Rheometry of Admixture Containing Cement Pastes

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Chemistry of Construction Materials

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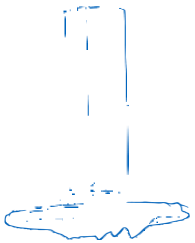
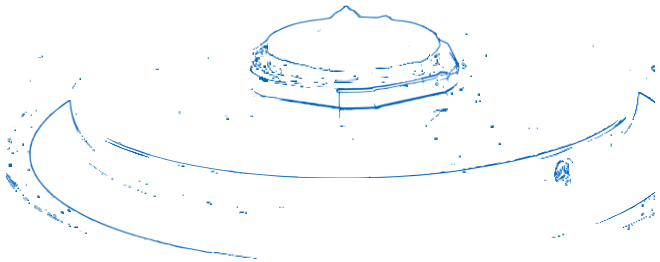
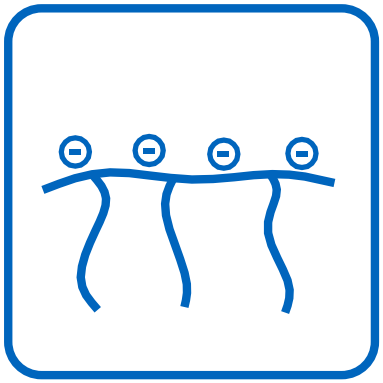
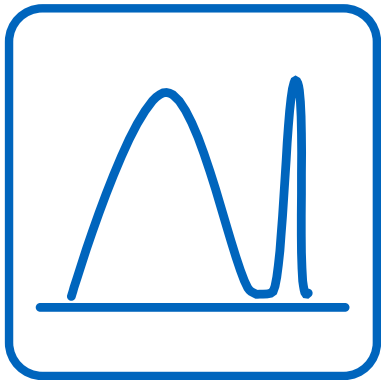


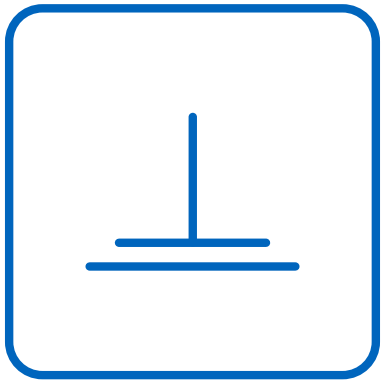




Synthesis

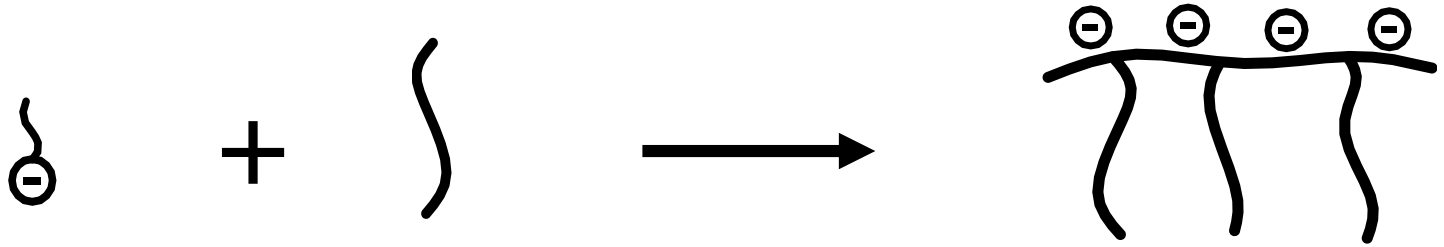


Characterization



Performance

Copolymer Synthesis

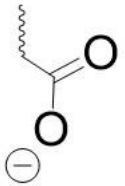


Anionic functionality

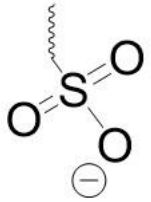
Side chain

Copolymer

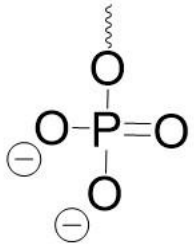
Anionic Functionality



Carboxylate

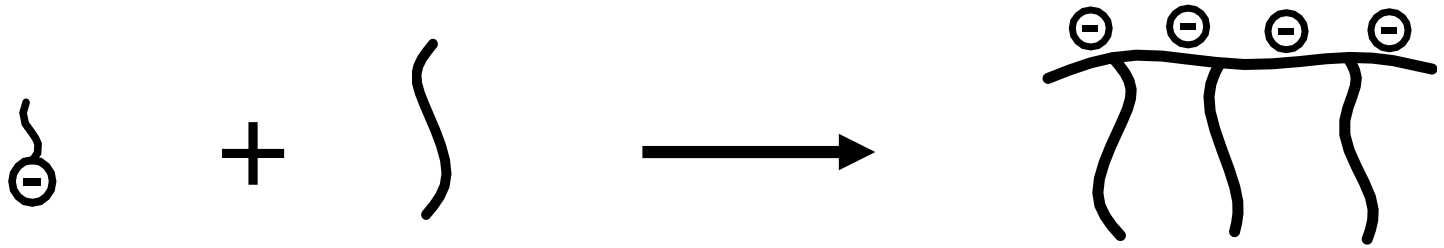


Sulfonate



Phosphate

Copolymer Synthesis

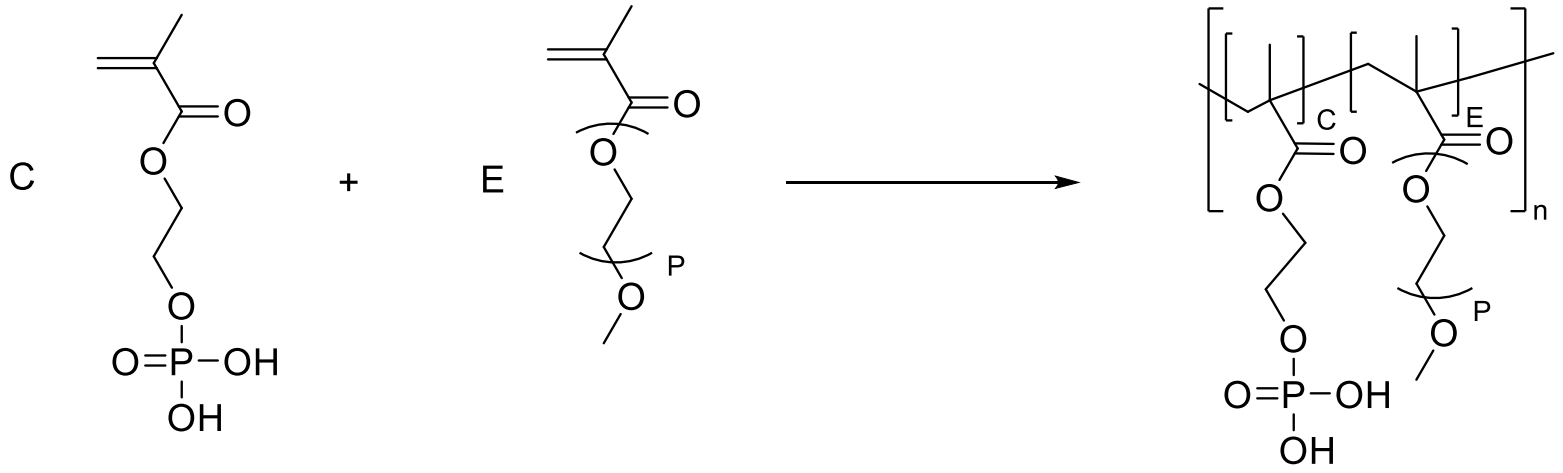


Anionic functionality

Side chain

Copolymer

Copolymer Synthesis

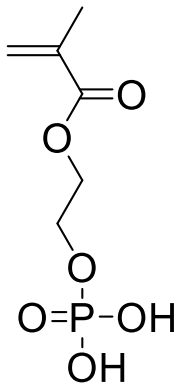


Anionic functionality

Side chain

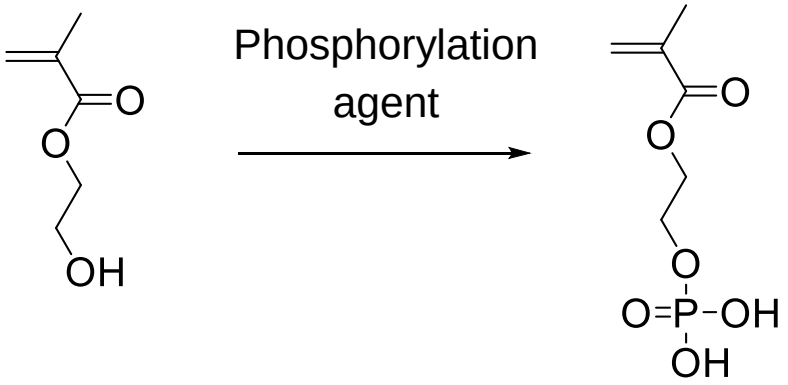
Copolymer

Monomer



2-(methacryloyloxy)-ethylphosphate
(monohemaphosphate, **MHP**)

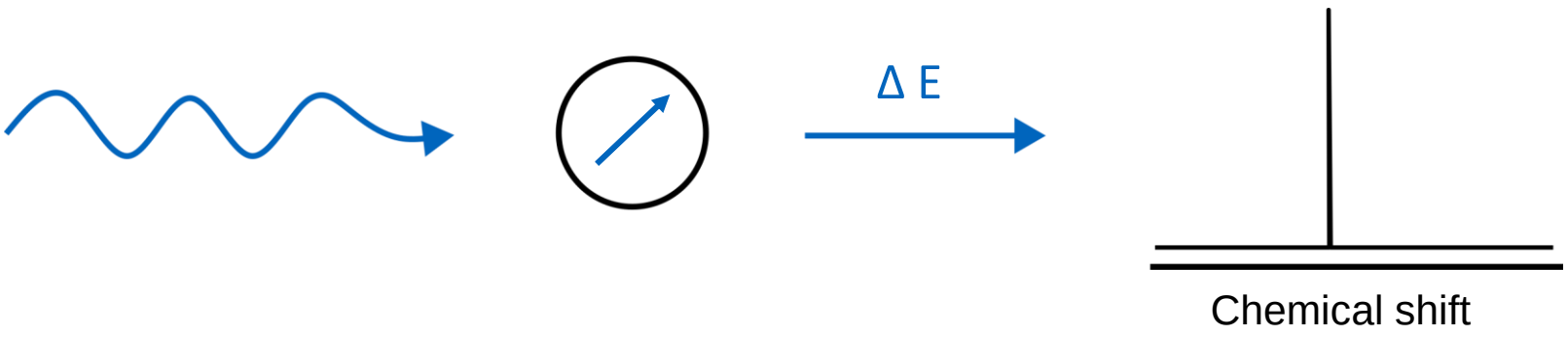
MHP Synthesis



2-**h**ydroxy**e**thyl**m**eth**a**crylate
(**HEMA**)

2-(methacryloyloxy)-ethylphosphate
(**m**ono**h**ema**p**hosphate, **MHP**)

Monomer Characterization: **N**uclear **M**agnetic **R**esonance (NMR) Spectroscopy

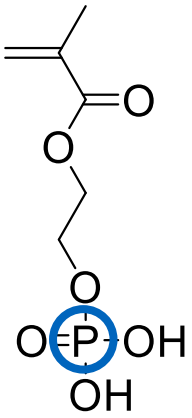


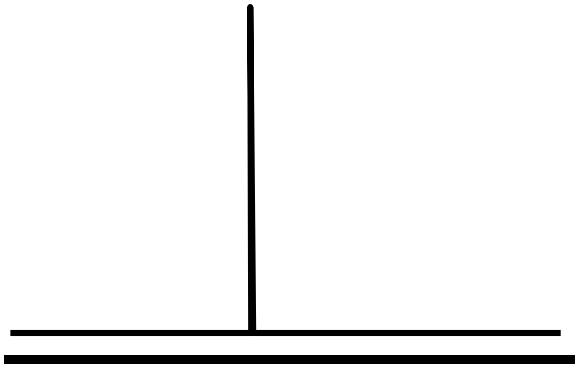
Electromagnetic radiation

Magnetically active atom nucleus

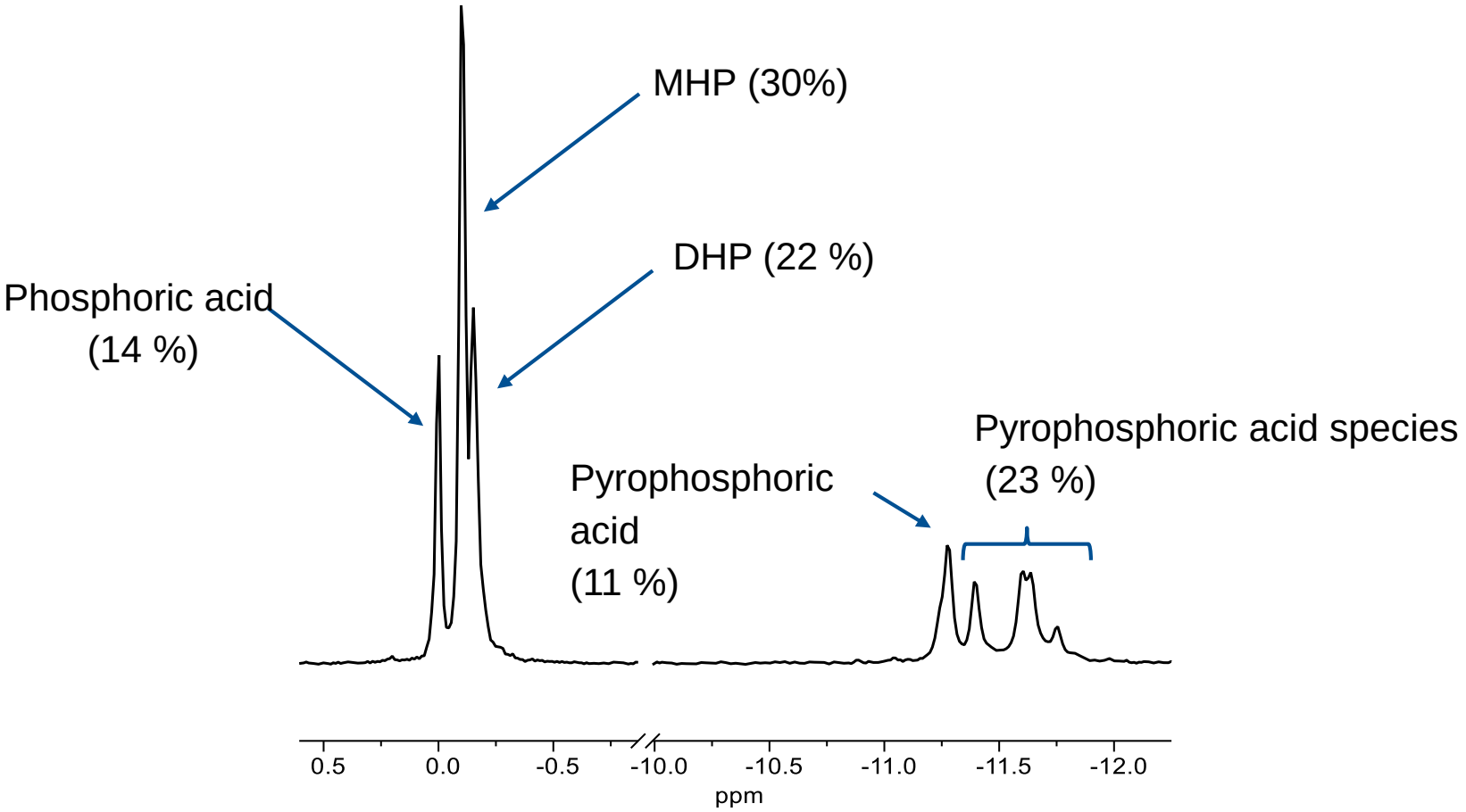
NMR spectrum

Monomer Characterization: ^{31}P-NMR

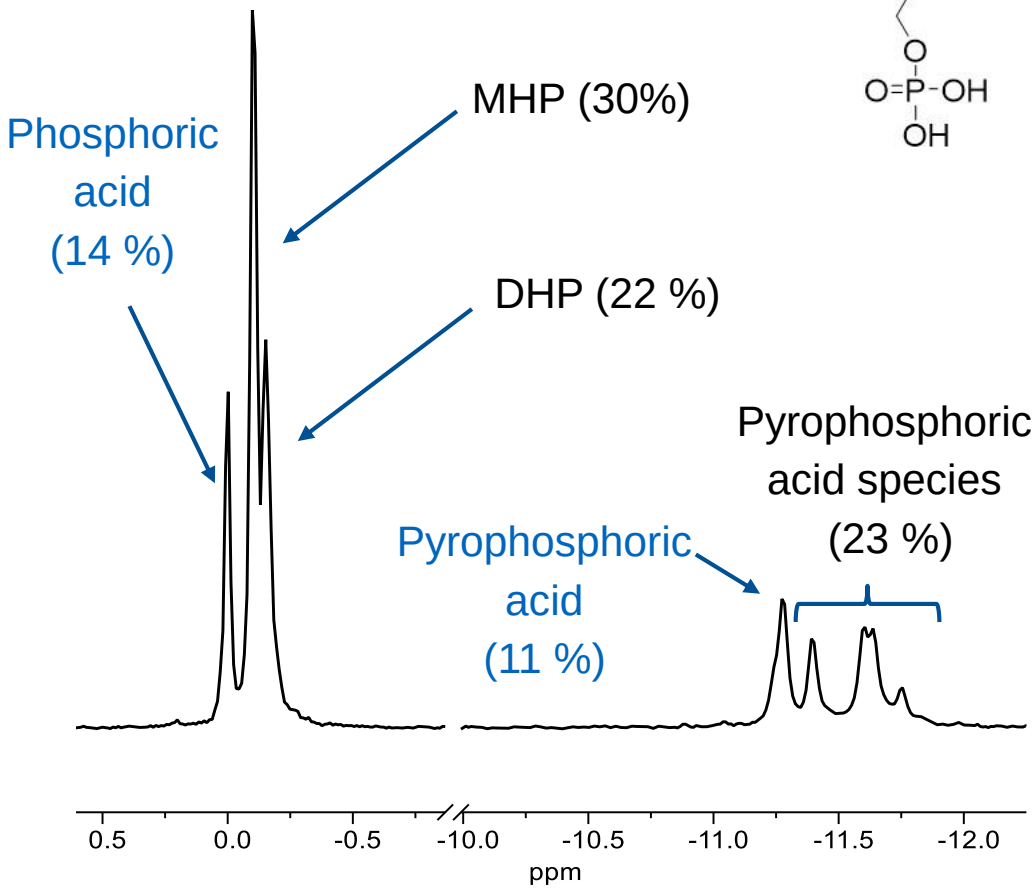


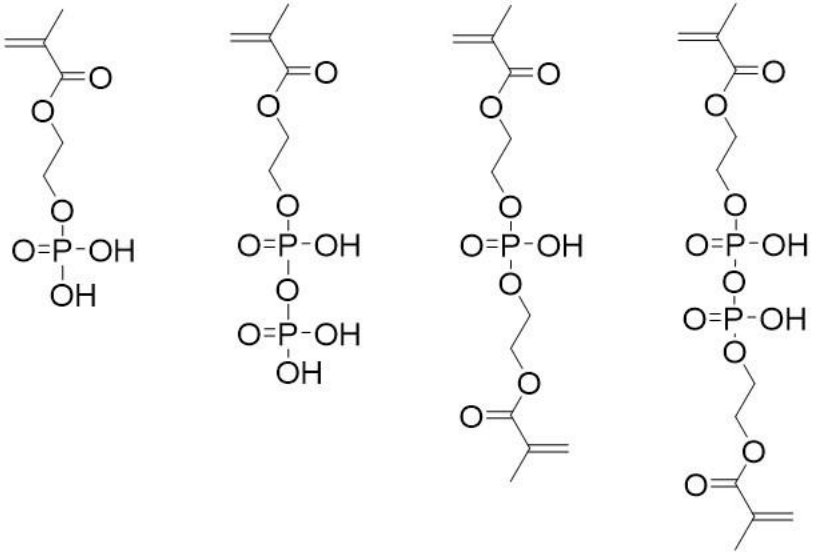


Commercial „MHP“

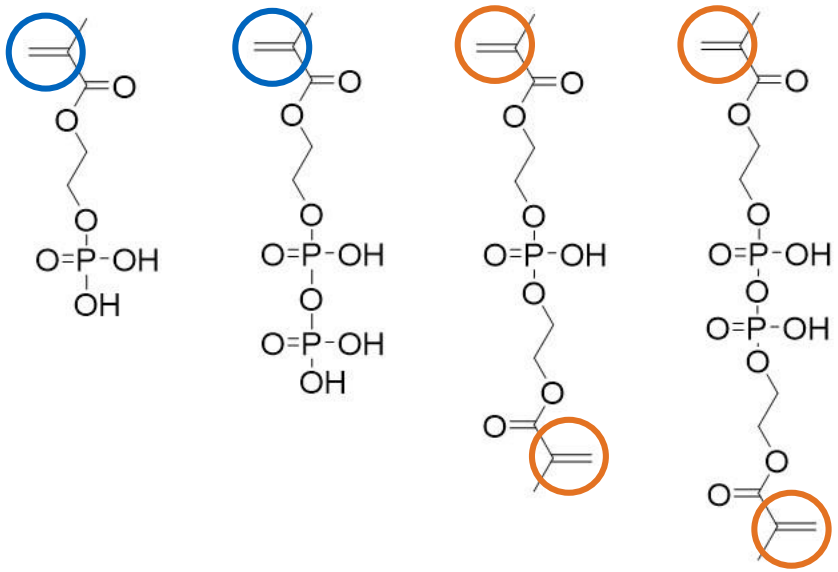


By-Products

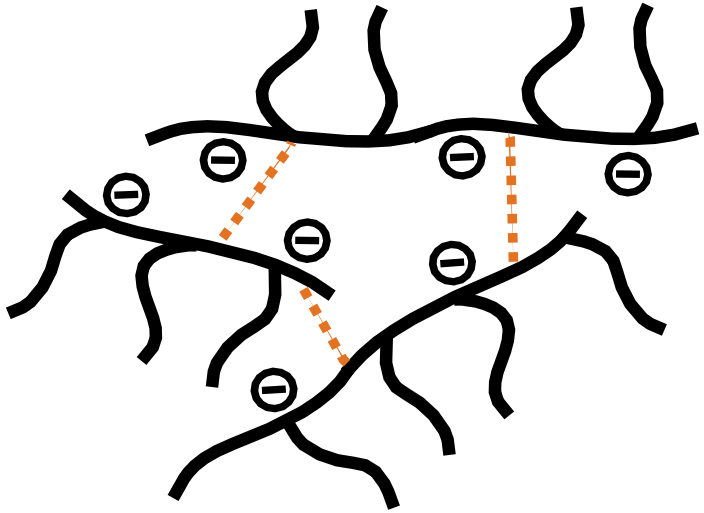

Phosphoric acid (14 %)
MHP (30%)
DHP (22 %)
Pyrophosphoric acid species (23 %)
Pyrophosphoric acid (11 %)
0.5
0.0
-0.5
-10.0
-10.5
-11.0
-11.5
-12.0
ppm



Reaktive Double Bonds

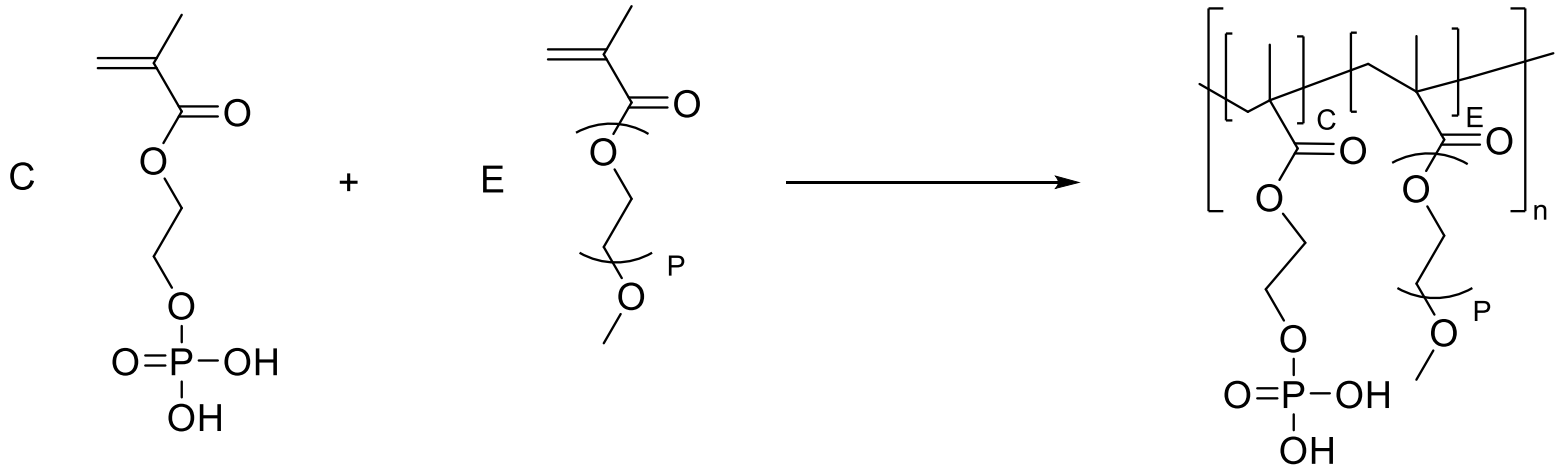


Crosslinked Polymer



Crosslinked Polymer

Copolymer Synthesis

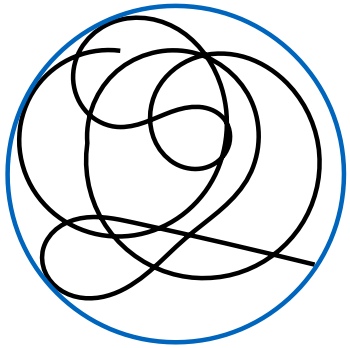


Anionic functionality

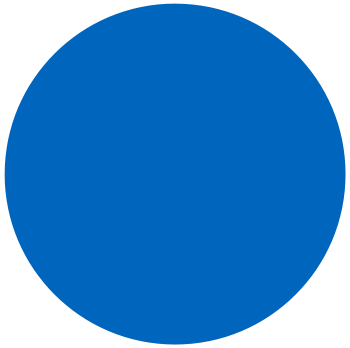
Side chain

Copolymer

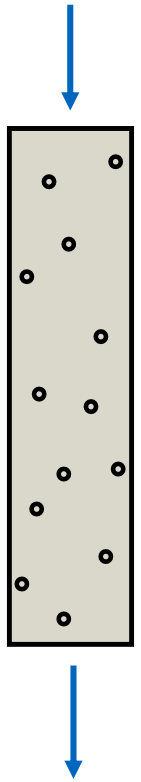
Polymer Characterization: **S**ize **E**xclusion **C**hromatography (SEC)



Hydrodynamic radius

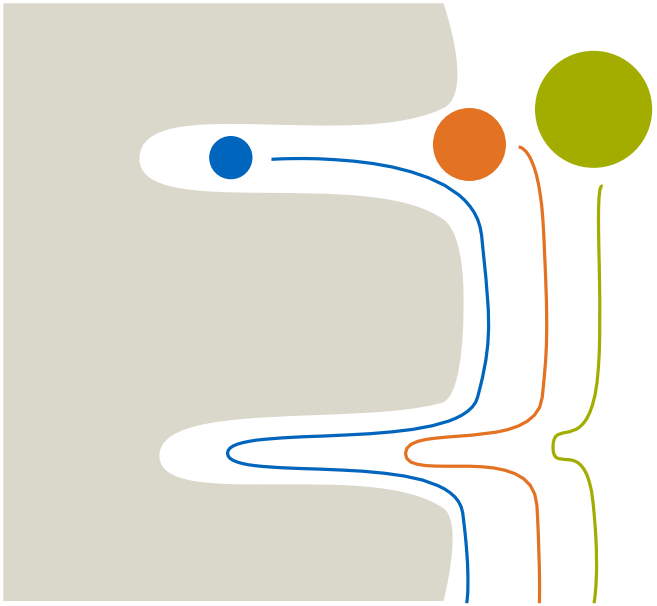


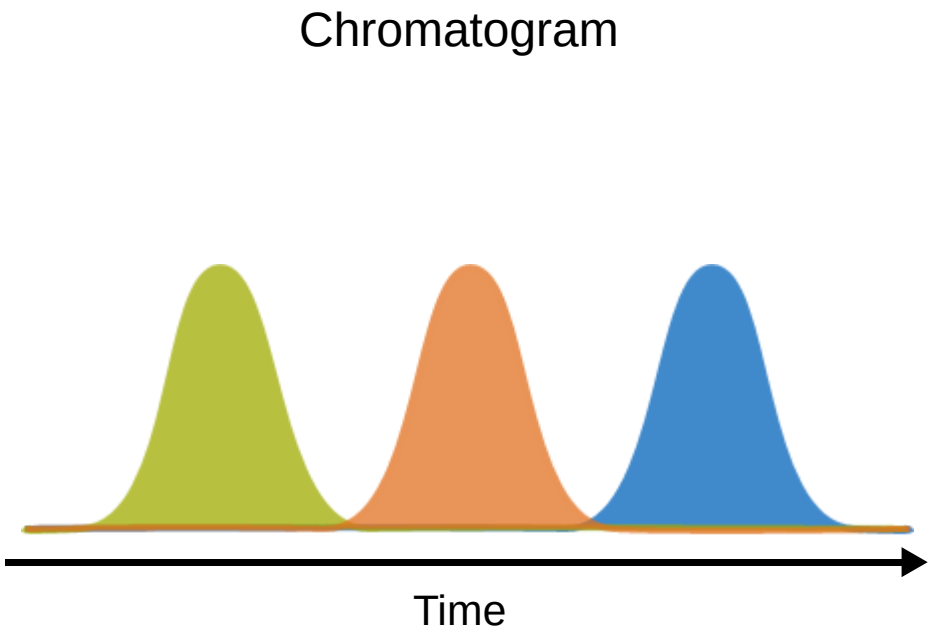
Volume (sphere)



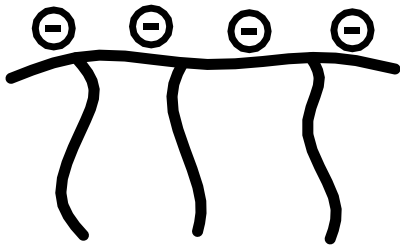
Porous column

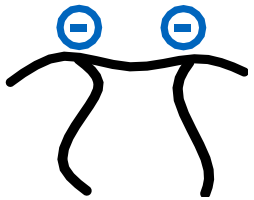
SEC Technique



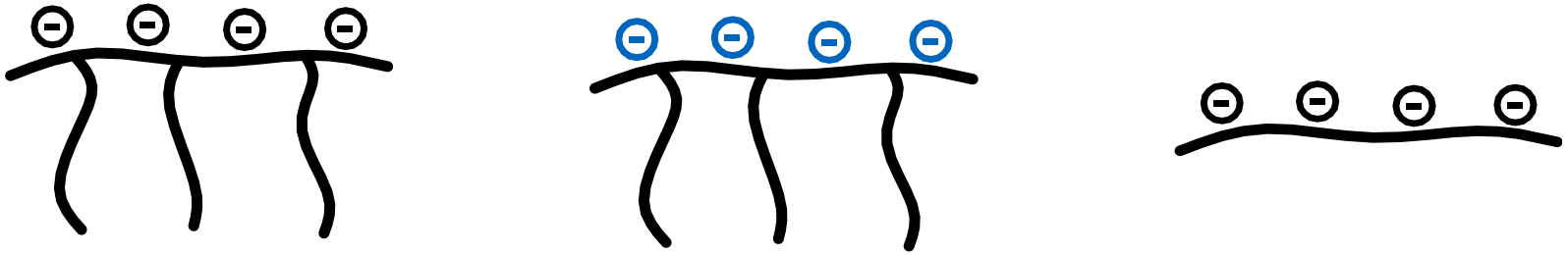


Polymer Performance

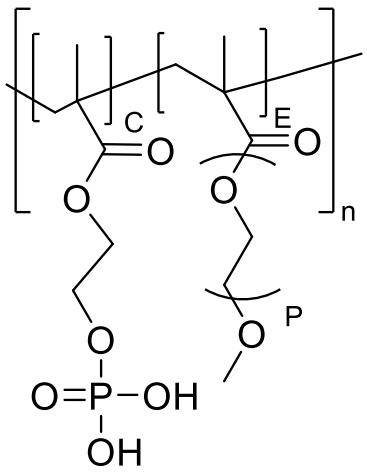


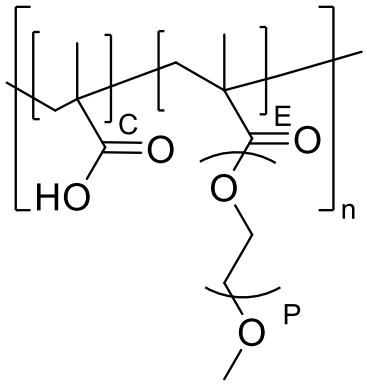


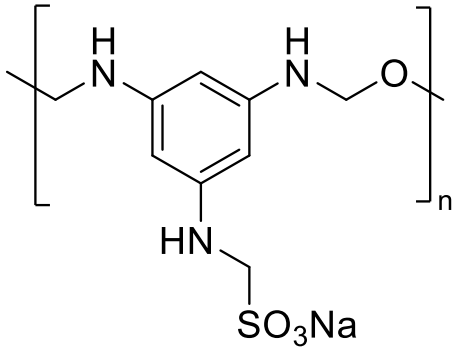
Dispersing Types



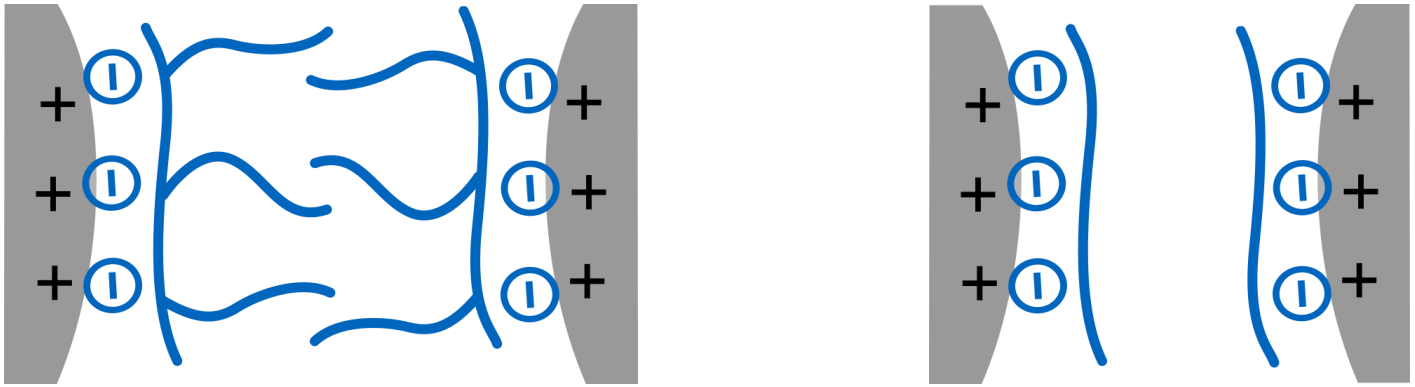
Polymers



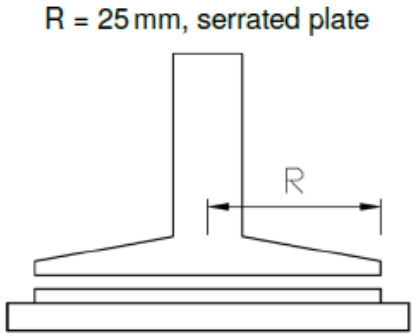




Polymer Performance: Rheology of Cement Paste



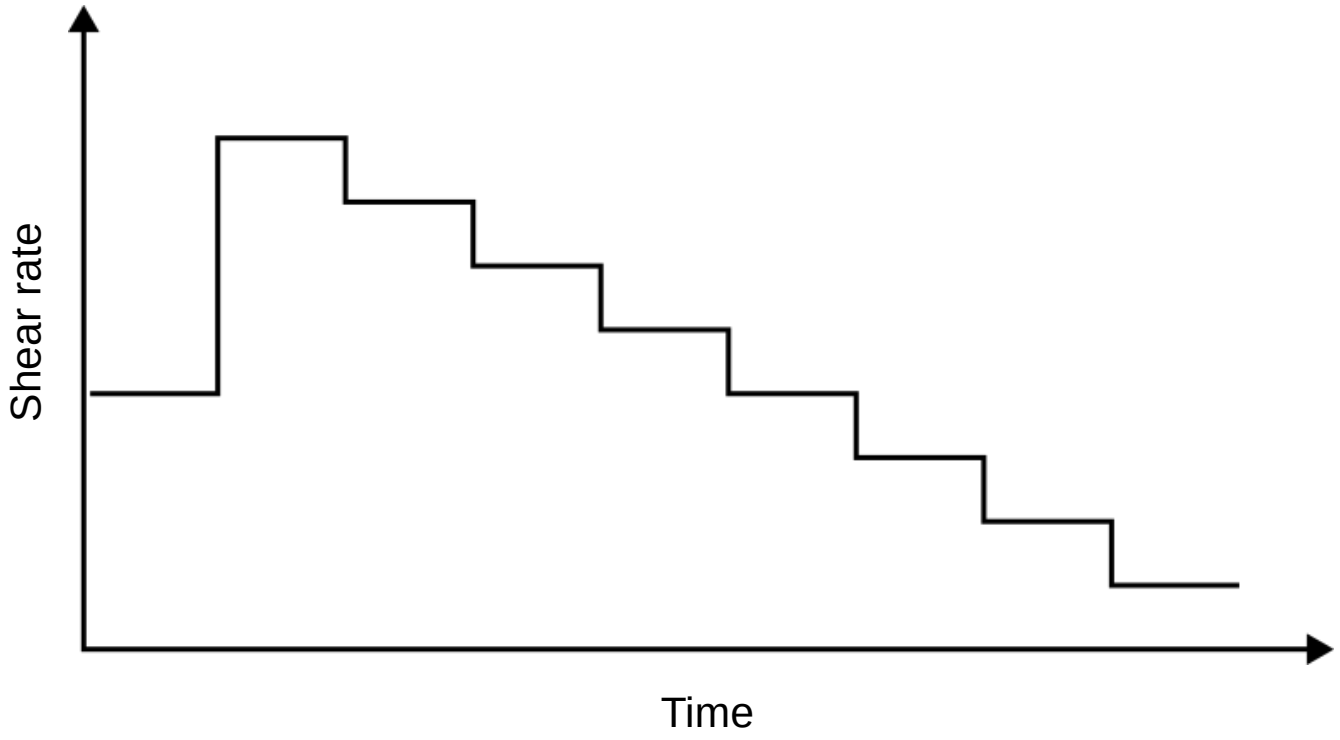
Polymer Performance: Rotational Rheometer



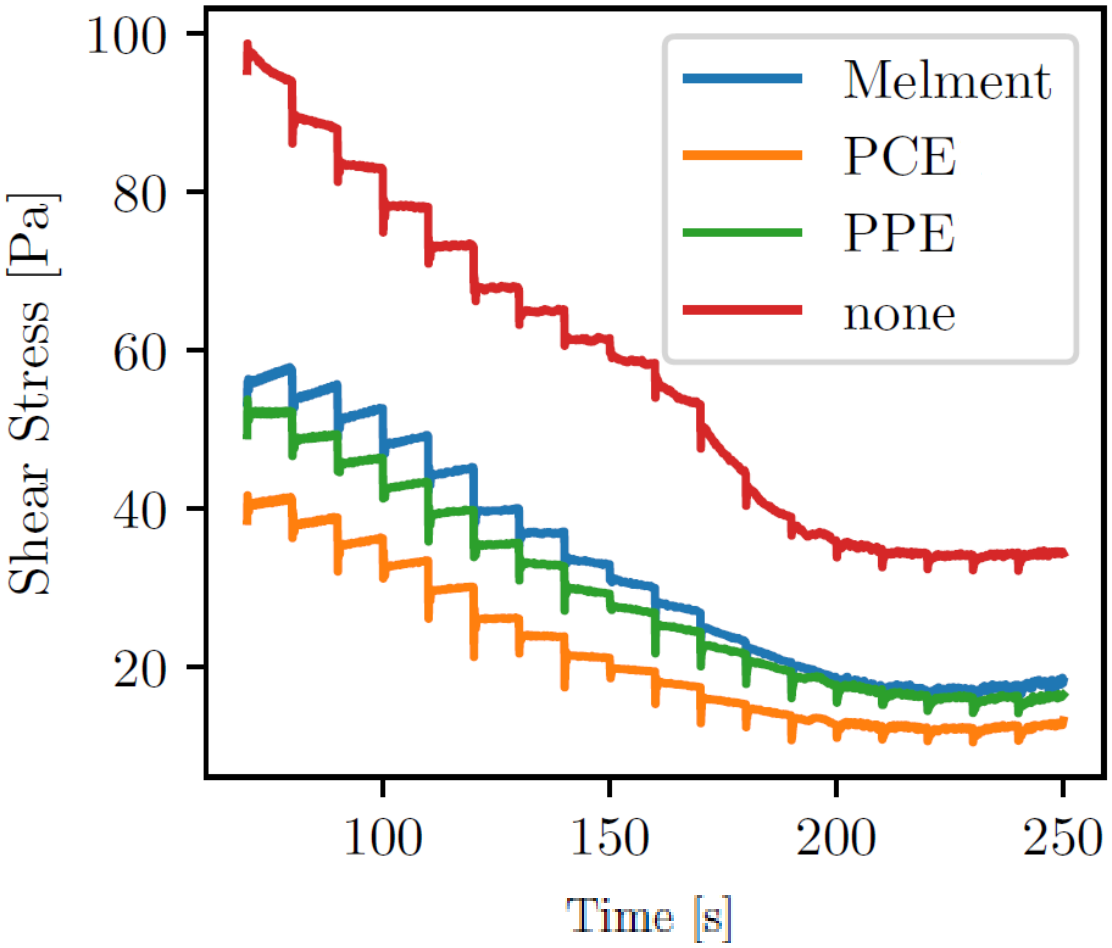
Mixing Protocol

- Dispersant is added 14 minutes after the first contact of the cement paste with water
- Mixing for 1 minute
- Sample is introduced into the rheometer 15 minutes after the initial contact with mixing water

Rheological Procedure



Raw Data



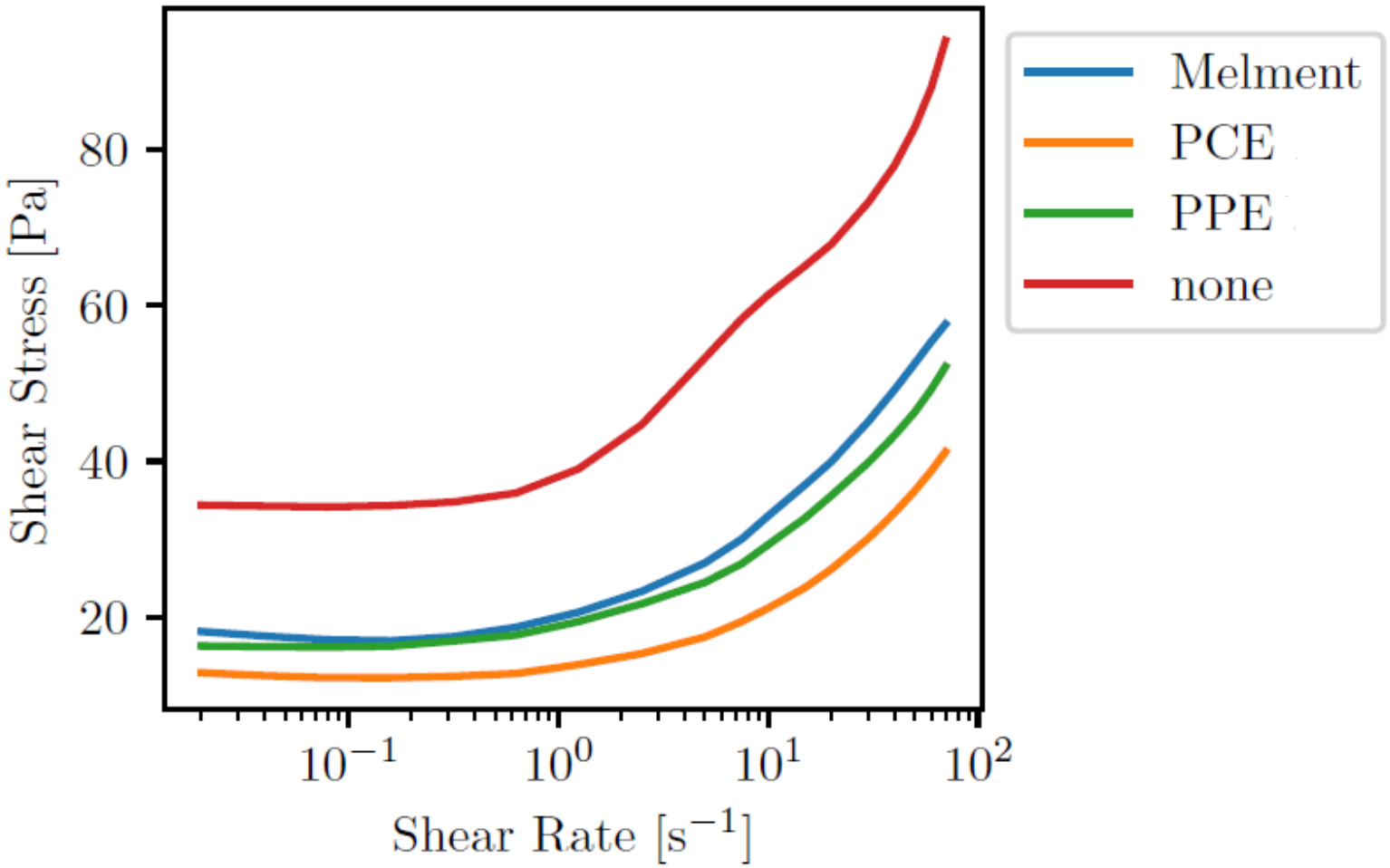
Dosage:

Melment: 0.12 %bwoc

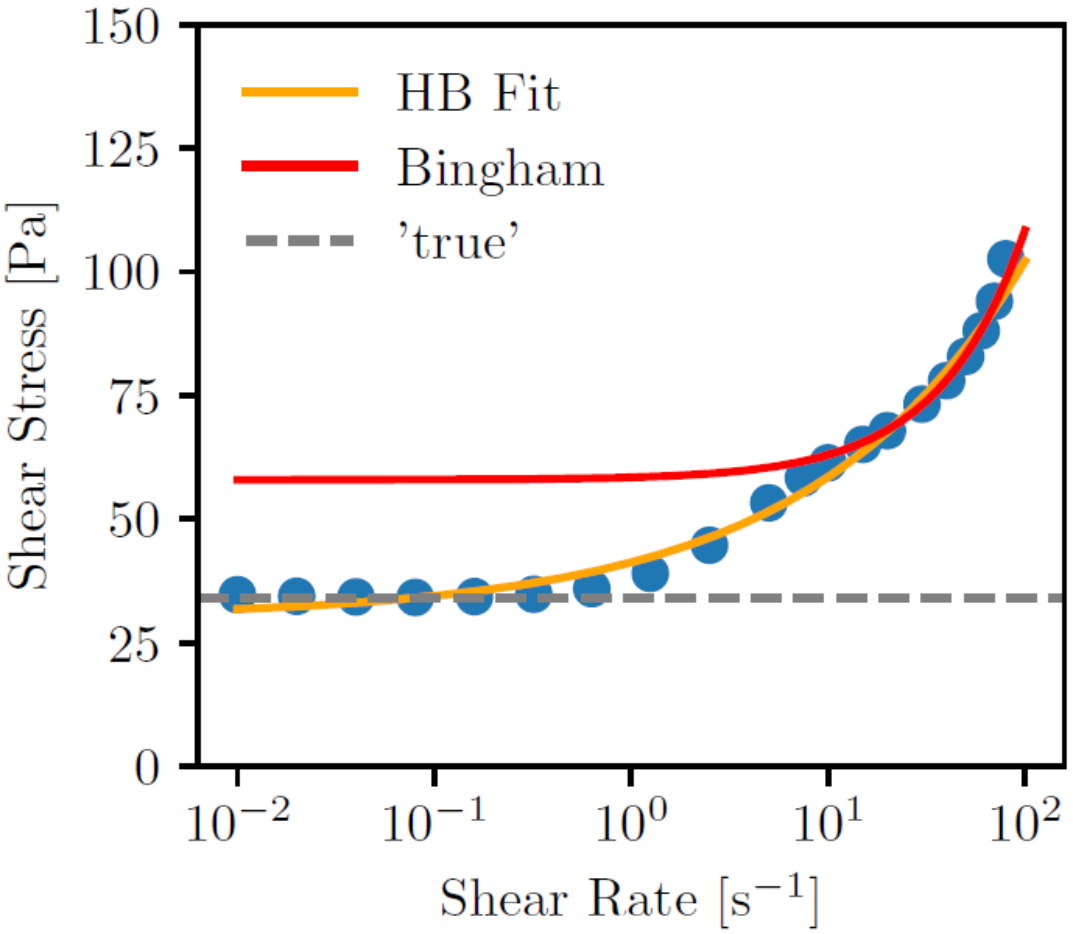
PCE: 0.03 %bwoc

PPE: 0.03 %bwoc

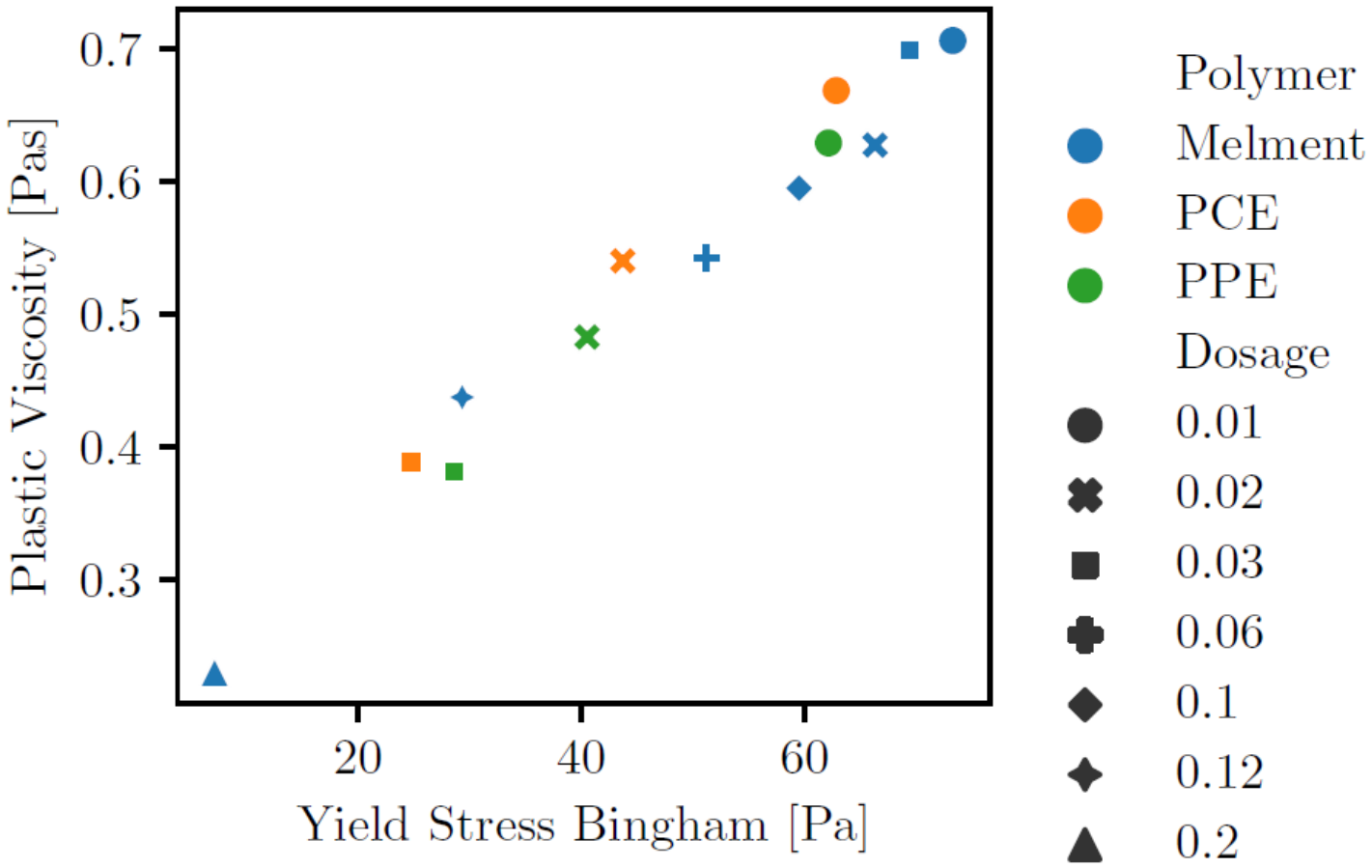
Raw Data


Shear Stress [Pa]
80
60
40
20
10^{-1}
10^{0}
10^{1}
10^{2}
Shear Rate [s^{-1}]
Melment
PCE
PPE
none

Rheological Models for Data Fitting



Bingham Model



To be continued…