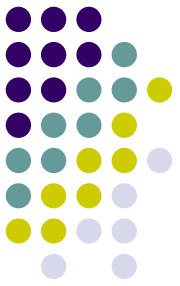
Influence of temperature on cement paste



after 20 min

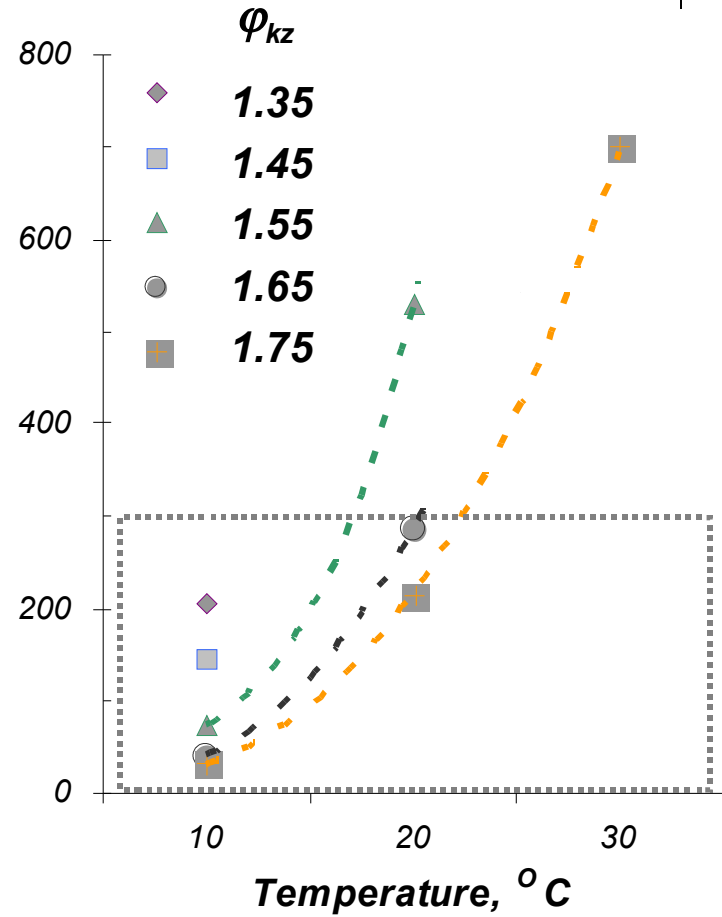
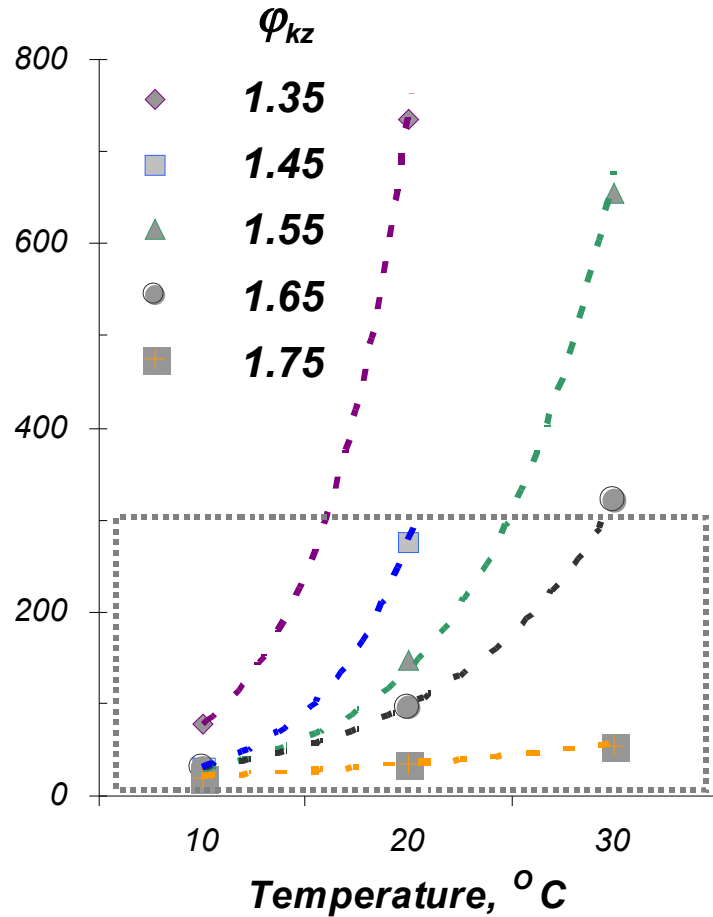
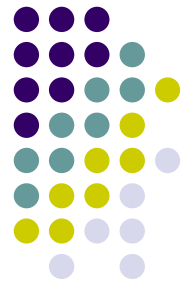
$w/b = 0.30$

Influence of temperature on cement paste



SP1

Influence of temperature on SCC yield value g

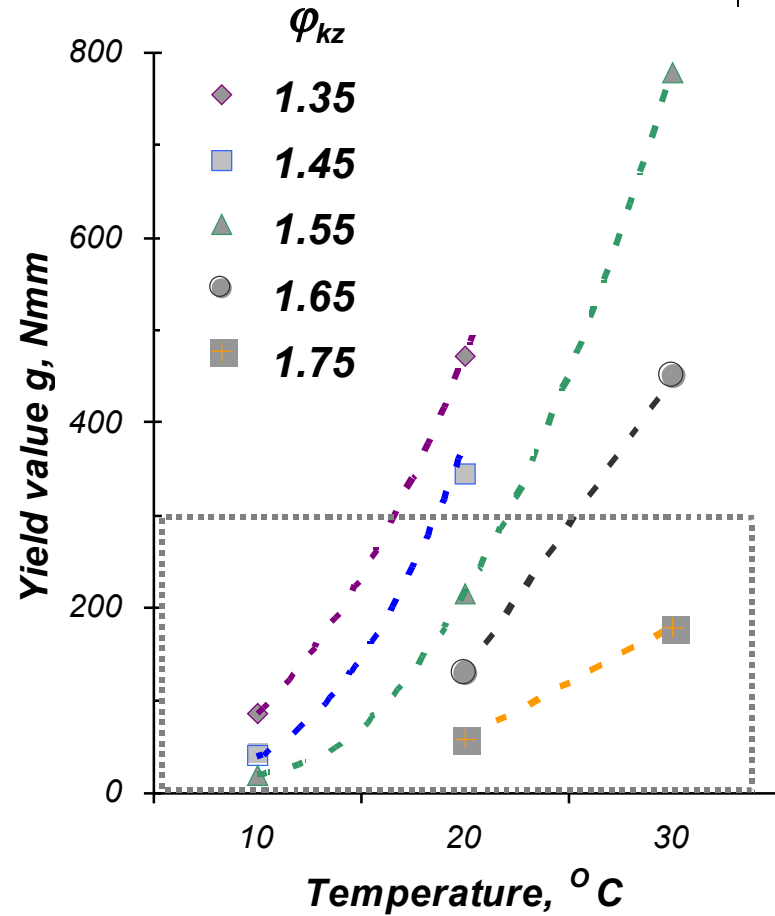
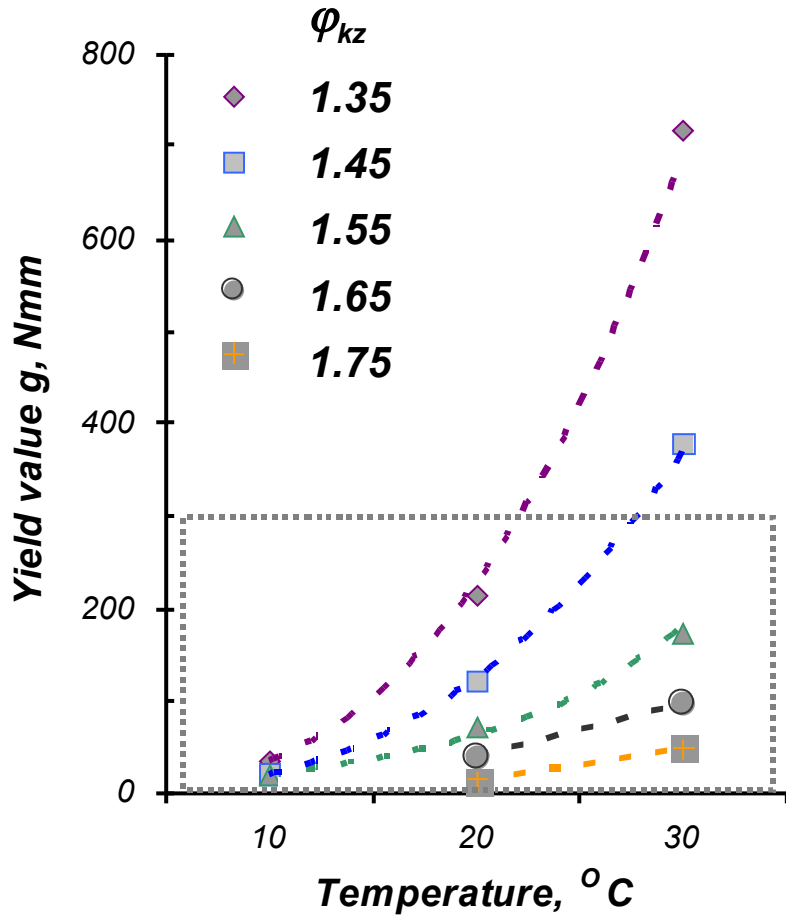
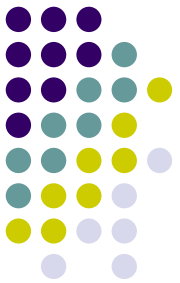


after 20 min

$w/c = 0.30$

after 60 min

Influence of temperature on SCC yield value g

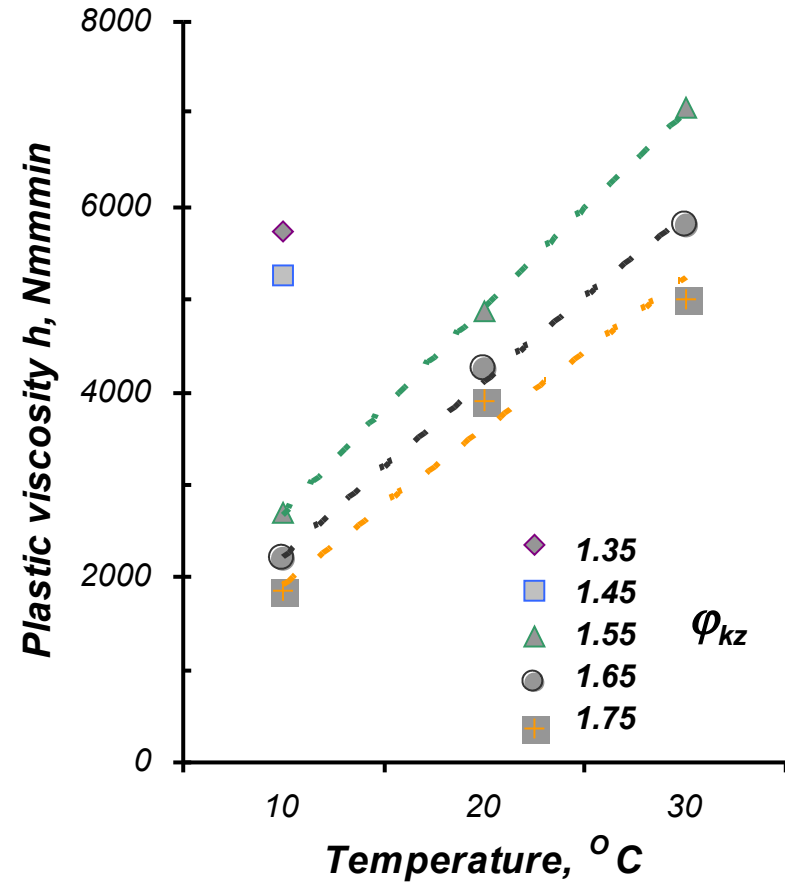
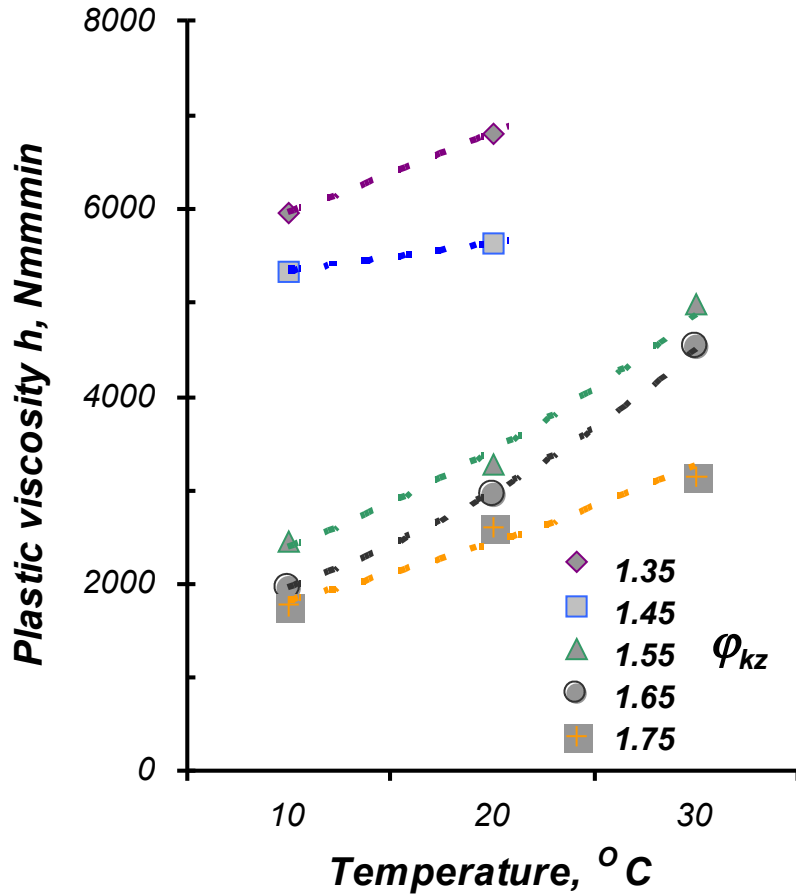
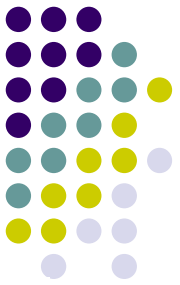


after 20 min

$w/c = 0.40$

after 60 min

Influence of temperature on SCC plastic viscosity h

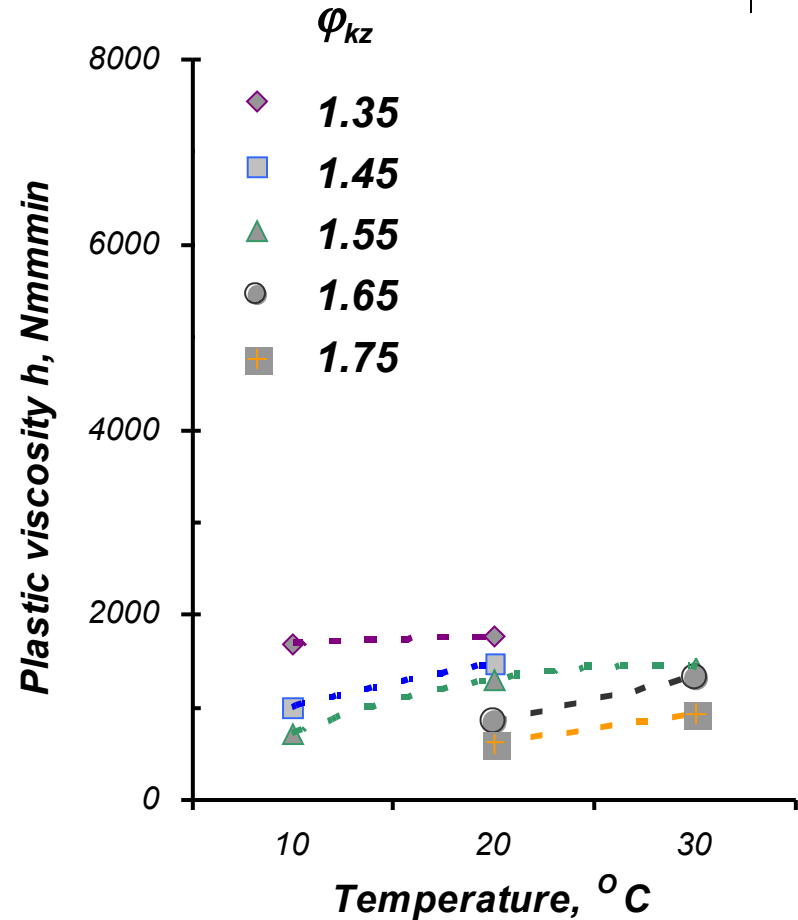
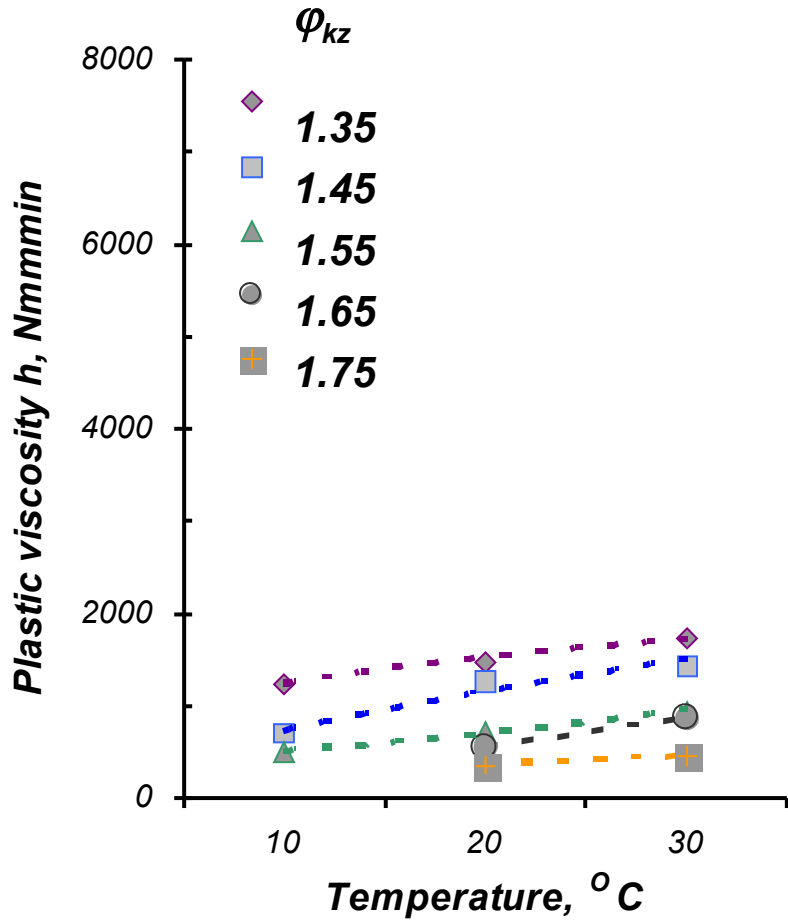
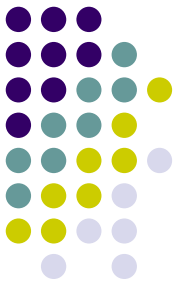


after 20 min

$w/c = 0.30$

after 60 min

Influence of temperature on SCC plastic viscosity h

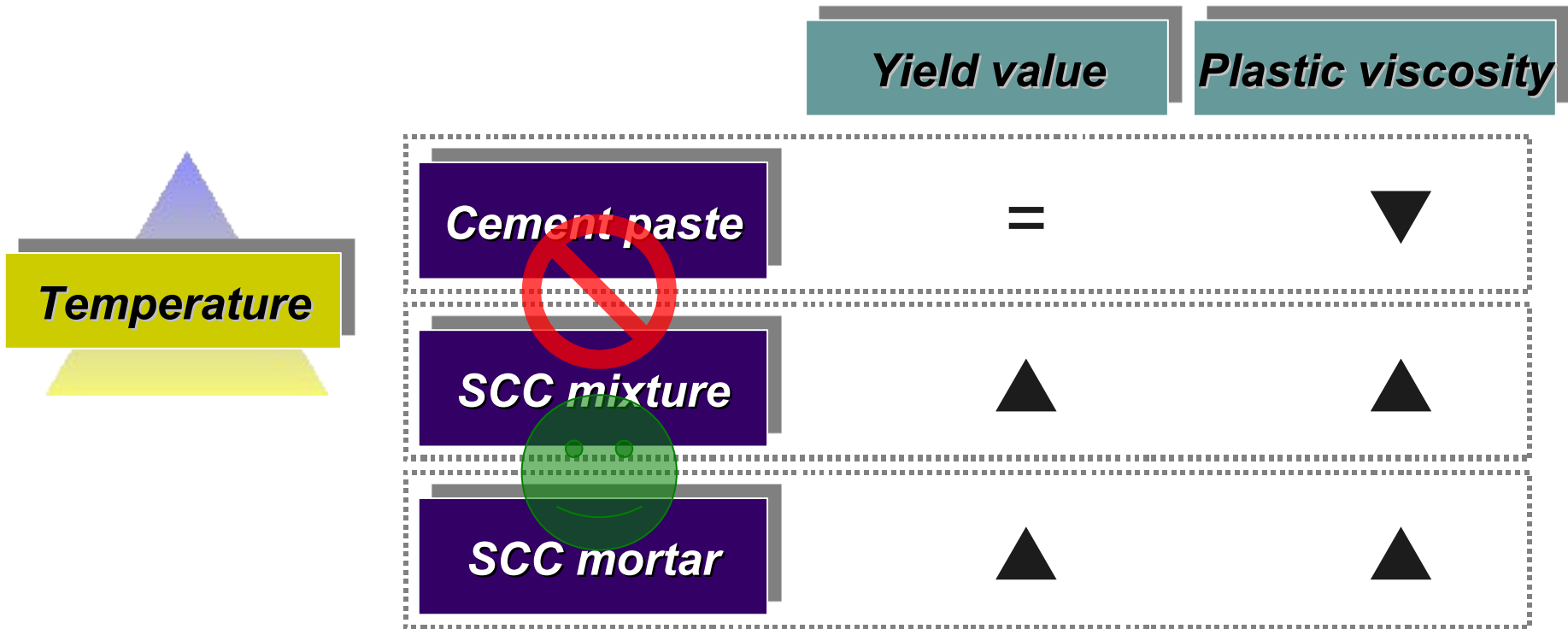
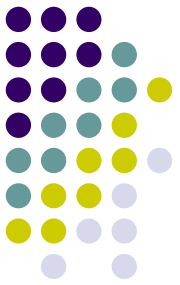


after 20 min

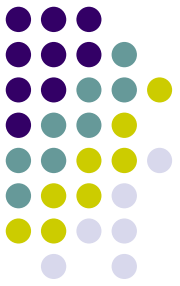
w/c = 0.40

after 60 min

Influence of temperature Cement paste vs SCC mixture



Conclusions



Temperature influences rheology of cement paste and fresh self-compacting concrete. Temperature is an important factor which must be taken into account in designing and development self-compacting concrete.

Testing influence of temperature on cement paste may be inadequate for selection of compatible cement – superplasticizer system and in designing workability of self-compacting concrete.

The results obtained with mortars generally may be used for predicting trends of changes in rheological behavior of fresh concrete in different temperatures.