Proceedings alternative approaches of designing porous reference samples

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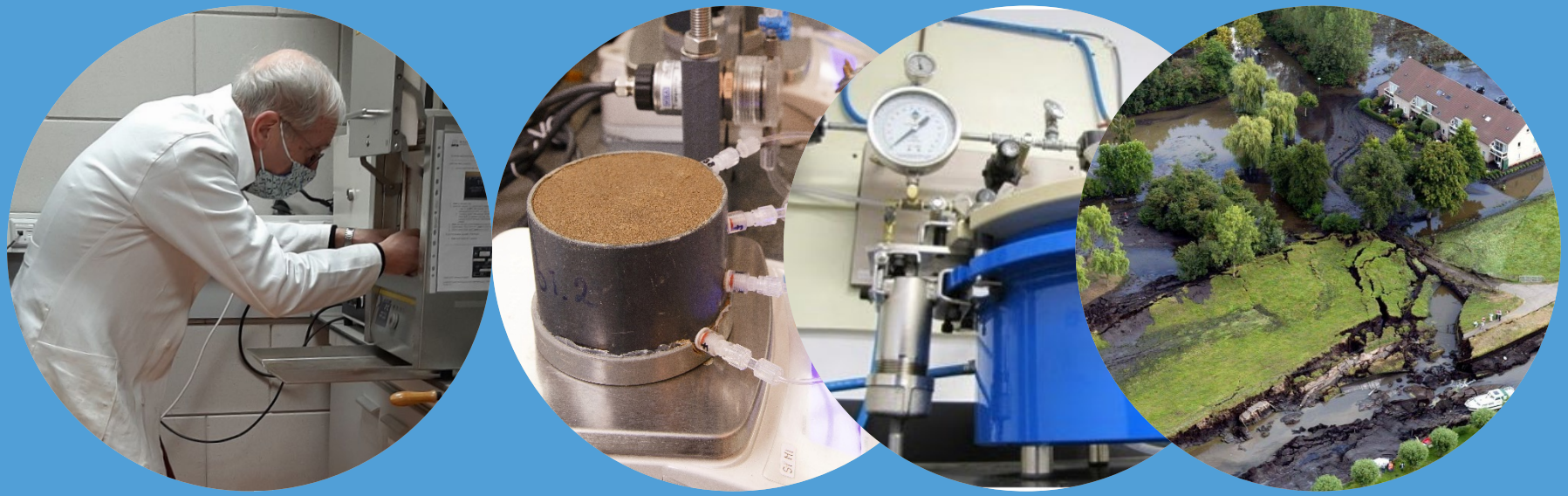


SOPHIE

Covered in this presentation

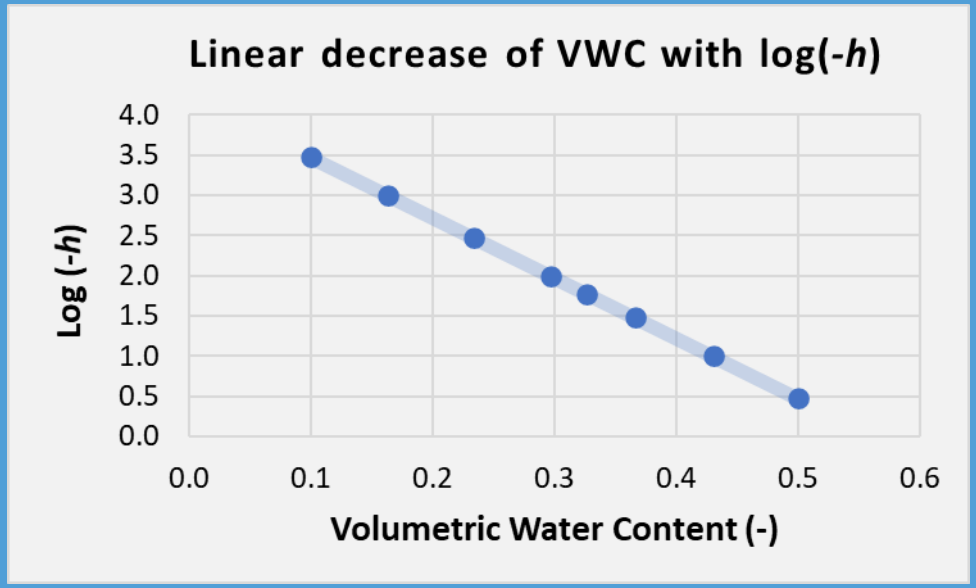
1. Objectives and requirements of reference samples
2. Possible techniques and current focus (2-fold)
    a. Clay with additives
    b. Sintering glass beads
3. Realization
4. Results (some retention curves)
5. Next steps
6. Discussion

1/6 Objectives of reference samples

- To check the equipment in one lab
- To compare measurements between different labs (inter laboratory control)

1/6 Requirements of reference samples

1. Water release must be a clear measurable amount, preferably a linear amount as a function of log(*h*)
2. Water release does not need to be comparable to that of real samples.



3. Water release must be reproducible, but may 'shift' in time
4. The reference sample needs to be robust

1/6 Requirements of reference samples

- For now focus on retention curve only in the wet range ($-3000 < h < 0$ cm)

- Strive for:
  - normal dimensions (height 5 cm; diameter 5 cm)
  - use of materials with well defined properties
  - continuous pores, because isolated pores are not measurable with regular lab equipment ('effective' versus 'real' porosity).

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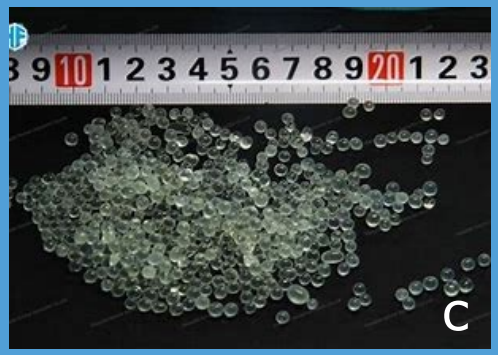
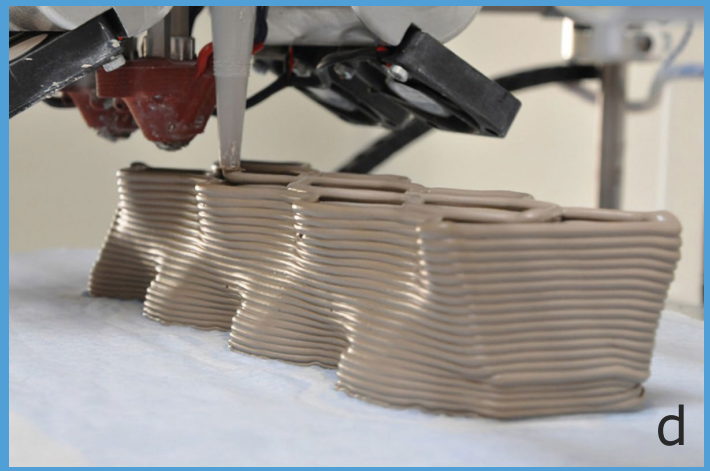
2/6 Possible techniques

a. Use of existing porous media like bricks or sandstone
b. Cementing glass beads (current inter lab comparison)
c. Sintering of ceramics (incl. soil particles, glass beads)
d. 3D printing with clay
e. Other?

a



c


d

2/6 Focus on sintering beads & baking clay

C. We focus in Wageningen on sintering of ceramics:

- clay with additives
- glass beads

Because then the reference samples

- can be designed and mixed
- uses course as well as fine materials
- are relatively ‘easy’ to construct
- can independently be reproduced with the same ingredients and methods

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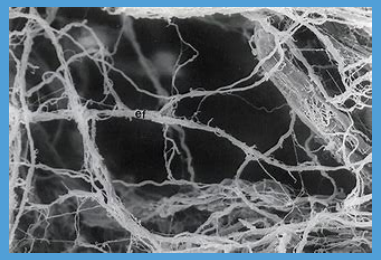
3/6 Realization clay with additives

1. Use of clay with little shrinkage (8.5%)
2. Thoroughly mix wet clay with organic compounds like:
    - Rice
    - Sawdust
    - Hemp
    - Fibers
    - Milled coffee
    - etc




- Strongly press into core
- Slowly dry to prevent cracking
- Slowly heat to 1050 °C (organics burn, leaving pores)
- Test result on Sandbox

3/6 Realization clay with additives

First series

Later series

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3/6 Realization sintering glass beads

1. Use of 4 bead size ranges
2. Fill vermiculite blocks (100 ml) with bead mixture
3. Sinter beads
4. Test specimen on robustness and porosity (waterdrop penetration)

1

Diameter (µm)	
from	to
2000	3400
1400	1680
850	1000
500	600

2

Experiments performed to determine sintering **temperature**, and sintering **time** per size range:

- Rough versus fine **temperature** determination (steps of 50°C in large temperature range, versus steps of 10°C in small range)
- Determination of sintering **time**

Use the resulting temperature and time to sinter mixtures

3/6 Realization sintering glass beads

First trials

Later series

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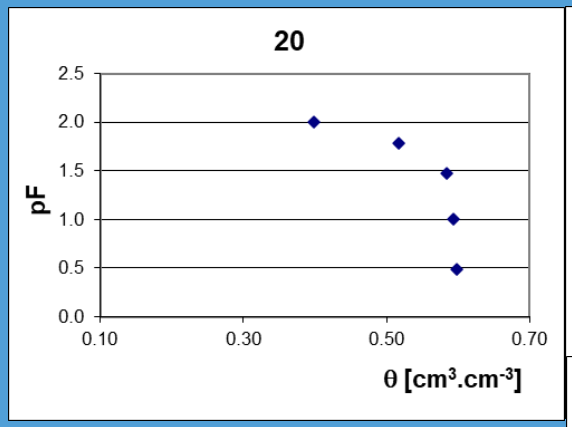
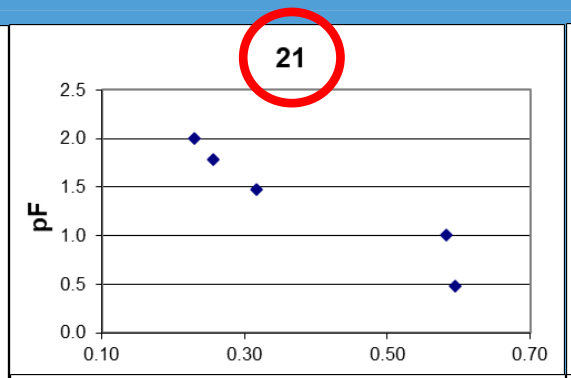
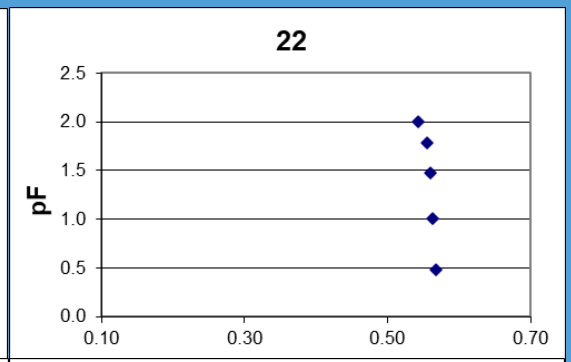
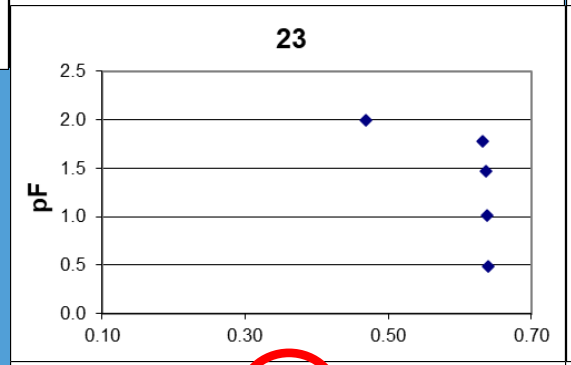
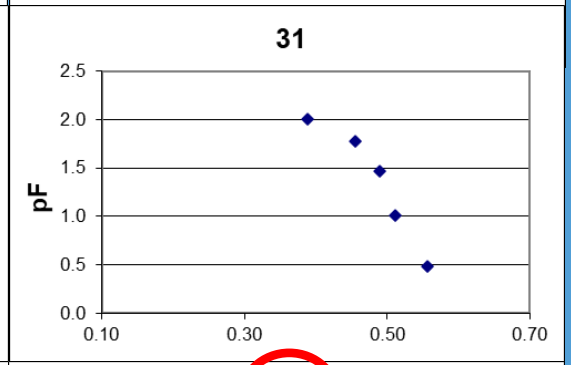
4/6 Results clay with additives

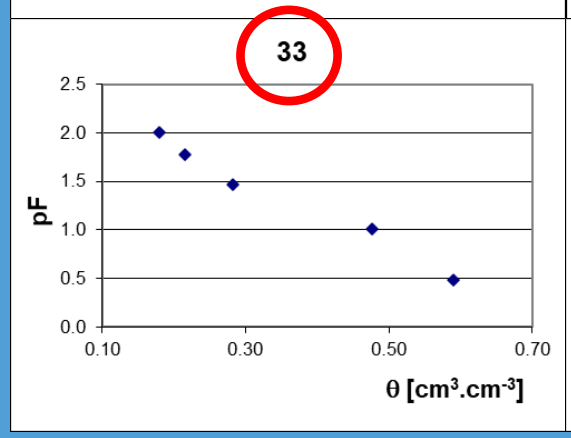


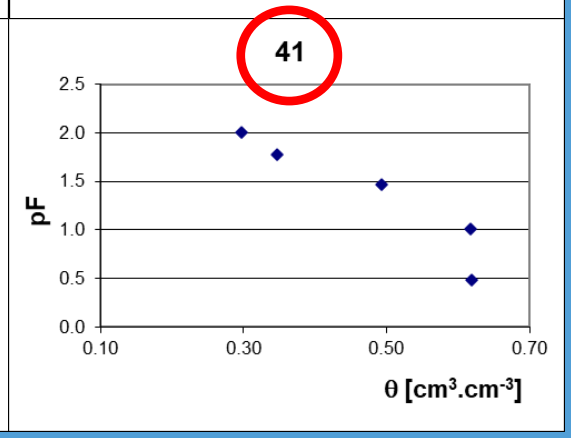












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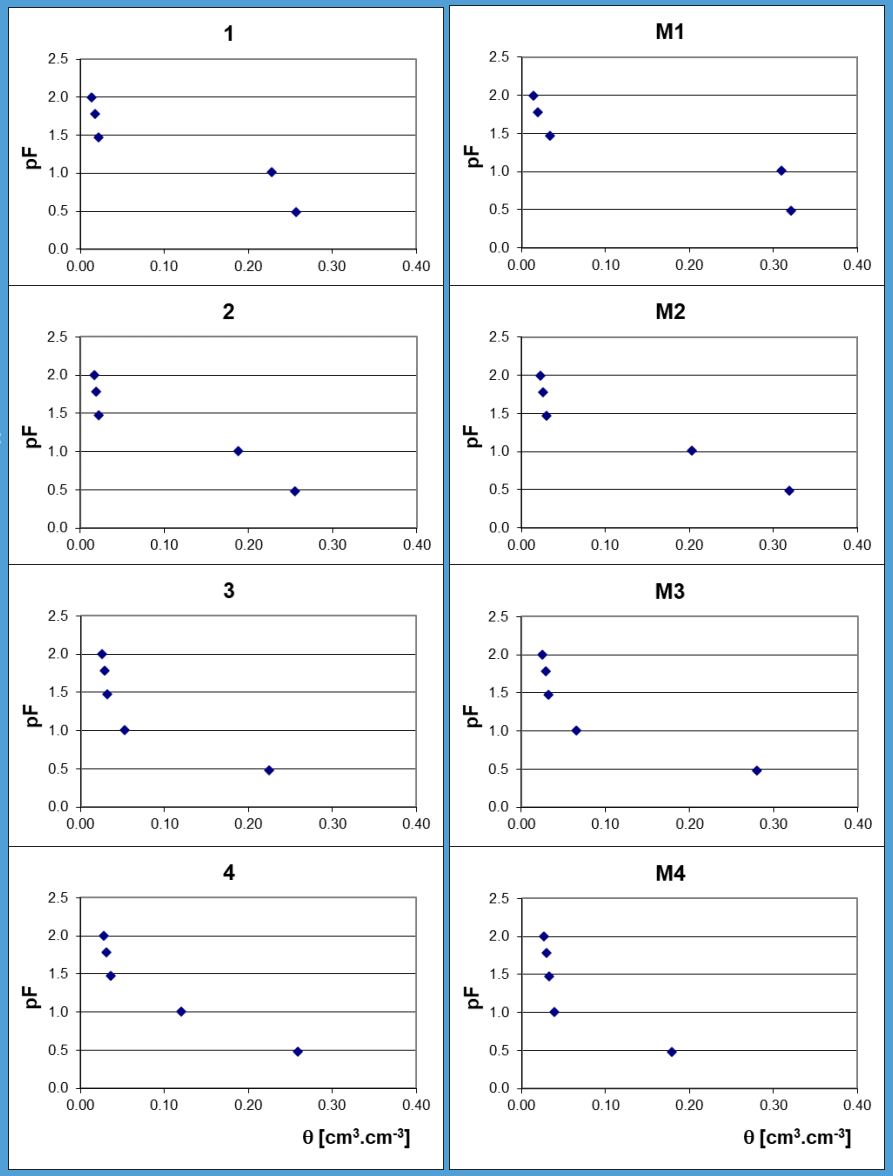
4/6 Results sintering glass beads

C (Course) =
2000-3400 µm

MG (Mid Course) =
1400-1680 µm

MF (Mid Fine) =
850-1000 µm

F (Fine) =
500-600 µm



¼ * (C+MC+MF+F)

½ * (C+MC)

½ * (C+MF)

½ * (C+F)

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5/6 Next steps

1. Select most promising clay-additive (=porosity) combinations
2. Grind these clay-additive combinations into small aggregates
3. Mix these aggregates with a selection of glass beads and sinter these (in order to construct a well defined pF curve)
4. Find a method to flatten the surfaces (problem due to shrinkage)
5. Find a method to seal the sidings of the samples
6. Finish the publication on methodology and use

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6/6 Questions & Discussion

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Thank you

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