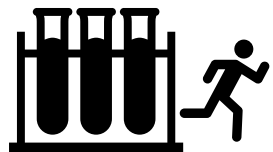


# Samspil mellem superplast og cement

v. Jacob Drejer

# Intro



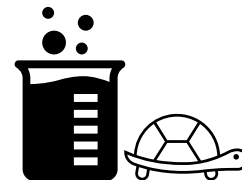
Accelerator



Flyveaske



Sand



Retarder



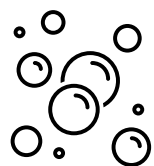
Kalkfiller



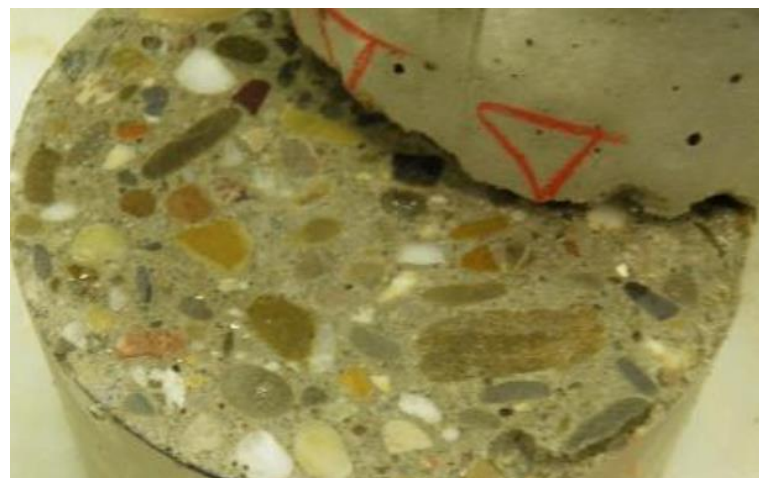
Superplast



Sten



Luftindblanding



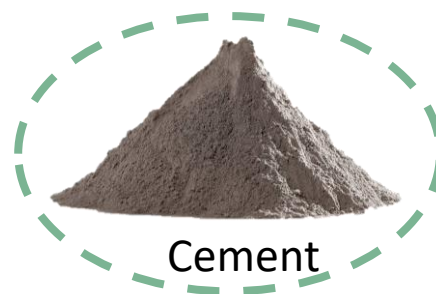
Vand



Kalcineret ler



Mikrosilica



Cement



Slagge/GGBS

# Agenda

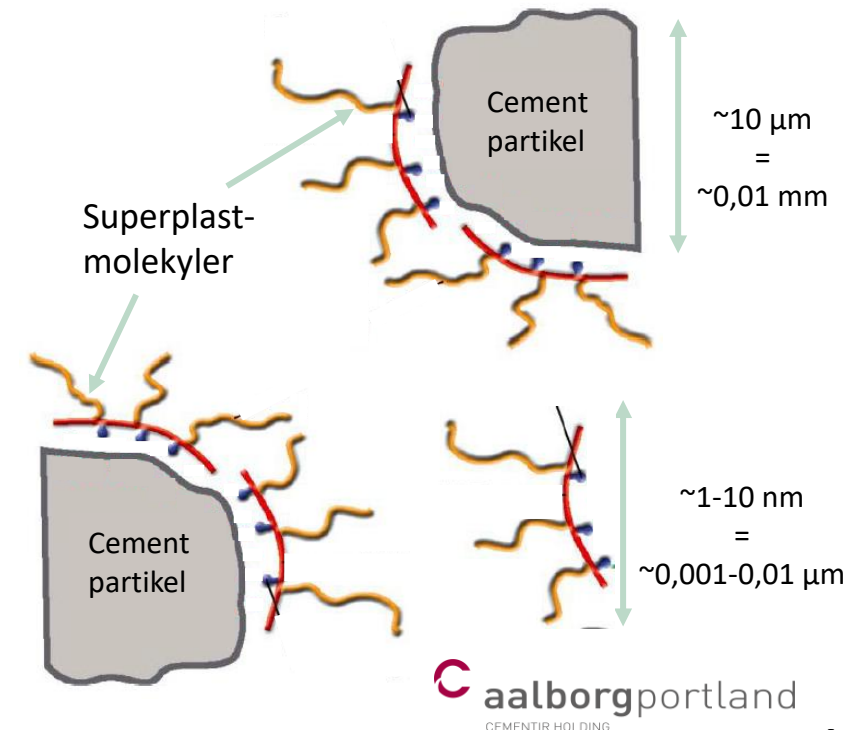
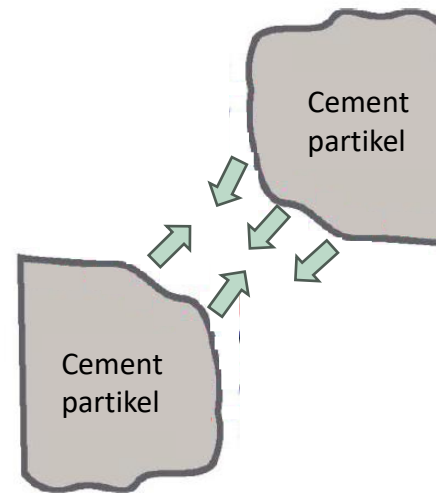
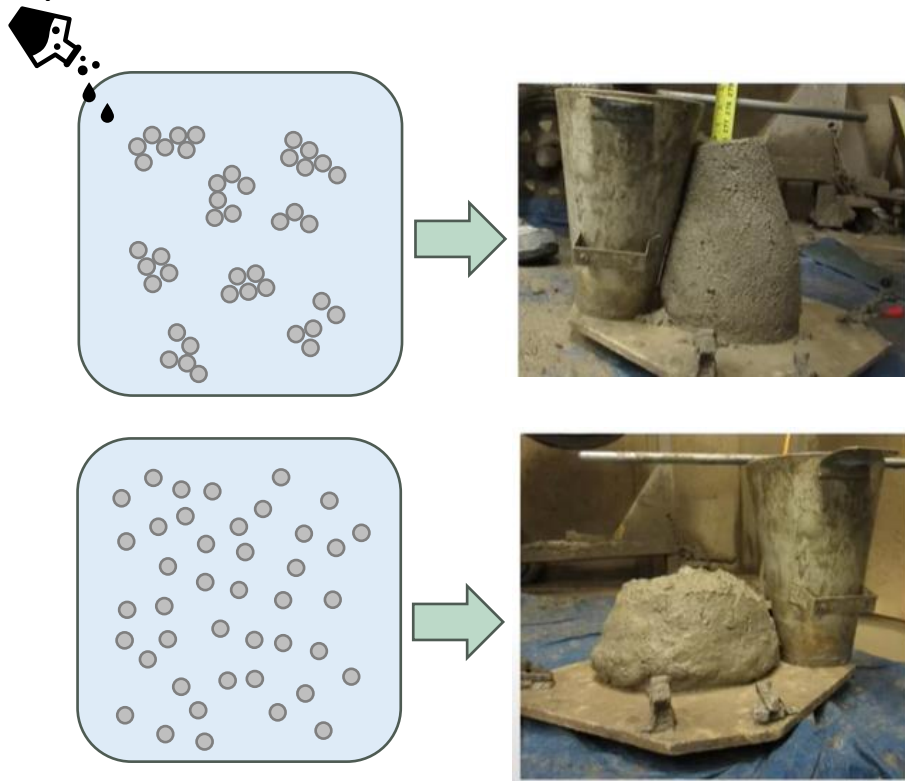
- Hvordan virker superplast?
  - Cementens bestanddele
  - Superplasts opbygning
- Hvor adsorberes superplast?
- Hvad påvirker adsorptionen af superplast?
- Opsummering

# Hvordan virker superplast?

- Cementpartikler danner agglomerater (klumper sammen), hvilket kan modvirkes med superplast
- Superplast adsorberer til cementpartiklers overflader og forhindrer dannelsen af agglomerater

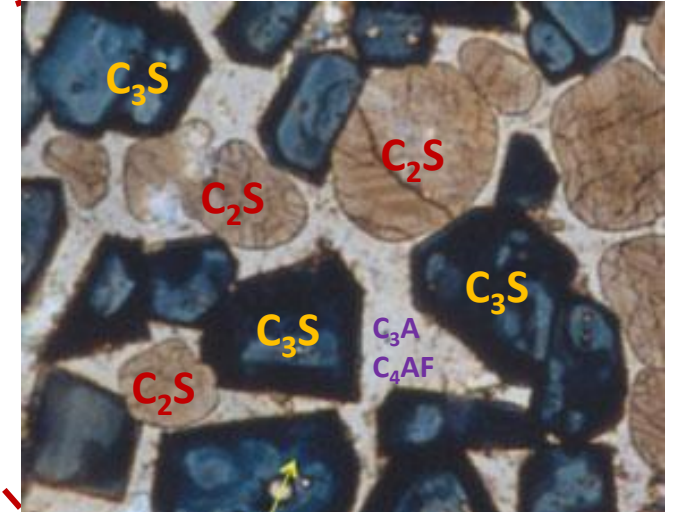
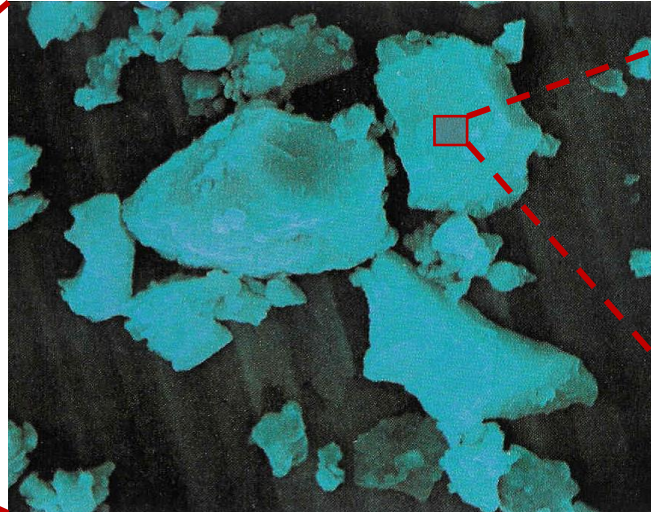
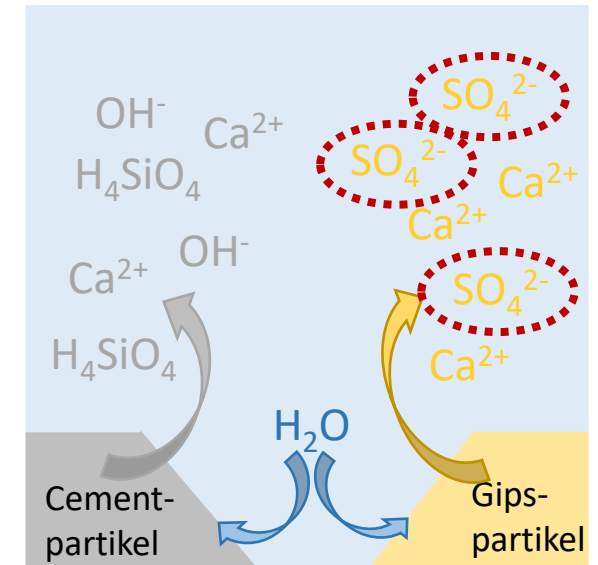


Superplast



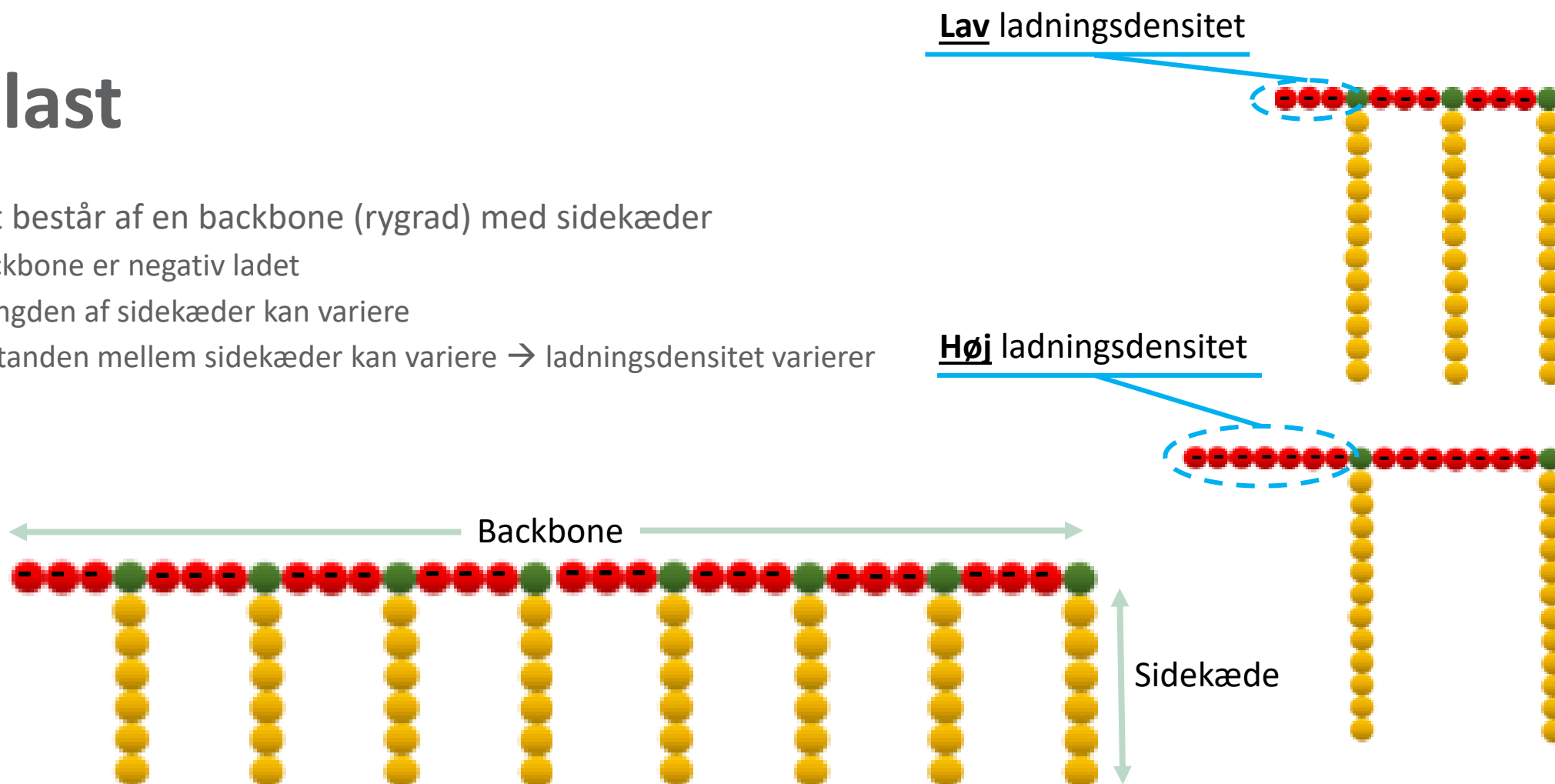
# Cements bestanddele

- Cementpartikler består af hovedsageligt 4 klinkemineraler
  - $C_3S$ ,  $C_2S$ ,  $C_3A$  og  $C_4AF$
- Derudover indeholder cement omkring 4 % gips
  - Gips danner følgende ioner ved kontakt med vand:  $Ca^{2+}$  og  $SO_4^{2-}$
  - $SO_4^{2-}$  fra gips sikrer, at betonen ikke lynafbinder



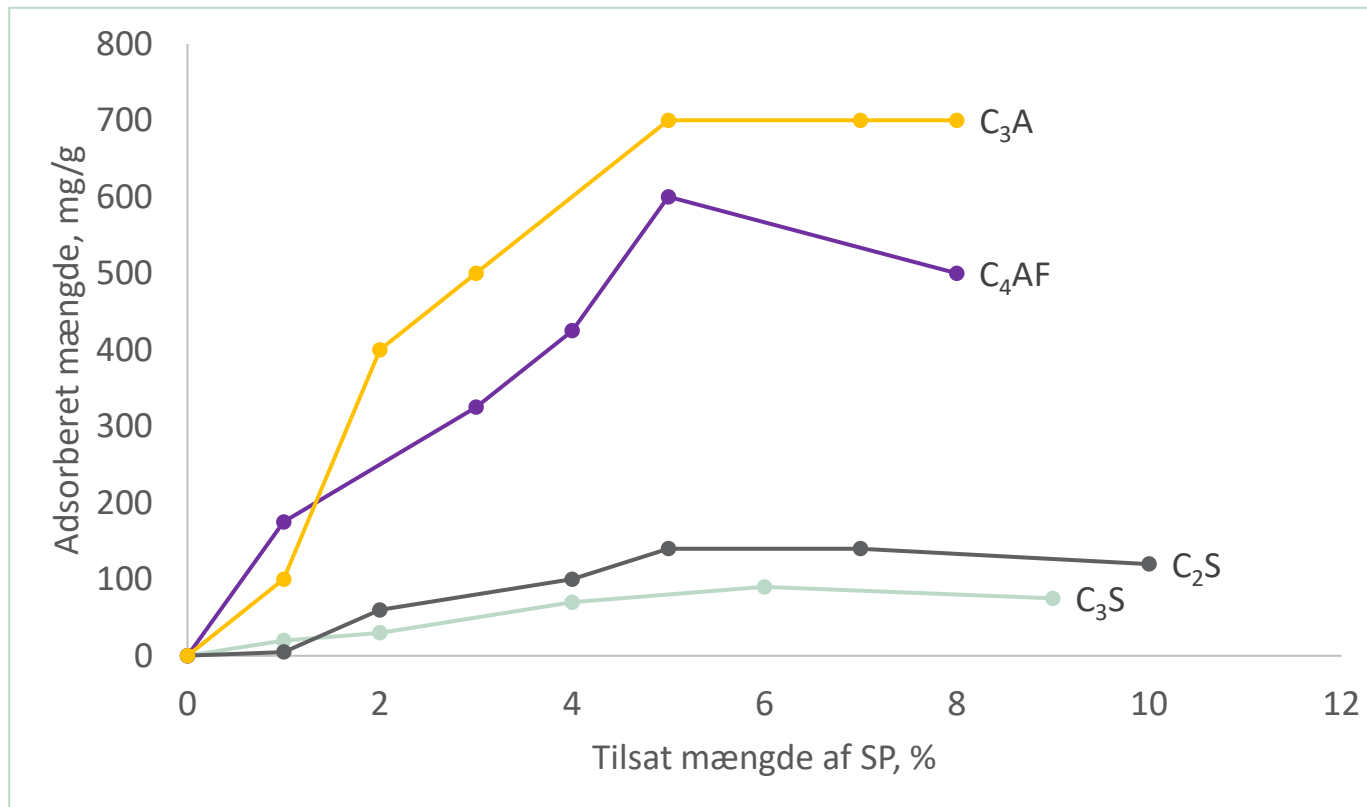
# Superplast

- Superplast består af en backbone (rygrad) med sidekæder
  - Backbone er negativ ladet
  - Længden af sidekæder kan variere
  - Afstanden mellem sidekæder kan variere → ladningsdensitet varierer

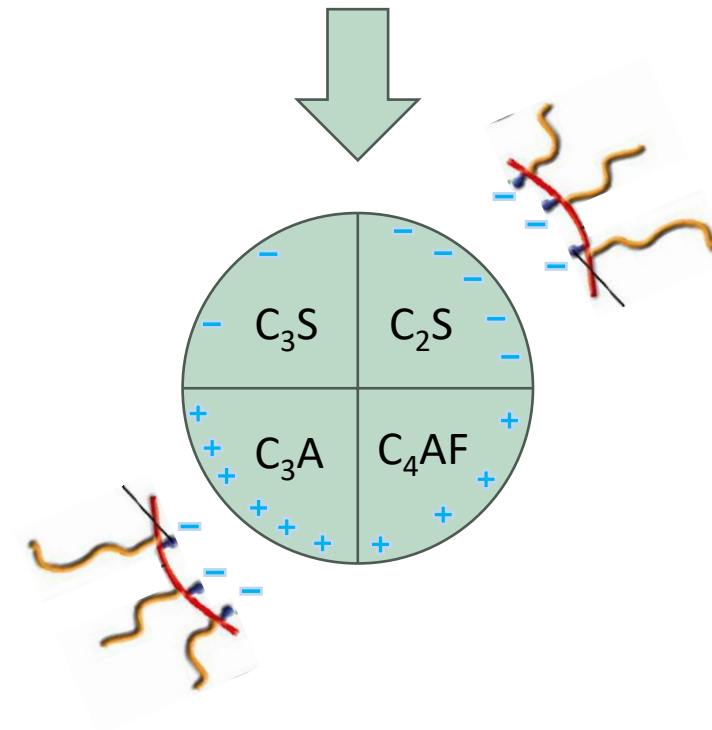
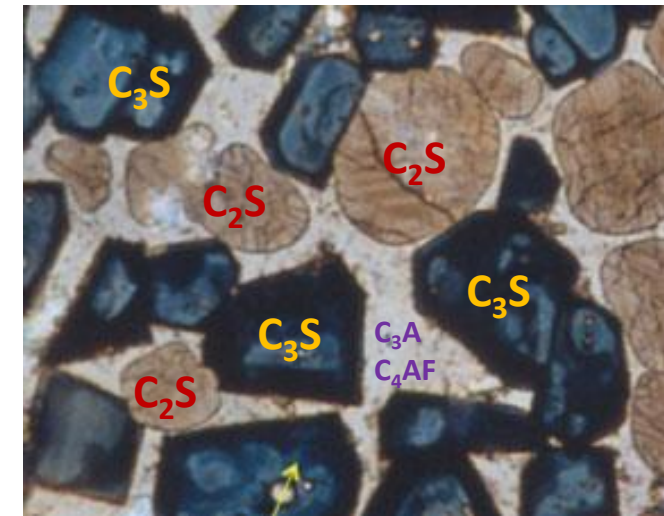


# Hvor adsorberes superplast?

- Negativ ladet SP adsorberer til/tiltrækkes af positiv ladede overflader
  - Negativ ladning:  $C_3S$  og  $C_2S$
  - Positiv ladning:  $C_3A$ ,  $C_4AF$

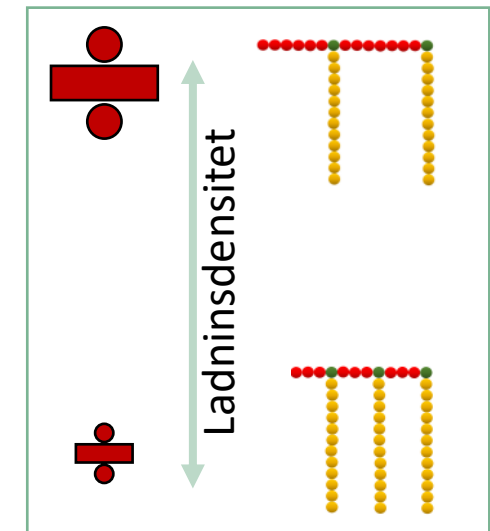
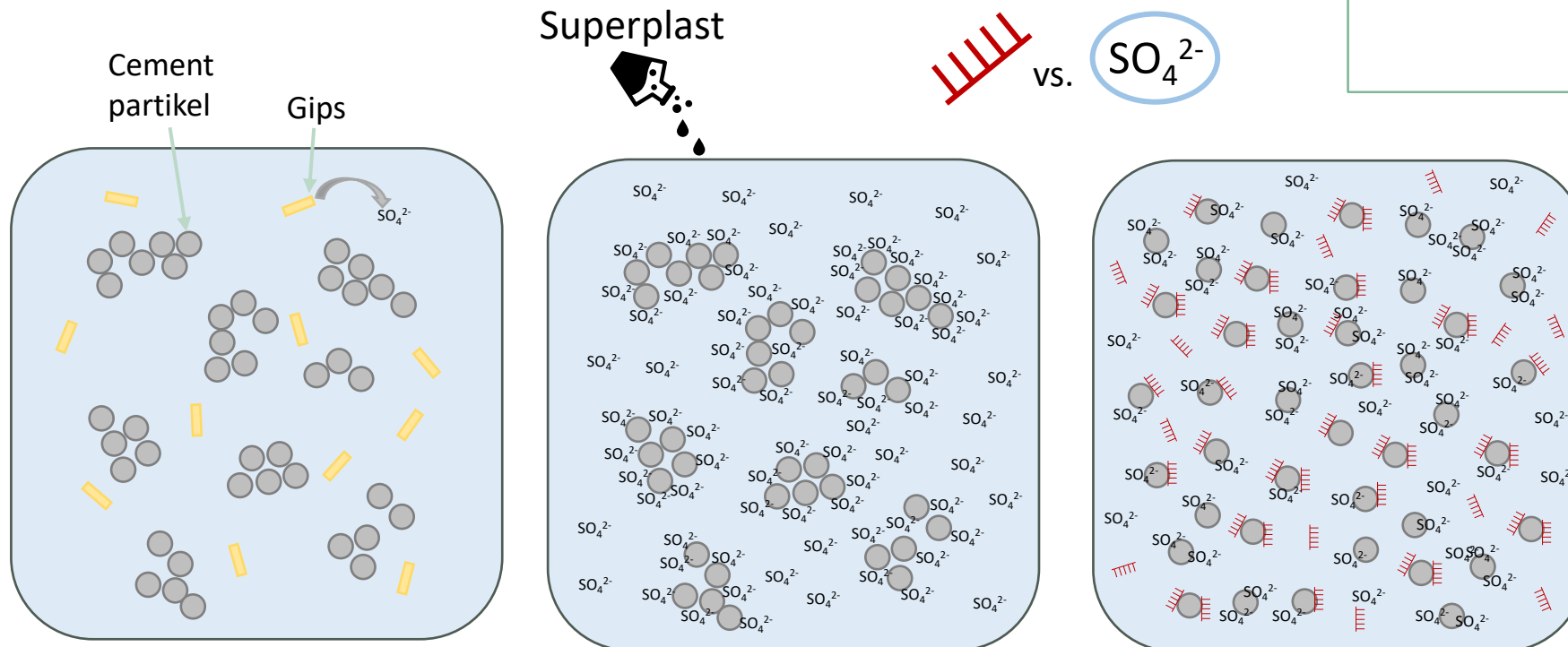
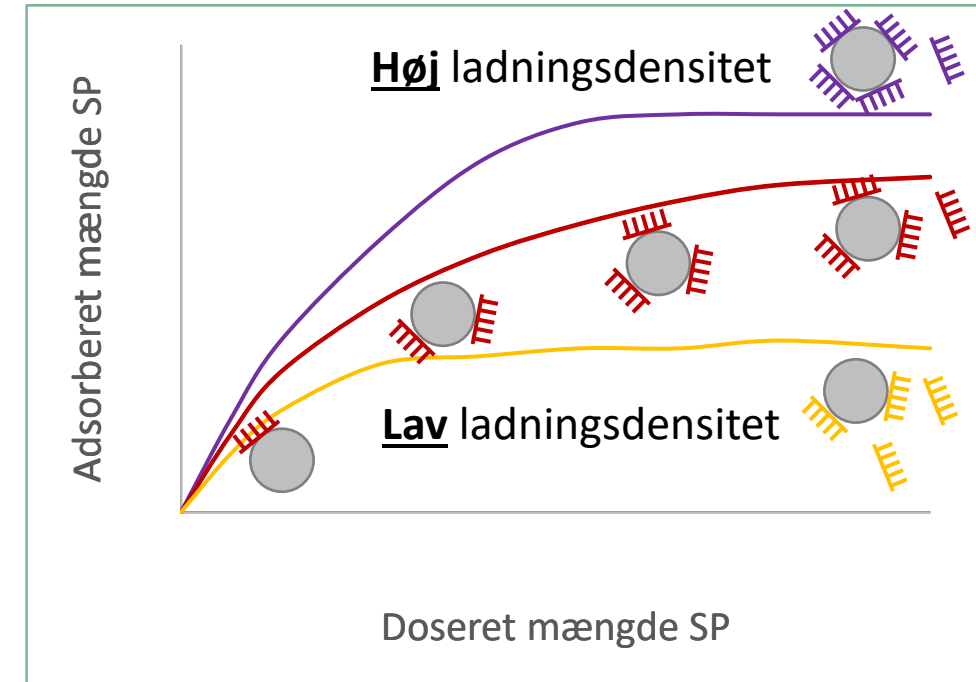


K. Yoshioka *et al.*, 2002

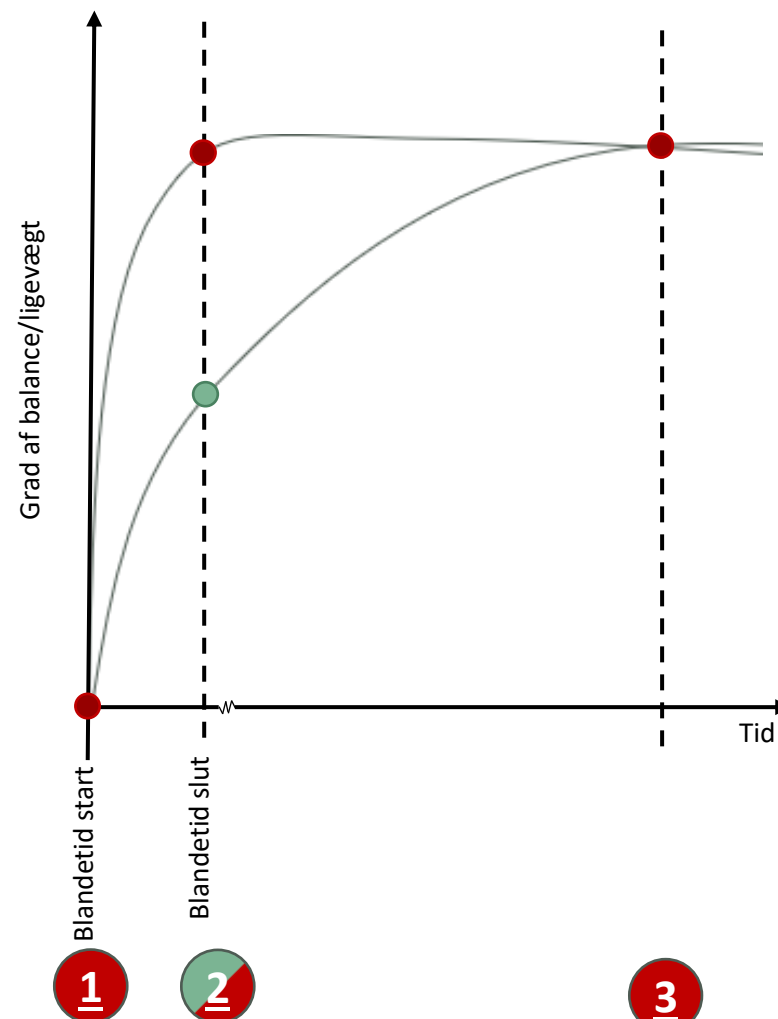
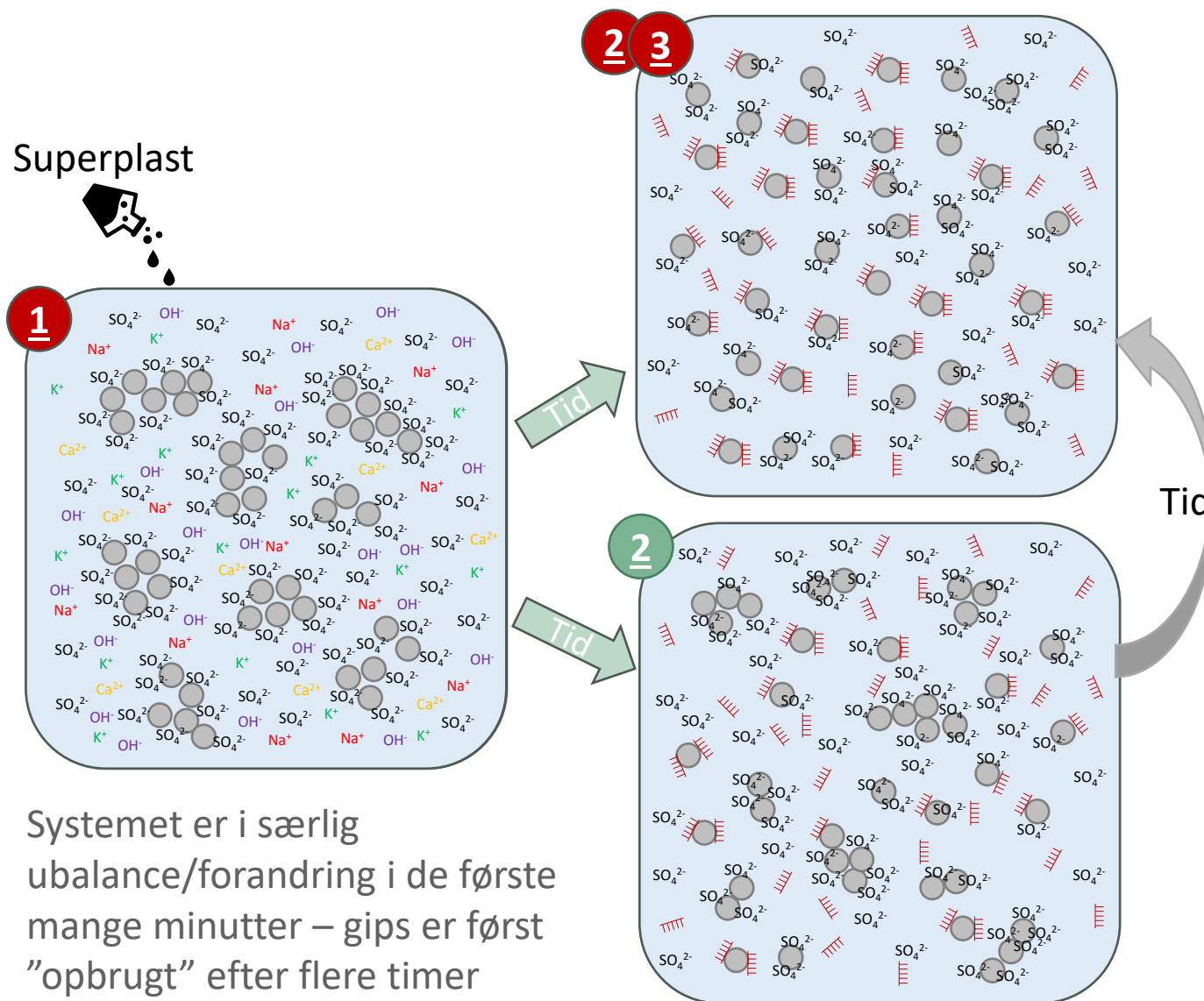


# Hvad påvirker adsorption af SP?

- Koncentration af superplast
- Ladningsdensitet på SP
- Koncentration af sulfat-ioner ( $\text{SO}_4^{2-}$ )
  - Sulfat-ioner stammer bl.a. fra gips ( $\text{CaSO}_4 \cdot \text{X H}_2\text{O}$ )
  - Sulfat-ioner er negativ ladet og ca. 0,5 nm i diameter

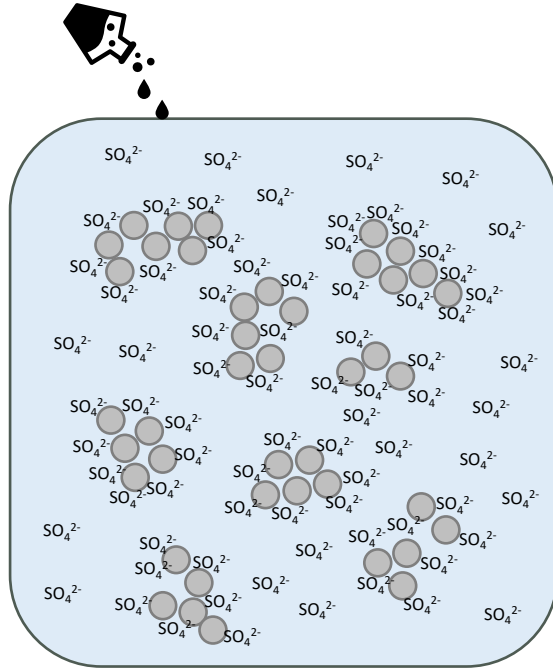


# Balancen mellem SP og $\text{SO}_4^{2-}$

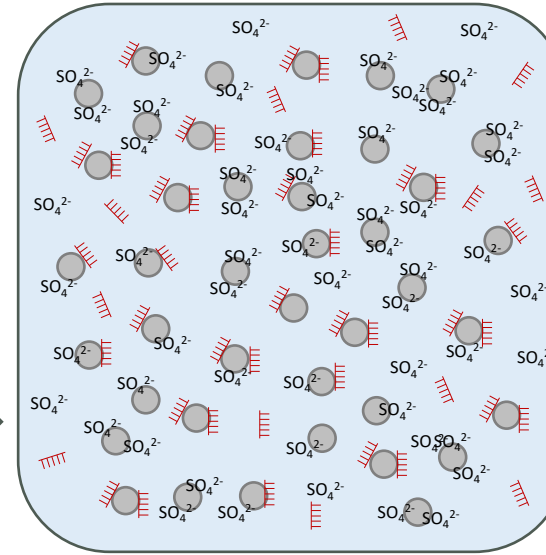


# Blandeprocedurens indflydelse

Superplast



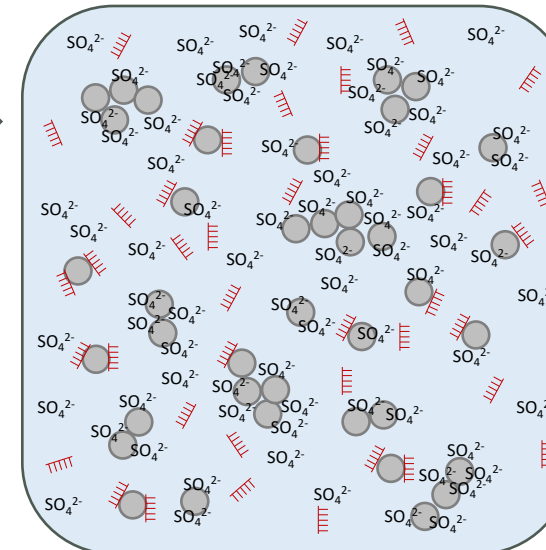
Effektiv blander /  
tilstrækkelig blandetid



Ingen agglomerater

Balance / ligevægt

Mindre effektiv blander /  
for kort blandetid

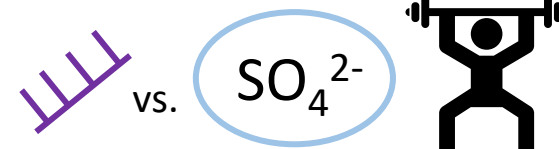
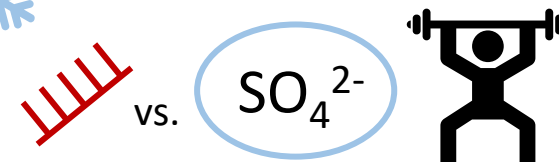
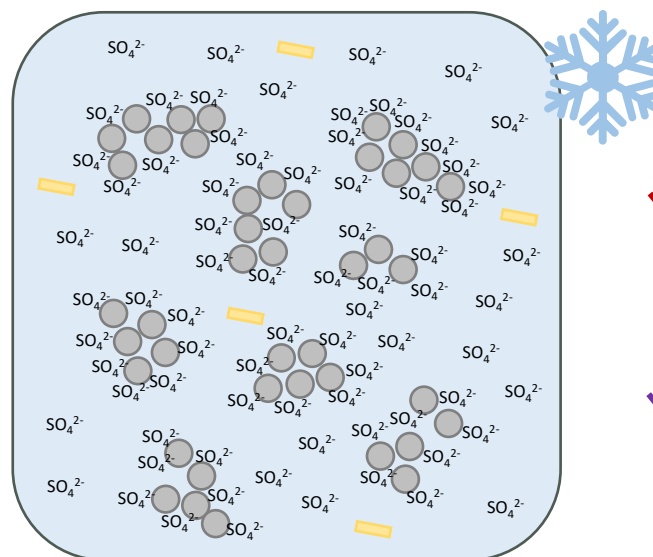
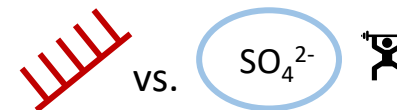
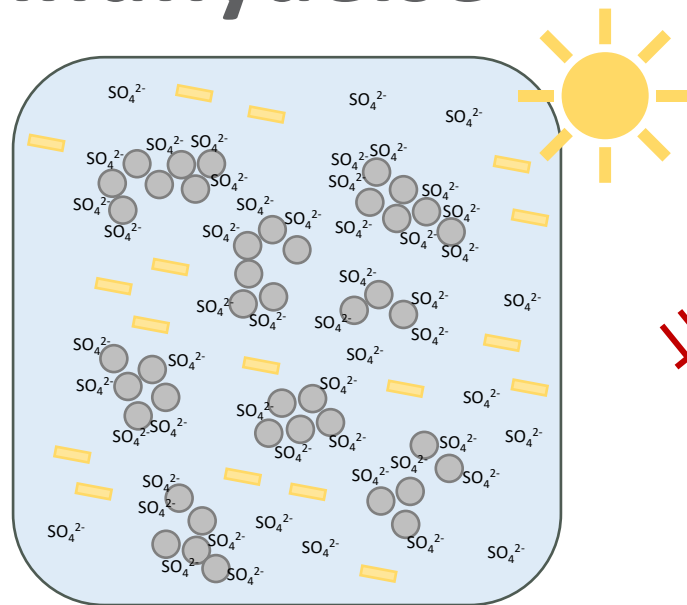
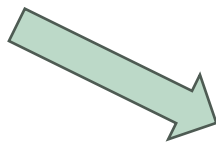
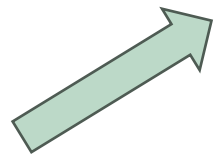


Forlænget  
blandetid

Fortsat agglomerater

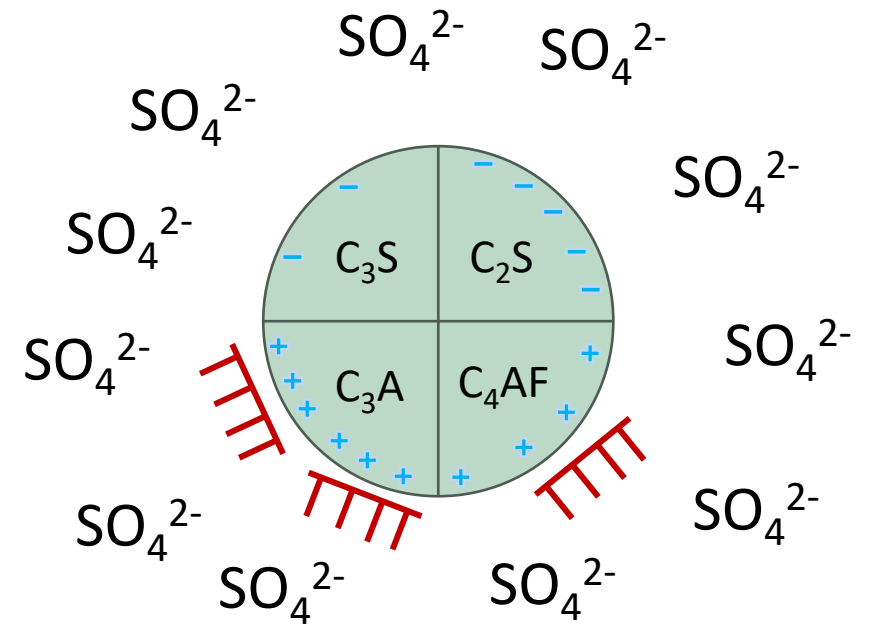
Ubalance /  
stadig i forandring

# Betontemperaturens indflydelse



# Opsummering

- Superplast er negativ ladet og tiltrækkes af positive områder på cementpartikler
- Sulfationer ( $\text{SO}_4^{2-}$ ) er negativ ladet og "kæmper" om de samme adsorption-sites som superplast
- Effekten af SP afhænger bl.a. af:
  - Koncentrationen af SP
  - SP's ladningsdensitet
  - Koncentrationen af opløst sulfat ( $\text{SO}_4^{2-}$ )
  - Tid og temperatur



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