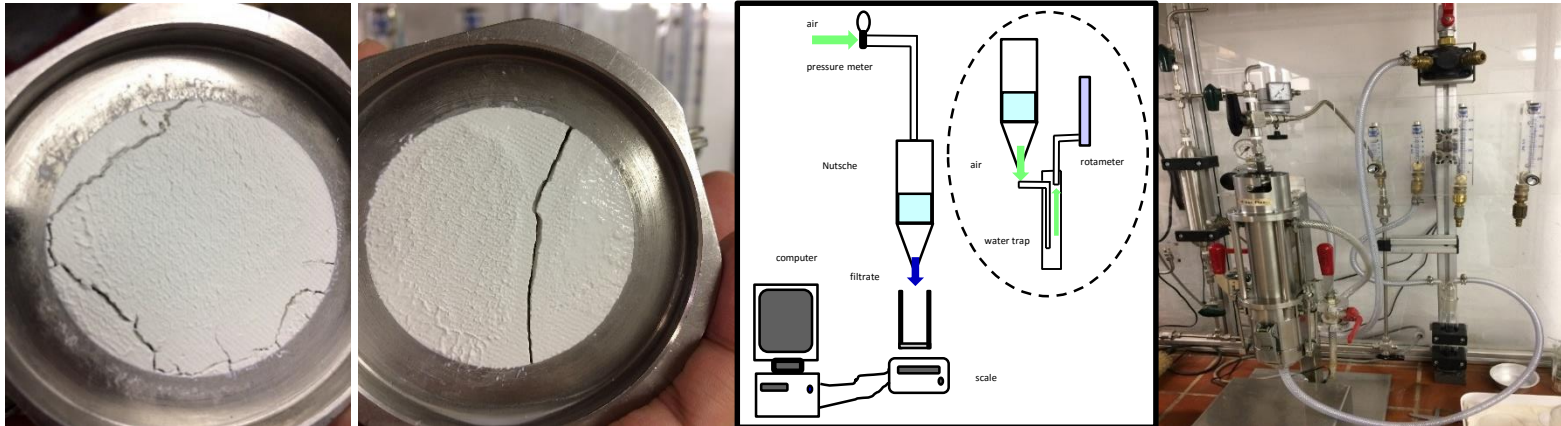


The effect of particle size distribution, concentration and settling time on cracks formation



MSc. Thanh Hai Pham

The effect of particle size distribution, concentration and settling time on cracks formation

1. motivation and study schedule
2. particle size distribution of materials
3. (relevant) parameters
4. effect of PSD on cracks formation
5. effect of concentration on crack formation
6. effect of settling time on crack formation
7. problems and discussion

motivation and study schedule

My project: Processing and upgrading of high ash fine coal of Hongai area, Quangninh province



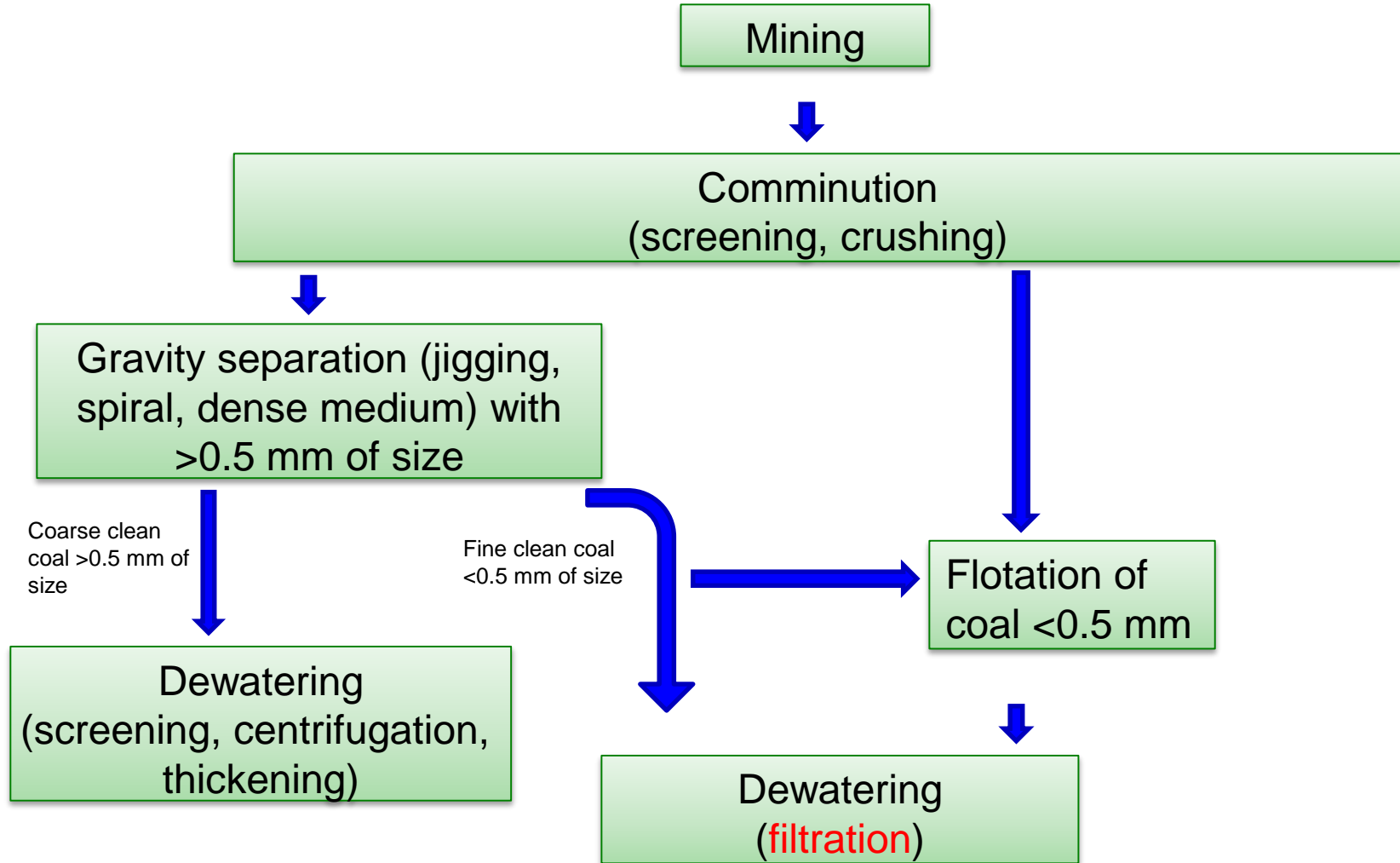
2 methods mining



underground mining



surface mining



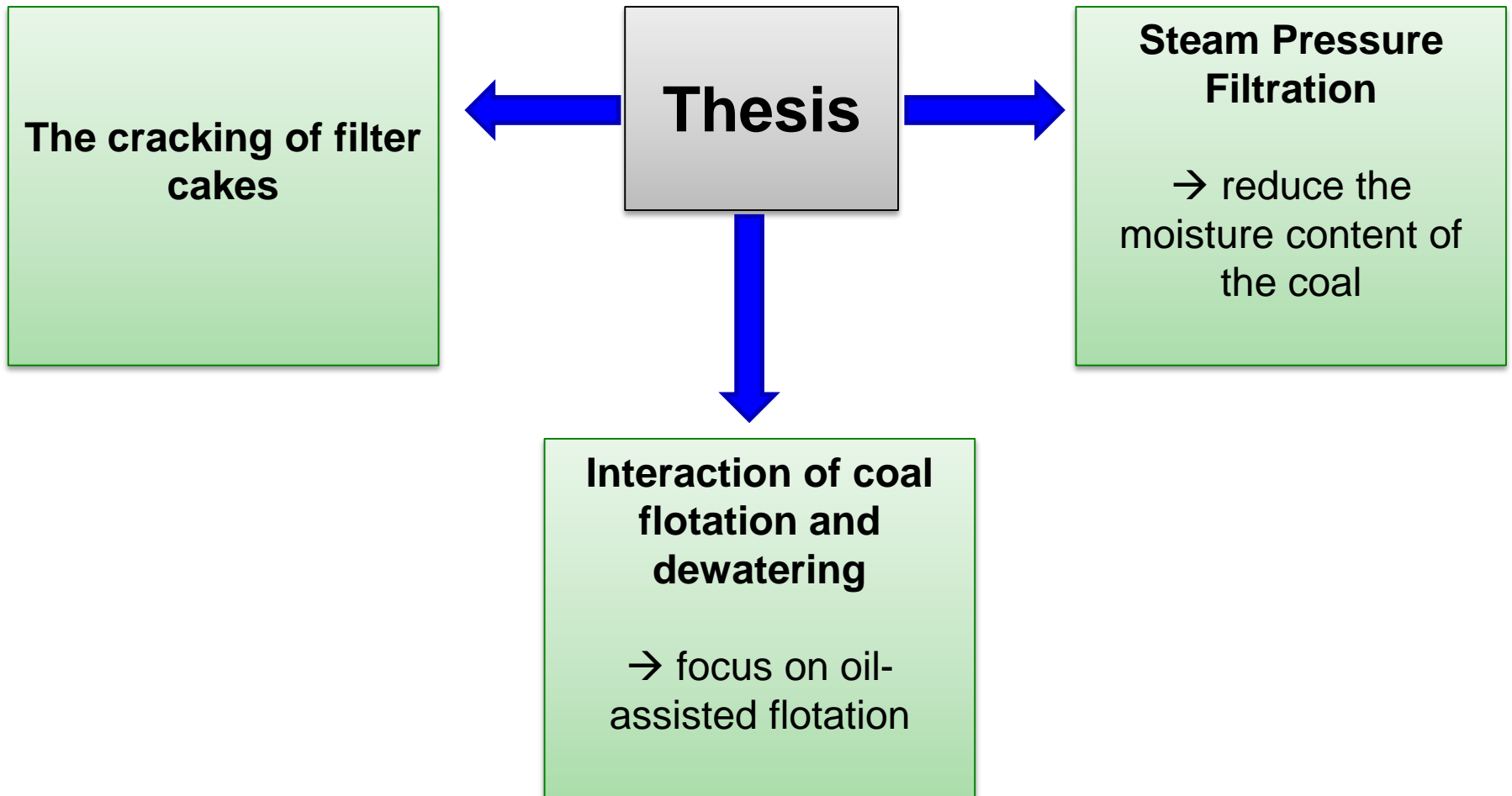
Clean fine coal (< 0.5 mm) after flotation which is dewatered by hyperbaric pressure filter.

Sometime, fine coal, after other processing, is also dewatered by hyperbaric pressure filter

The residual moisture content is usually 20% (15%) (but in Vietnam standard, the average moisture content is 8% for commercial fine coal)

This problem leads to:

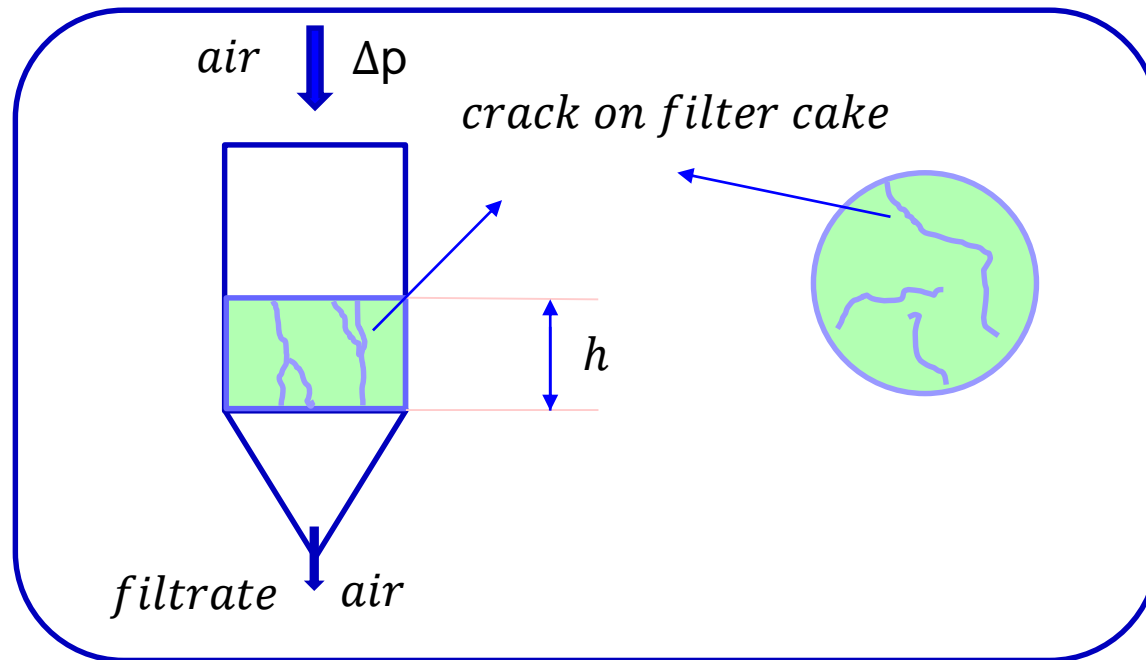
- + Water in the filter cake can not be recycled \rightarrow Increase of production costs
- + Increase of the transport costs
- + Reduction the product value
- + Difficult to mix with other kind of coal
- + Difficult to store \rightarrow Negative effect on the environment



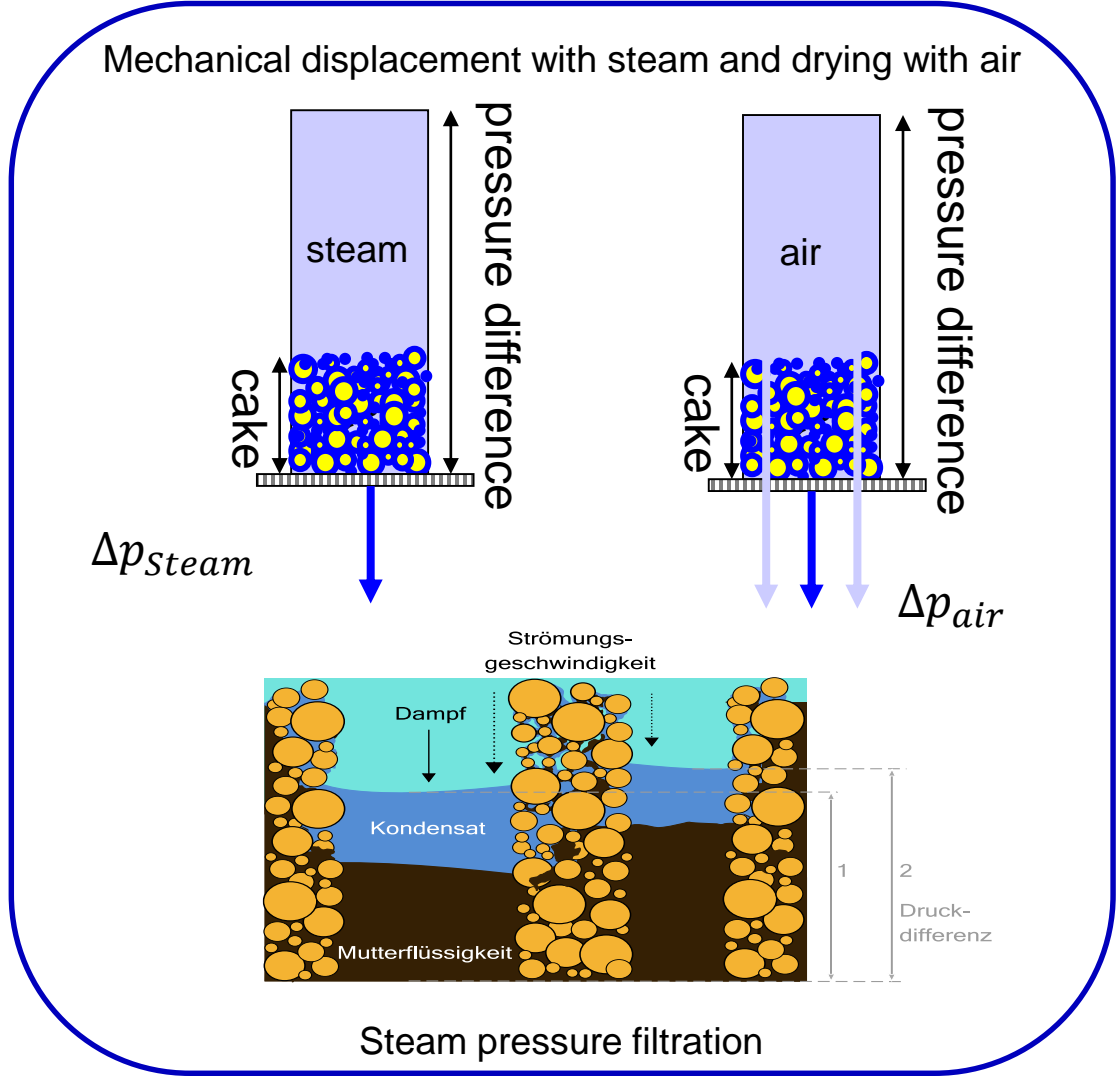
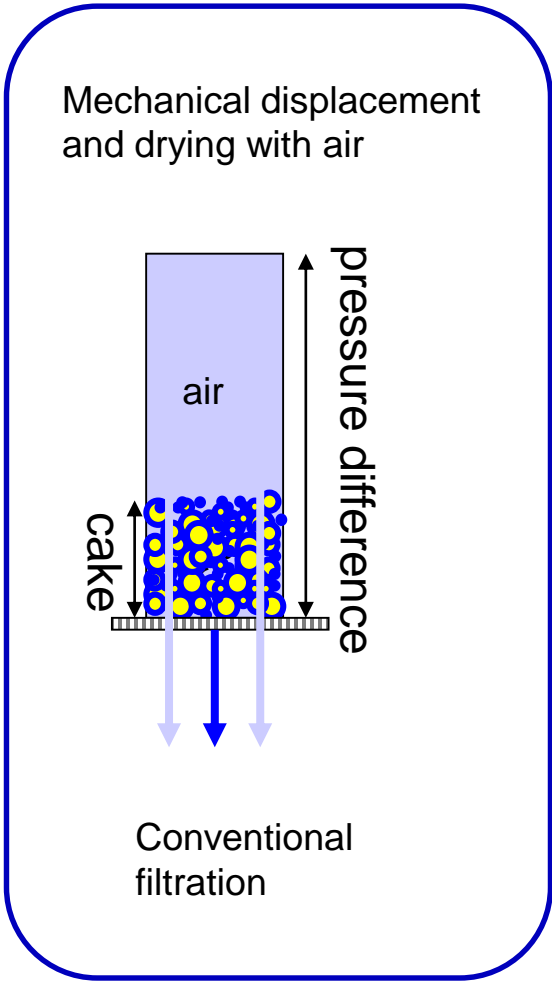
The crack on filter cake

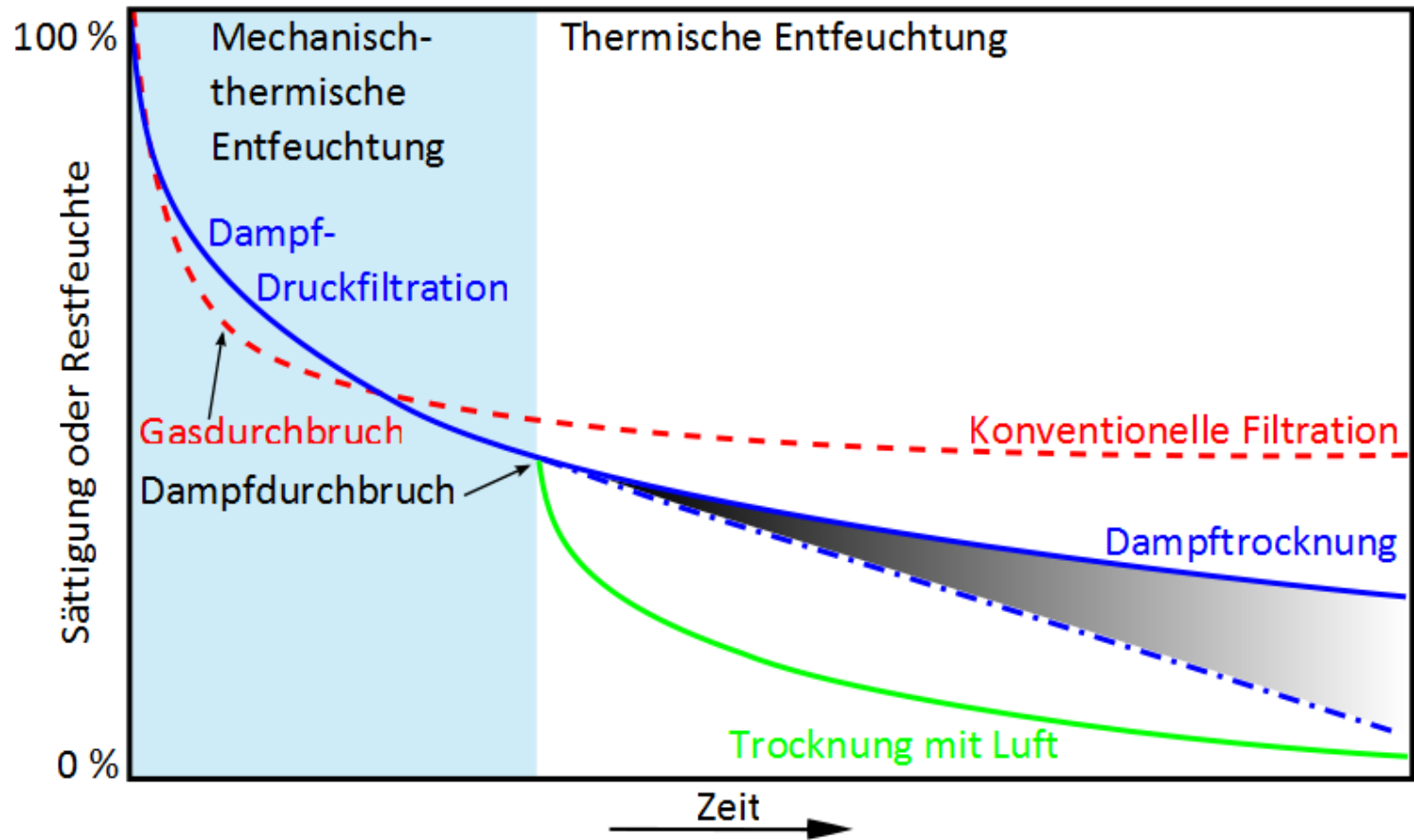
- Higher gas consumption
- A decrease in filtration pressure
- **Higher residual moisture content**

⇒ Objective: Quantification of cracks on filter cake and methods to avoid cracks.



Steam pressure filtration





Abstract

First step:

- Doing test with limestone

Second step:

- Using Quangninh coal
- Survey the crack formation in filter cake, dewatering coal by steam filtration, interaction of coal flotation and dewatering processing, especially focus on oil assisted flotation

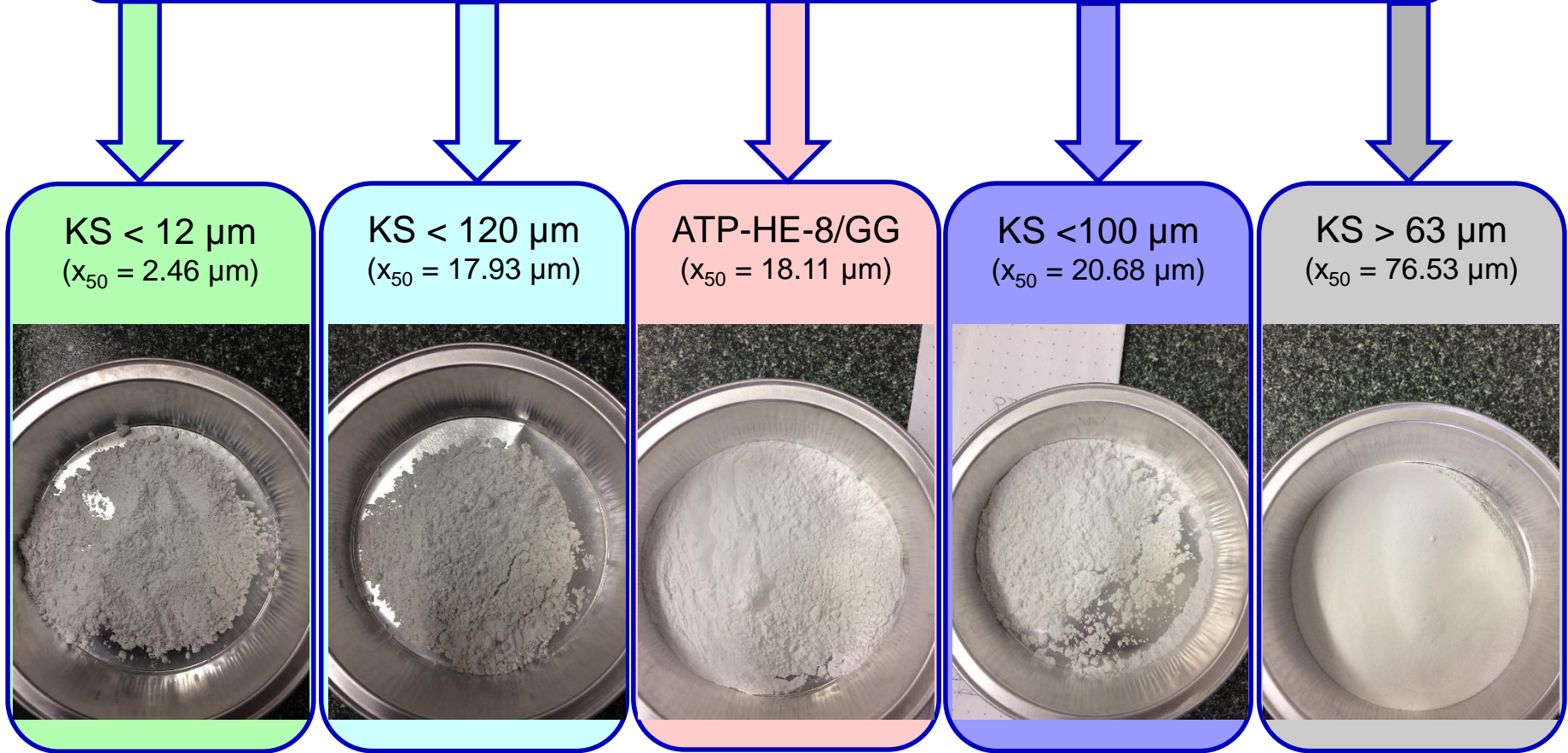
Third step:

Collect all data, publication and write and submit thesis

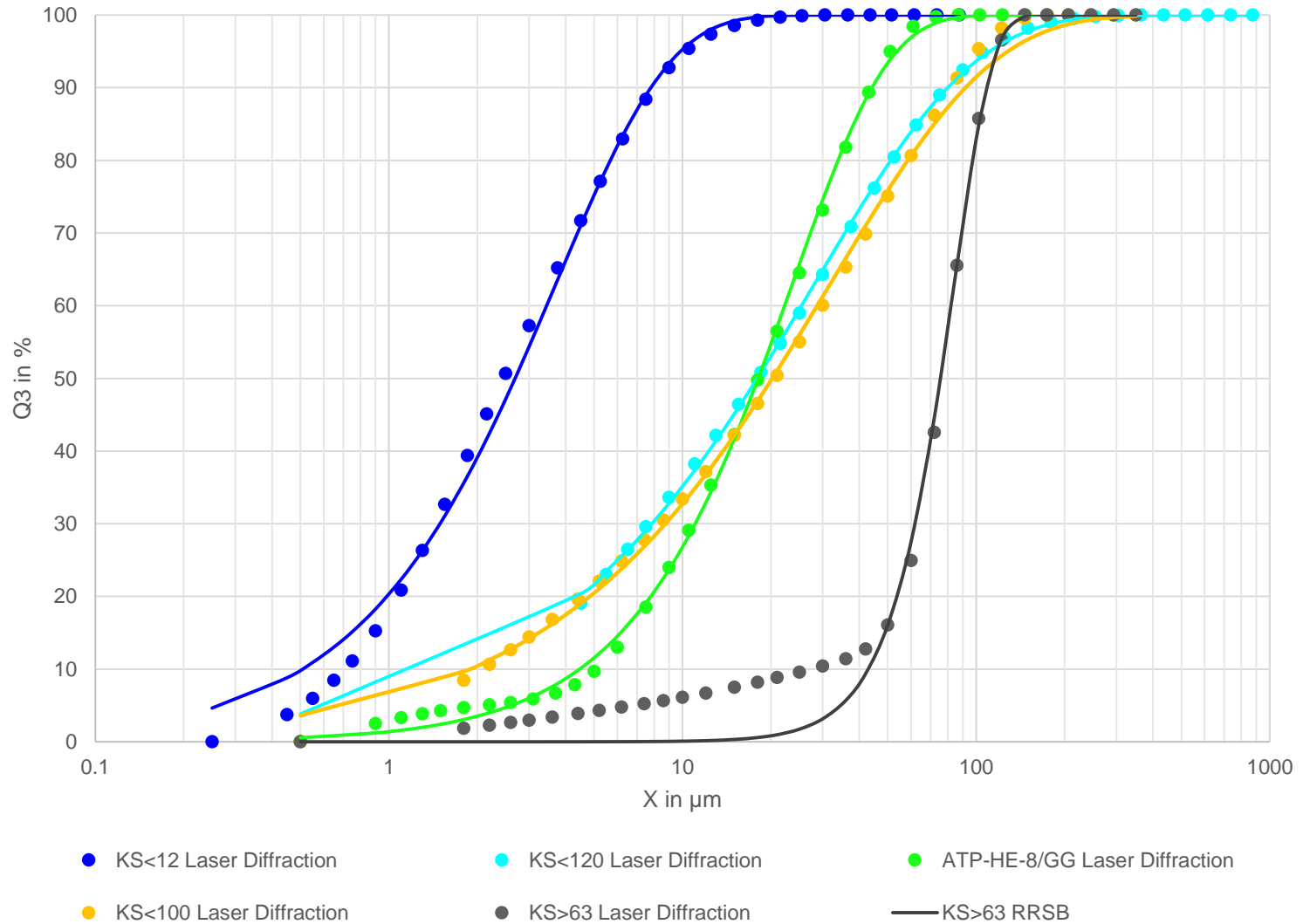
The detailed study schedule in next 3 years [\(1\)](#)

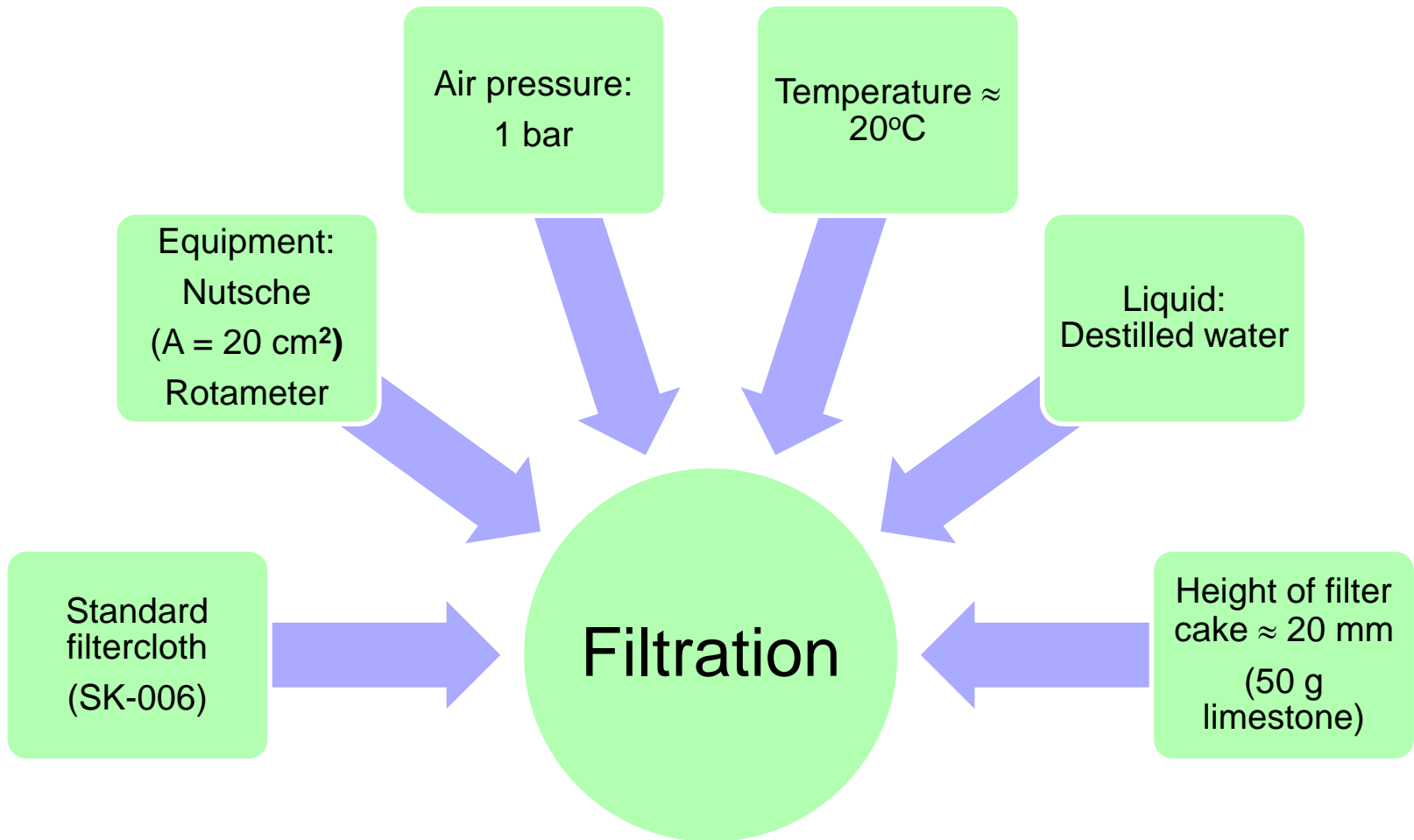
First test with limestone

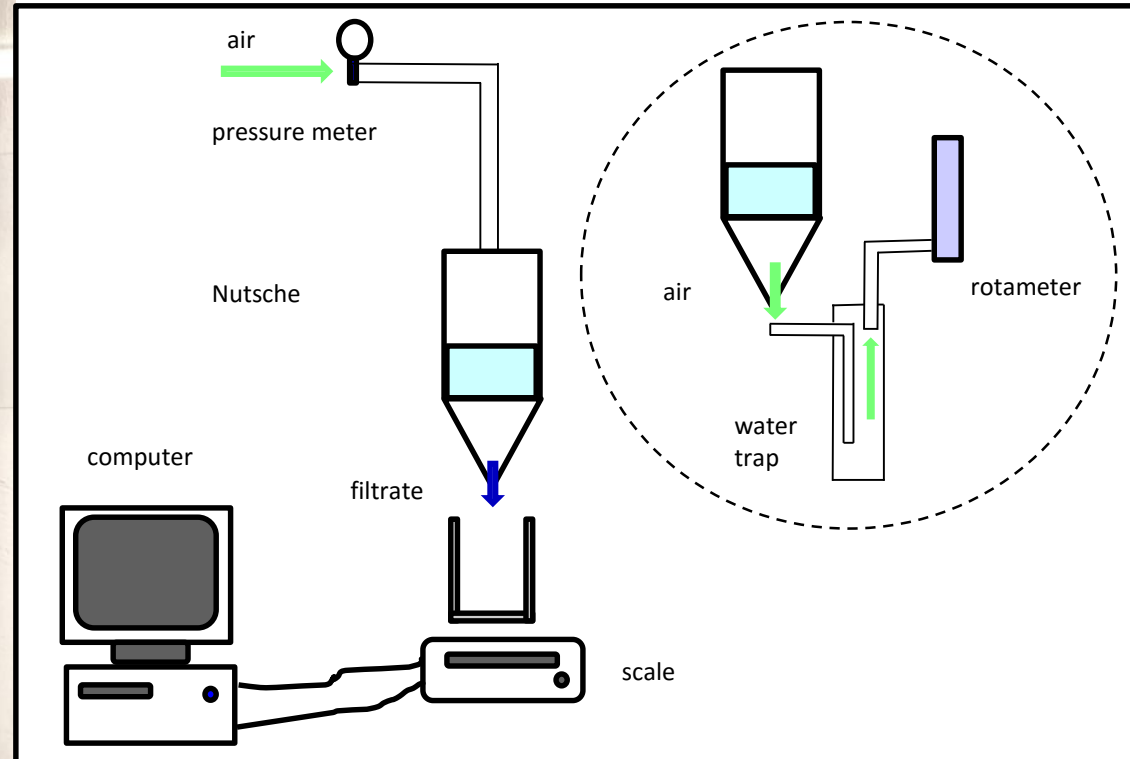
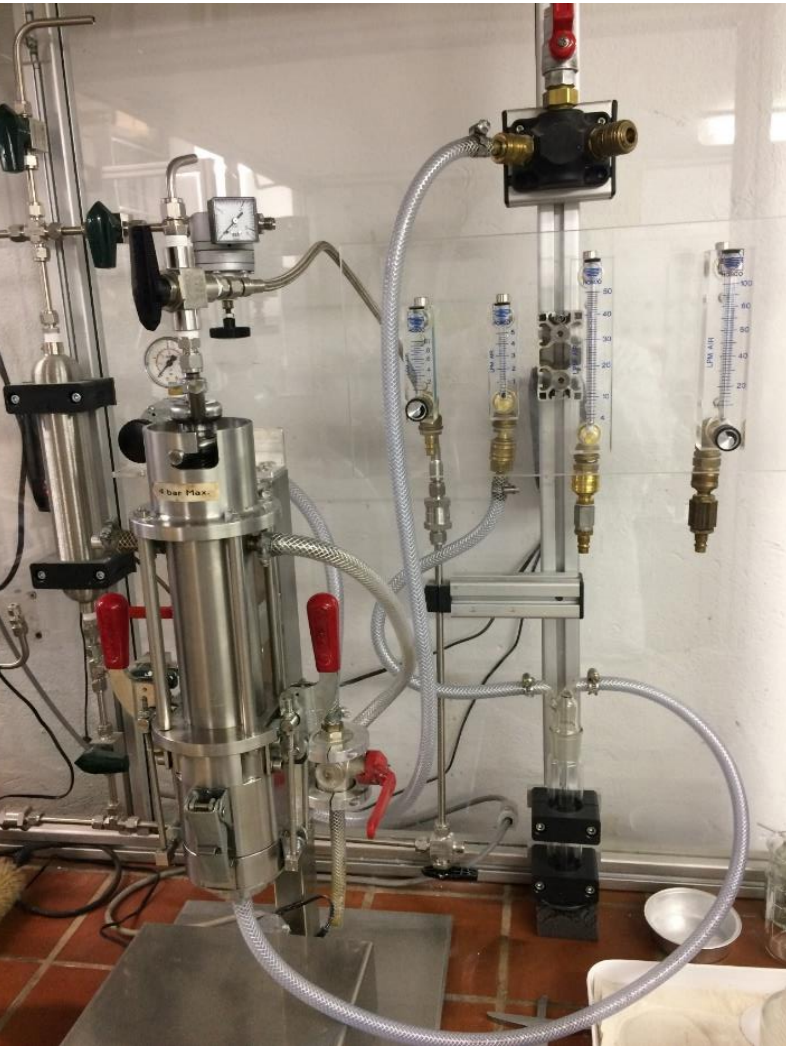
The materials for tests are limestones with different medium size



The particle size distribution of materials







Relevant parameter

Darcy law:
$$\frac{\Delta P}{h_c} = \frac{\eta \cdot dV}{K \cdot dt \cdot A}$$

Permeability ratio

- method 1: **Permeability ratio** = $\beta = \frac{K_G}{K_L}$ [Barua, 2014]

$$K_L = \frac{V_L \cdot h_c \cdot \eta_L}{\Delta P \cdot A}$$

$$K_G = \frac{V_G \cdot h_c \cdot \eta_G}{\Delta P \cdot A}$$

- method 2: **Permeability ratio** = $\beta = \frac{K_G}{K_L} = r_c \cdot K_G$

$$K_L = \frac{1}{r_c}$$

$$K_G = \frac{h_{cG}}{R_{cG}}$$

$$R_{total} = R_{cG} + R_m \Rightarrow R_{cG} = R_{total} - R_m$$

$$r_c = \frac{a \cdot 2 \cdot \Delta p \cdot A^2}{\eta_L \cdot \kappa}$$

$$R_{total} = \frac{\Delta p \cdot A}{V_{(flow\ rate)\ G} \cdot \eta_G}$$

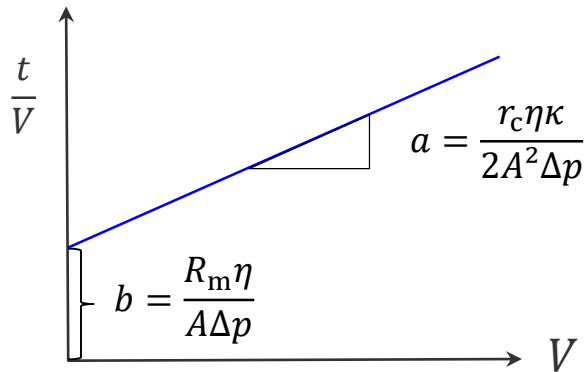
- method 3: Permeability ratio = $\beta = \frac{K_G}{K_L} = r_c * K_G$

$$K_L = \frac{1}{r_c}$$

$$r_c = \frac{a \cdot 2 \cdot \Delta p \cdot A^2}{\eta_L \cdot \kappa}$$

$$K_G = \frac{2(p * \dot{V})_t * \eta_G * h}{A * (p_1^2 - p_2^2)}$$

[Wyckoff et al]

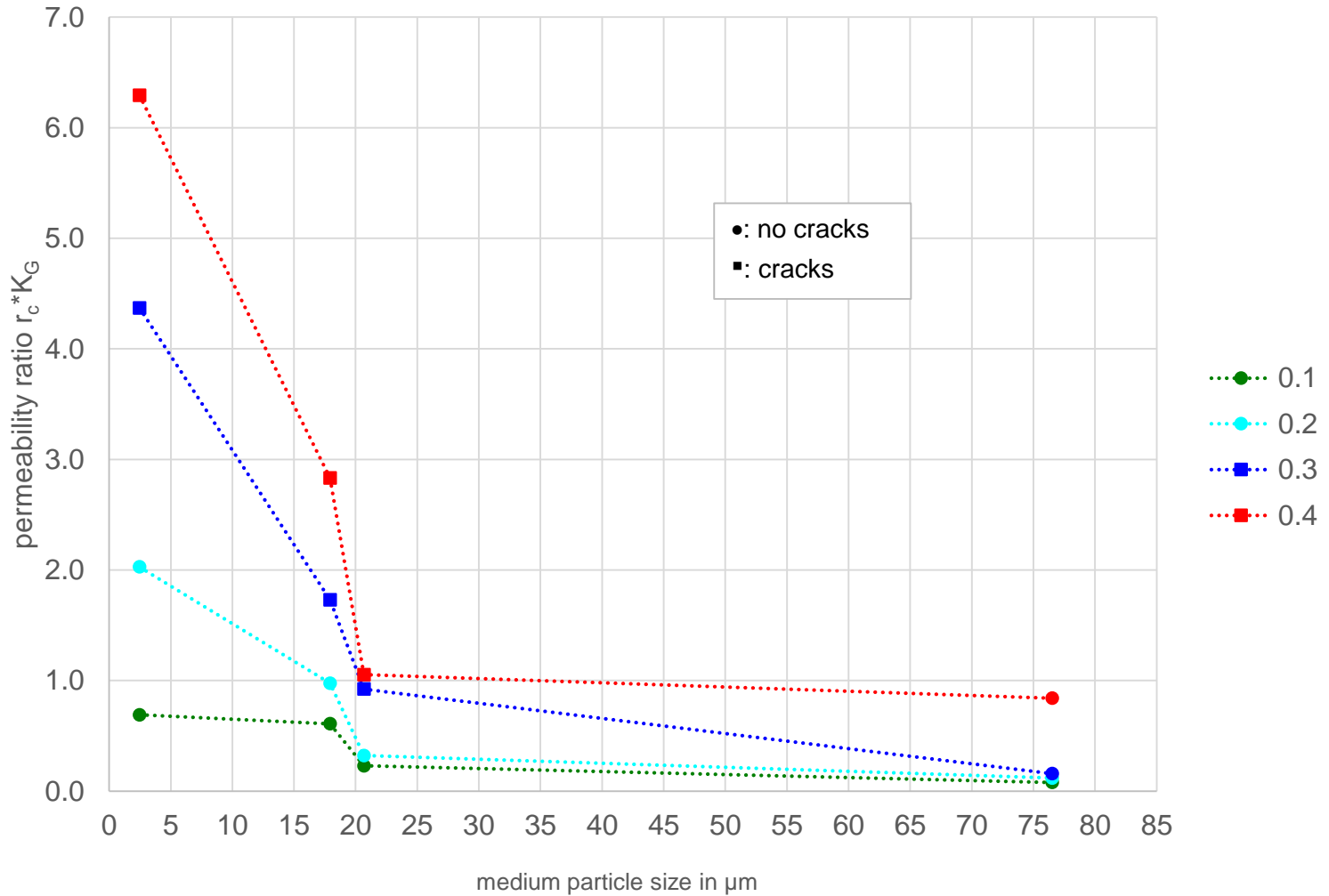


$$\kappa = \frac{c_v}{1 - \varepsilon - c_v}$$

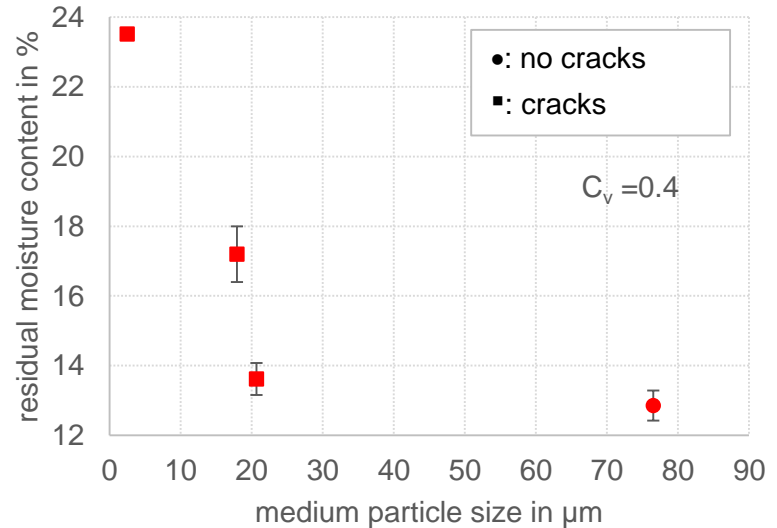
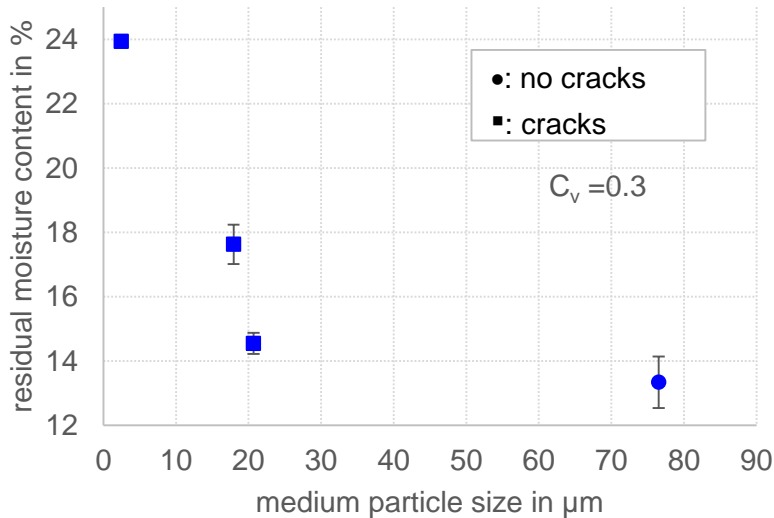
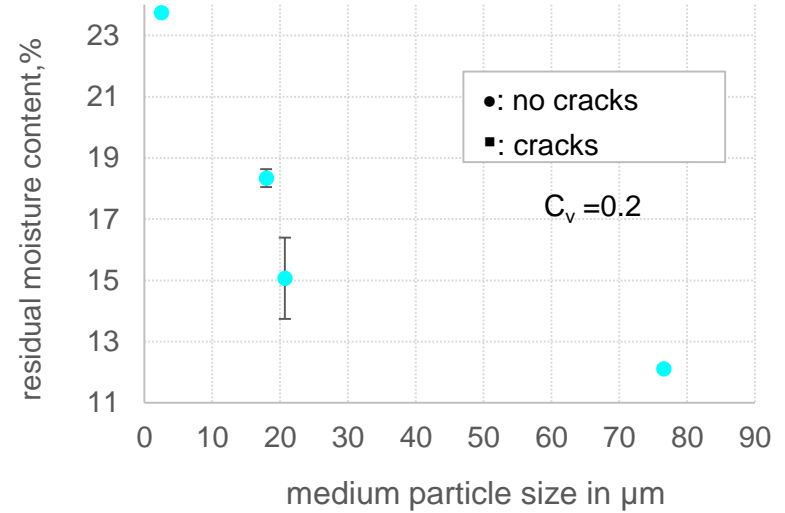
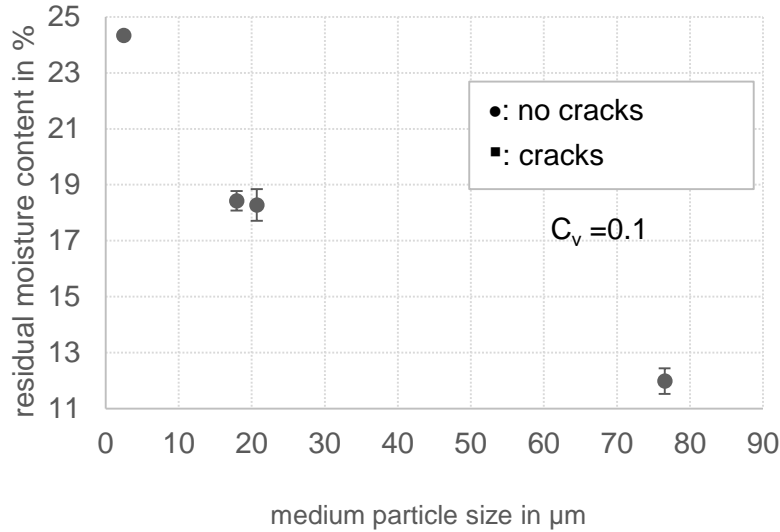
Residual moisture content (M)

$$M = \frac{m_{liquid}}{m_{wet\ in\ filter\ cake}} * 100\%$$

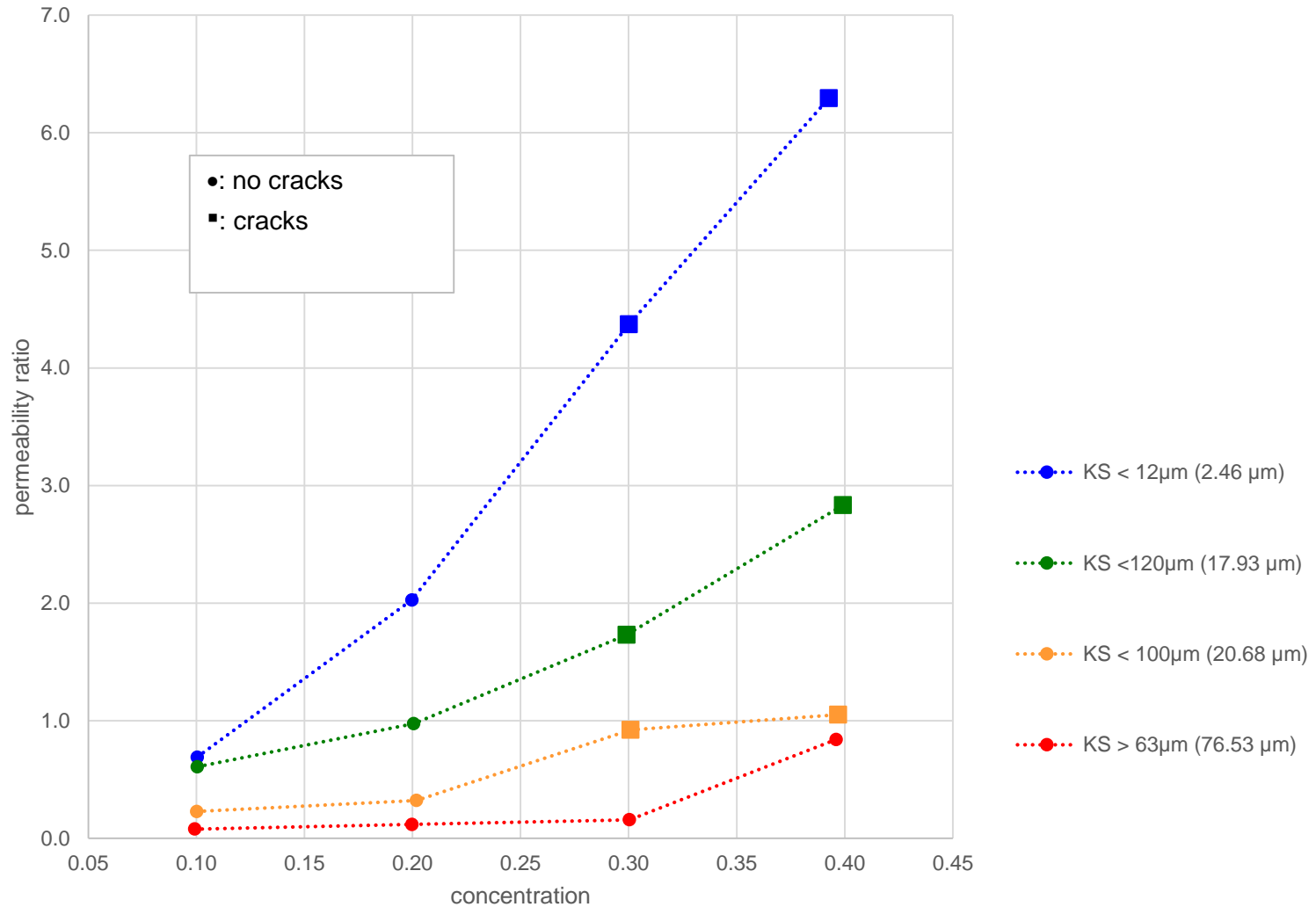
The effect of particle size distribution on cracks formation



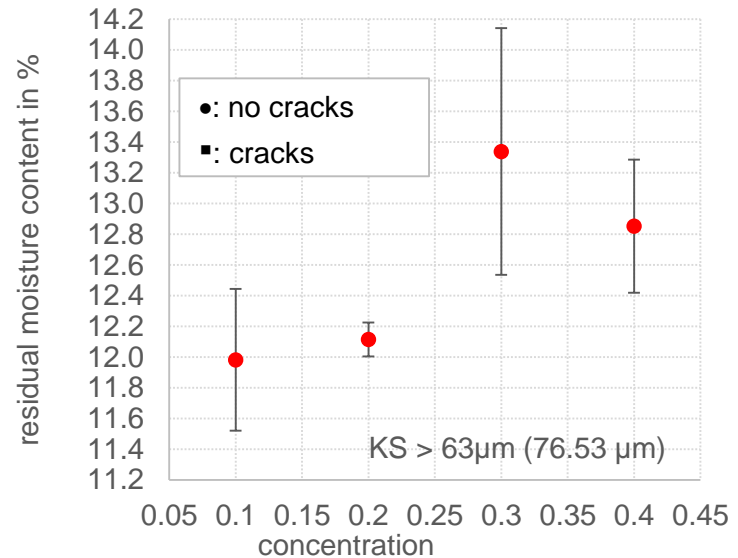
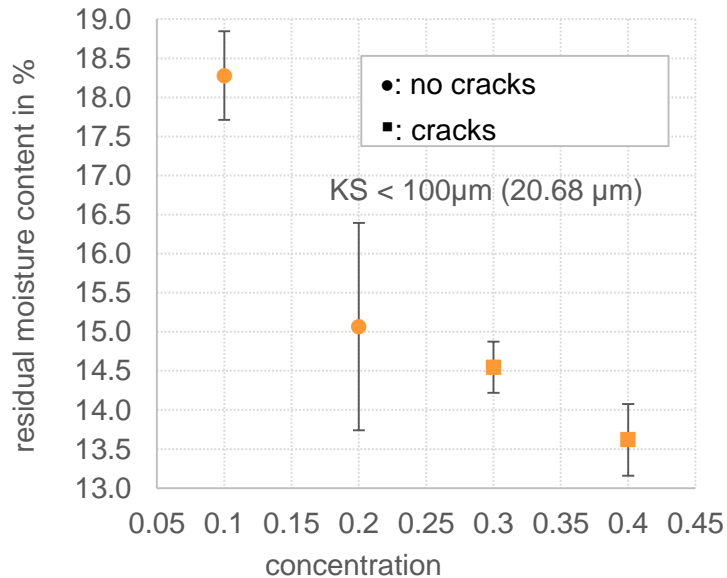
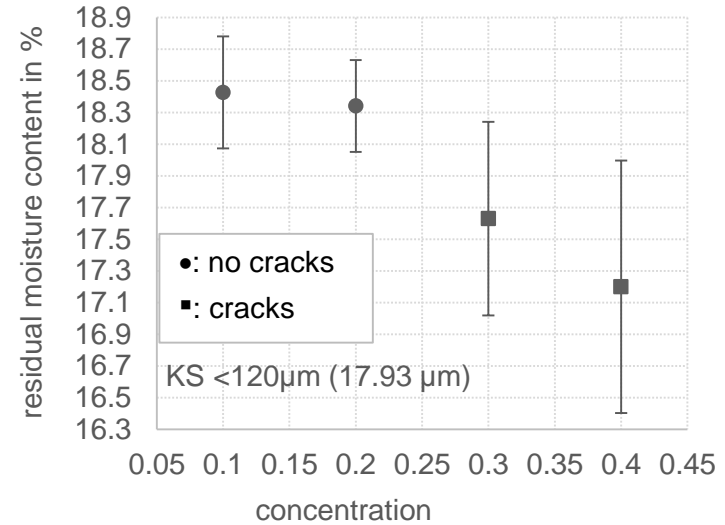
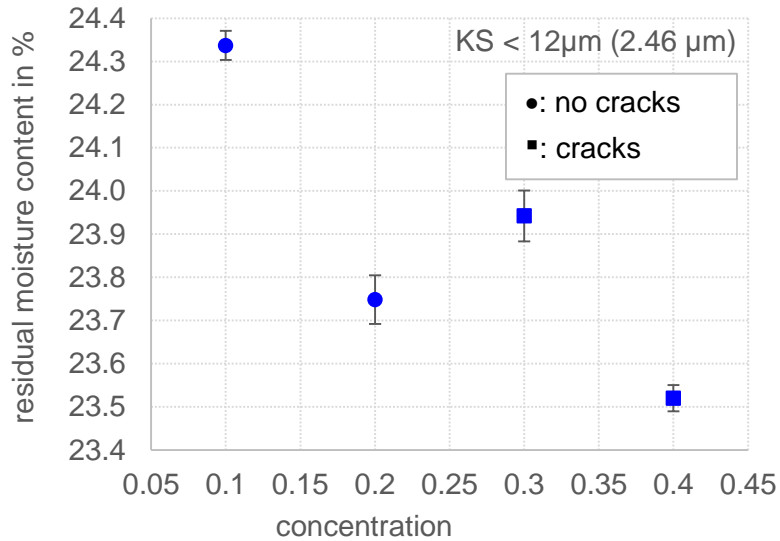
The effect of particle size distribution on cracks formation



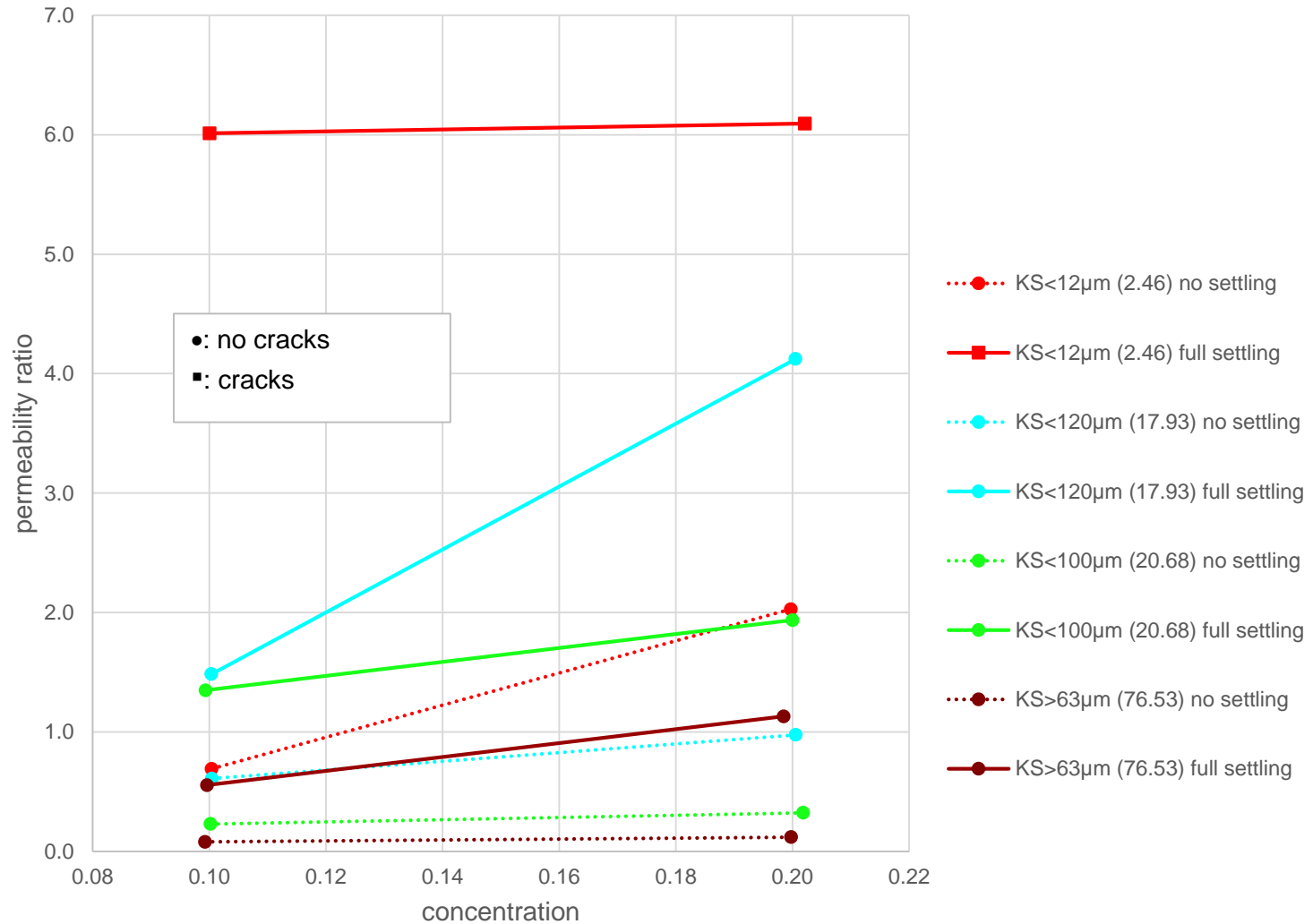
The effect of concentration on cracks formation



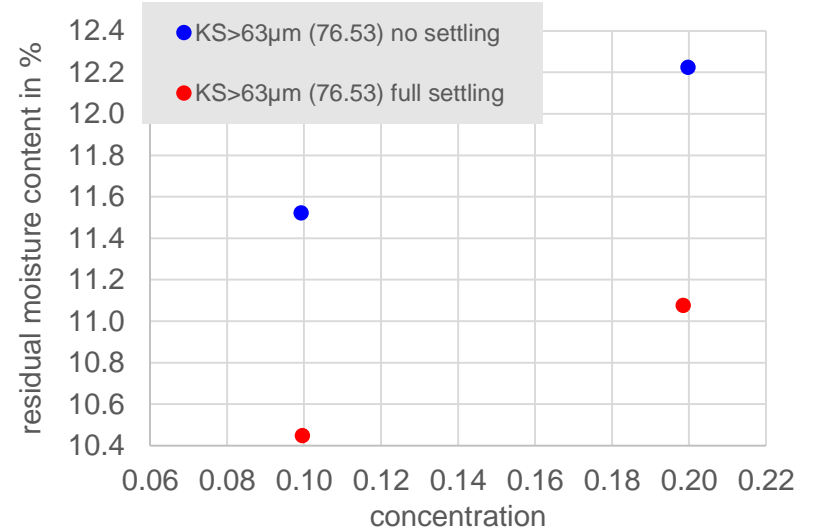
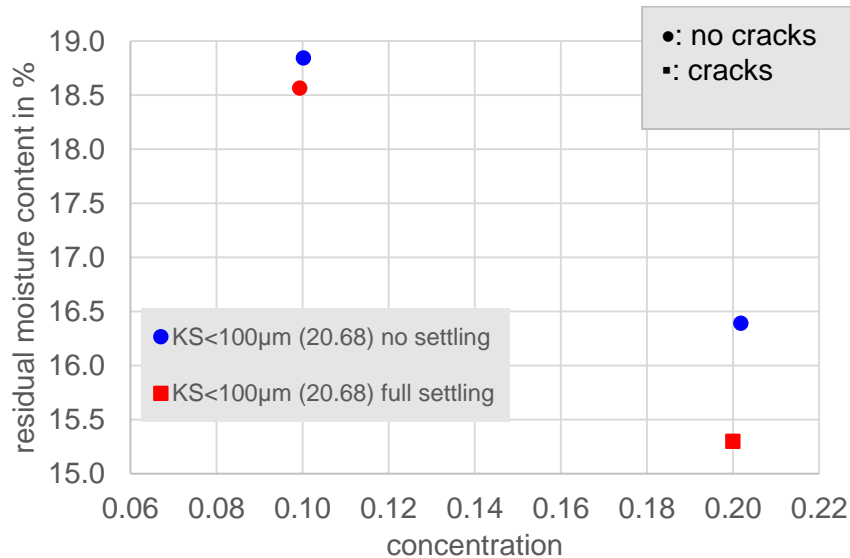
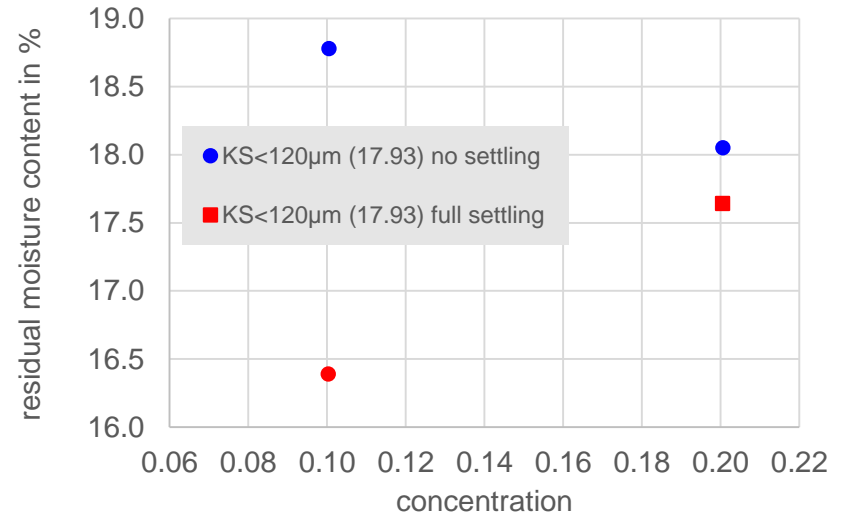
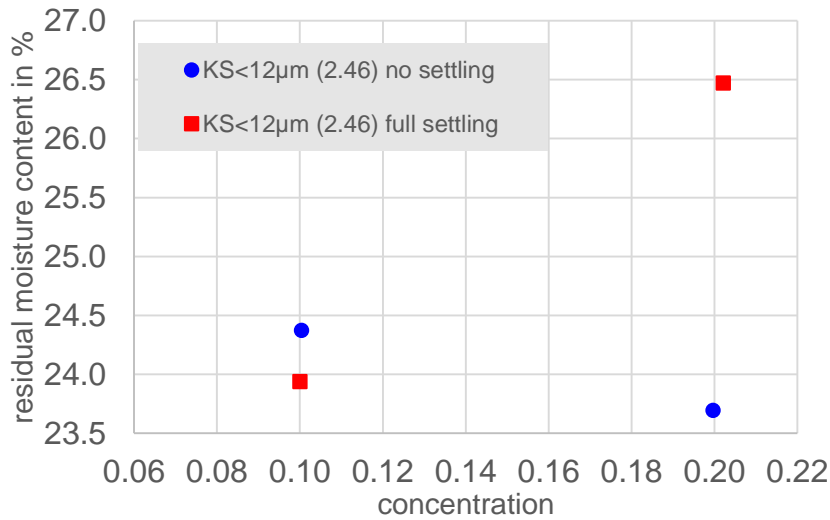
The effect of concentration on cracks formation



The effect of settling time on cracks formation



The effect of settling time on cracks formation



6. Problem and discussion

- behaviour of ATP HE-8/GG is different compared to the other samples → check properties, make more tests with this material [\(1\)](#)
- possible explanations for the results:
- particle size distribution should be indicated by more ratio $\frac{x_{90}-x_{10}}{x_{50}}$;
 $\frac{x_{90}}{x_{10}}$; x_{16} ; x_{10} ; *sauter parameter* ?
- plot t/V vs V is quite different in full settling condition; definition of cake resistance/permeability difficult [\(2\)](#) – **the result of filtration should draw by V vs t ?**
- making test to survey the effect of height of filter cake, pressure air on cracks formation.



Thank you for your attention!

Danke für Ihre Aufmerksamkeit!