Physical characterisation of pit latrine sludge

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Sanitation: a global challenge

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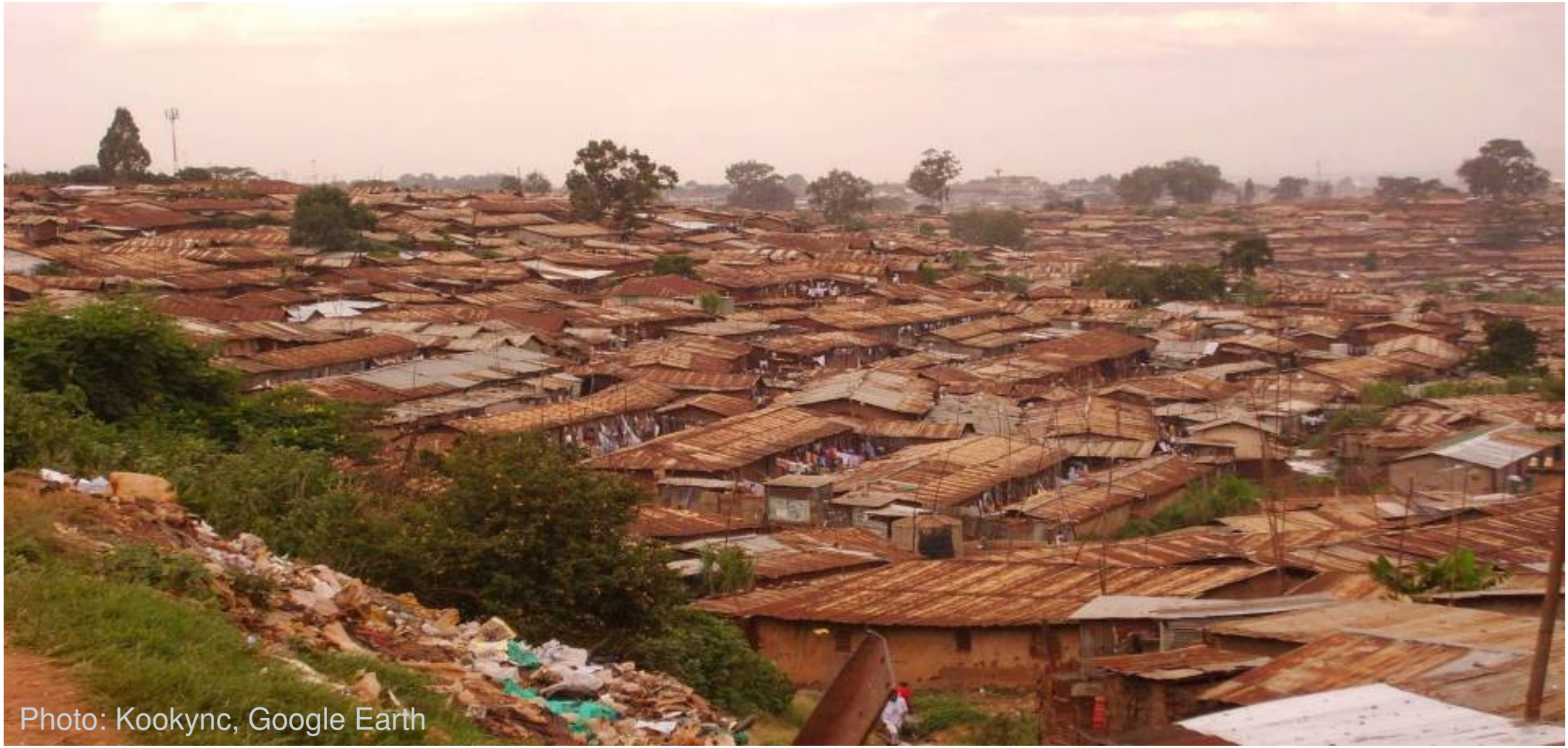
Emptying existing urban pits



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What happens when the latrine is full?

Photo: Partners in Development

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Manual pit emptying

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Pit emptying technologies

Photos: M.Coffey, PID, S.Sugden, M.O'Riordan

Subjective assessments

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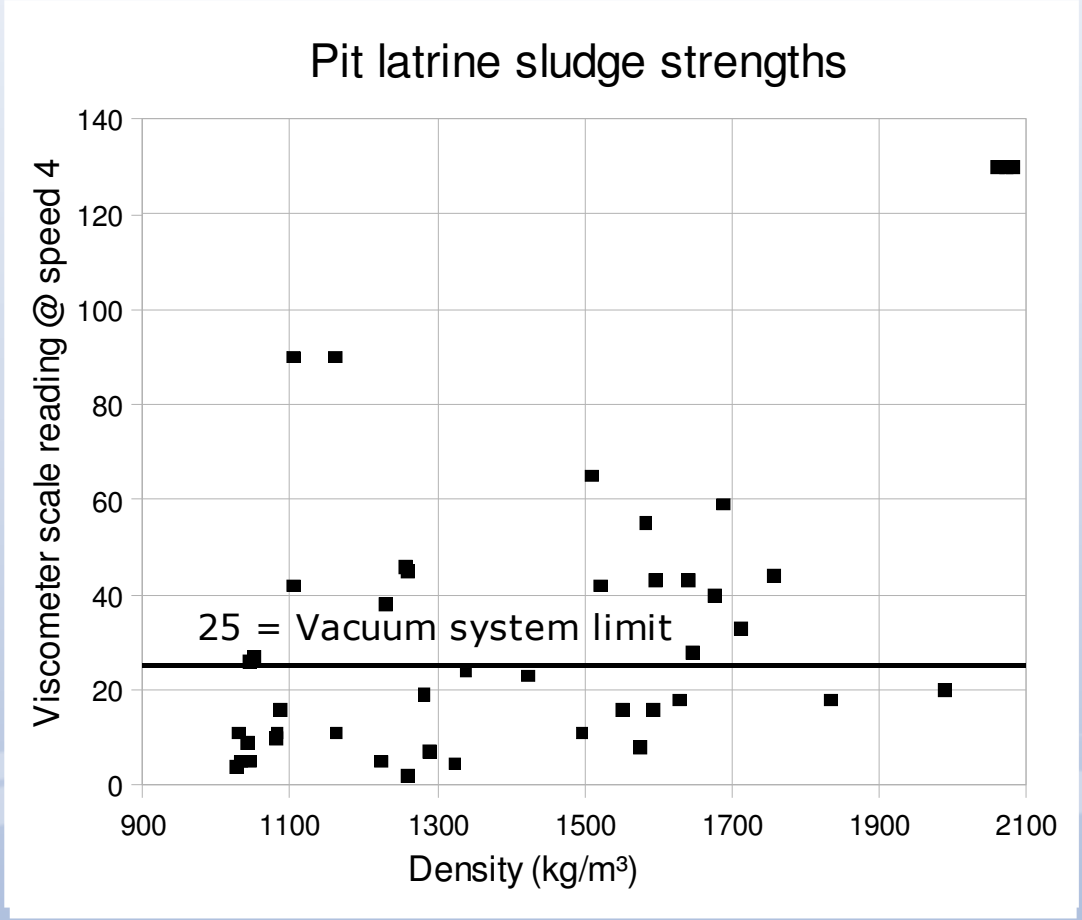
Previous studies: IRCWD, Botswana, 1985



Portable penetrometer: Design criteria

- Test sludge in-situ to 2.5m depth
- Simple to use
- Man-portable
- Human or battery powered
- $1000 target cost
- Rugged – mishandling, dusty environment

Laboratory mini-ball penetrometer

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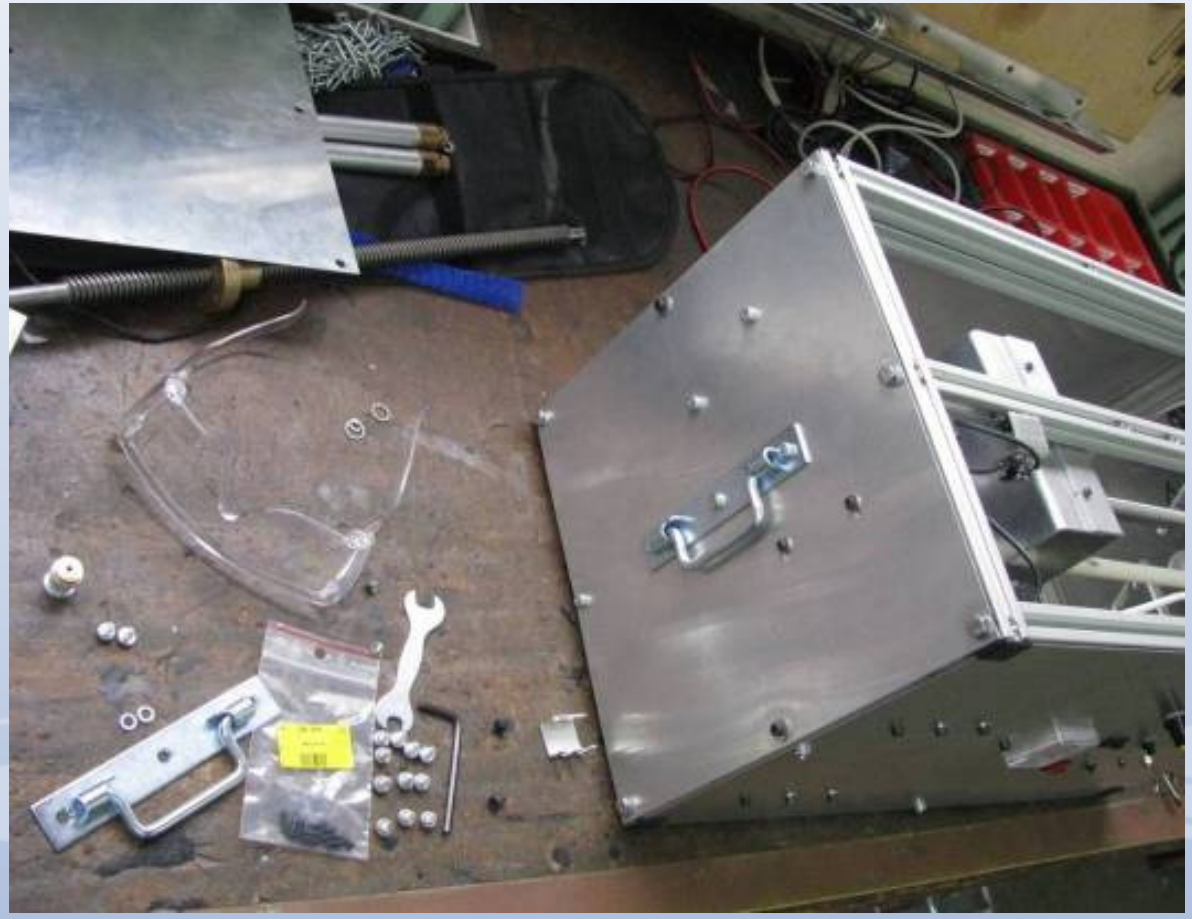
Design and manufacture



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Laboratory calibration

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Field testing: septic tanks

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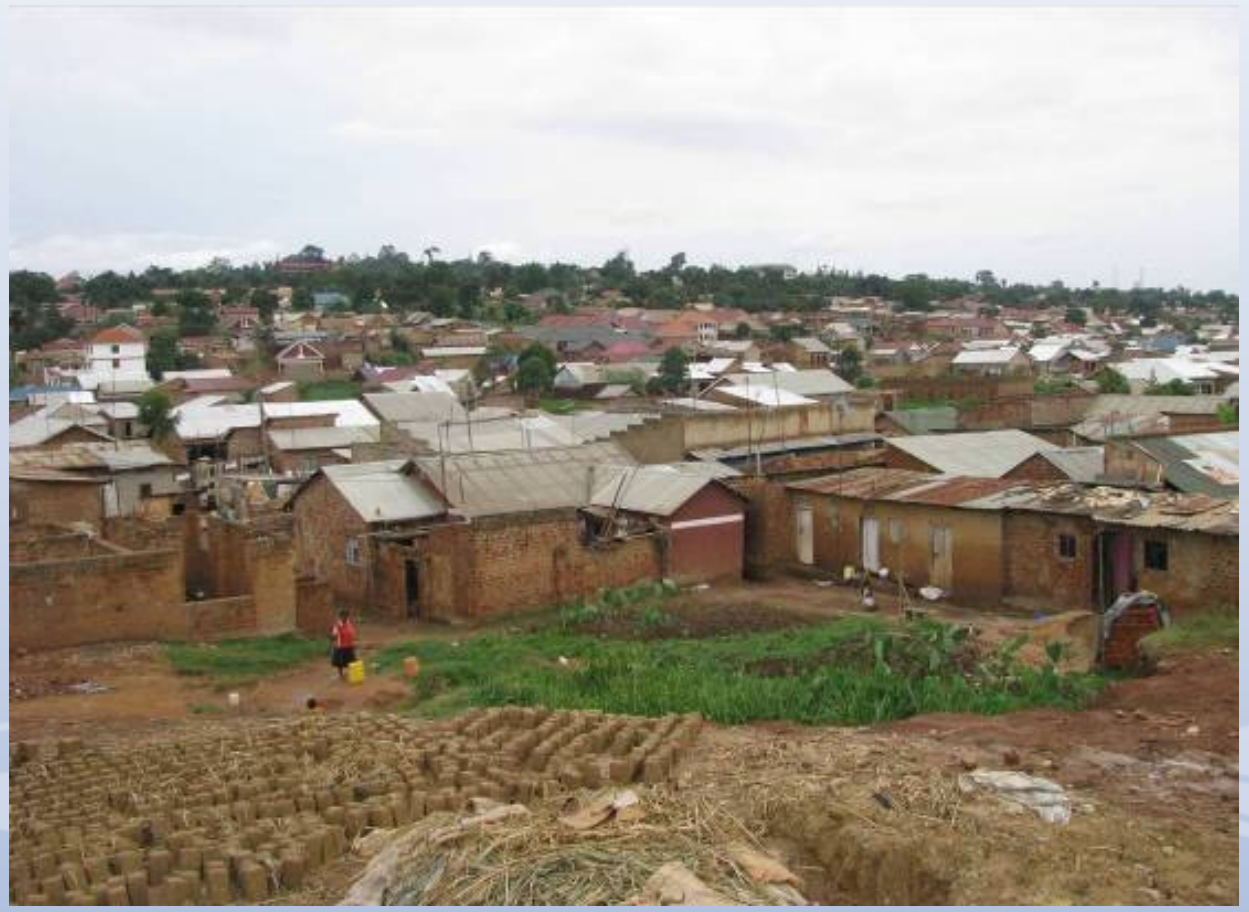
Field investigation: Kampala, Uganda



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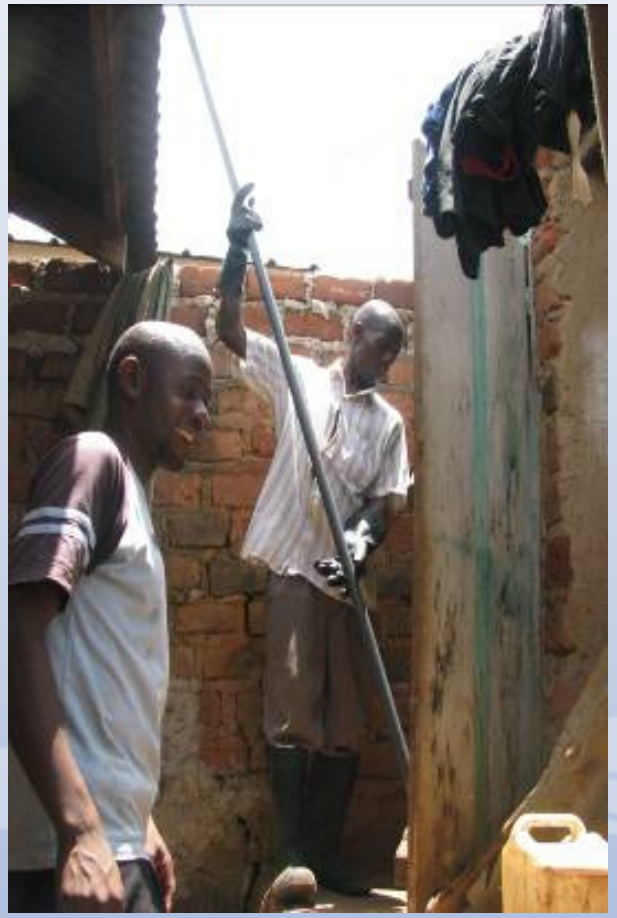
Field investigation: Kampala, Uganda



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Field investigation: Kampala, Uganda

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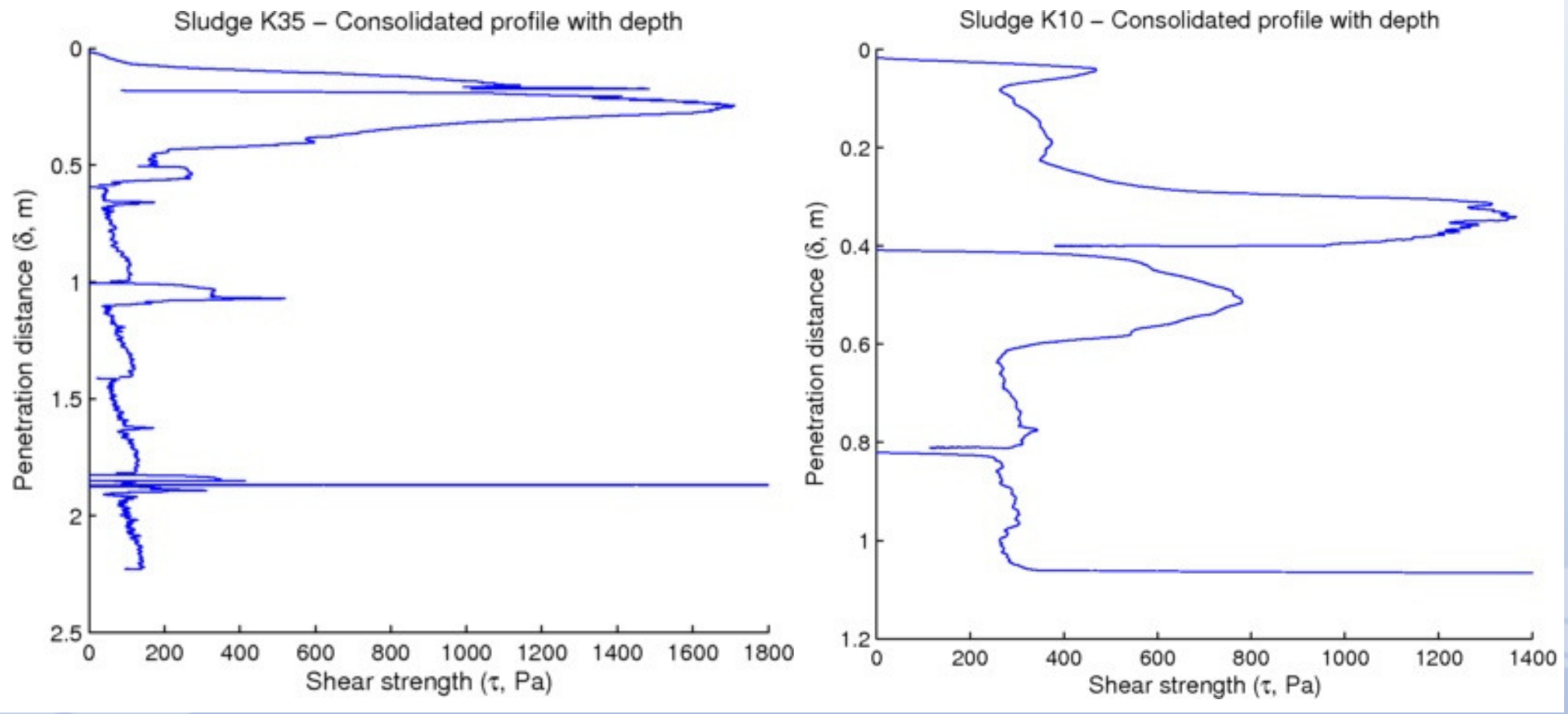
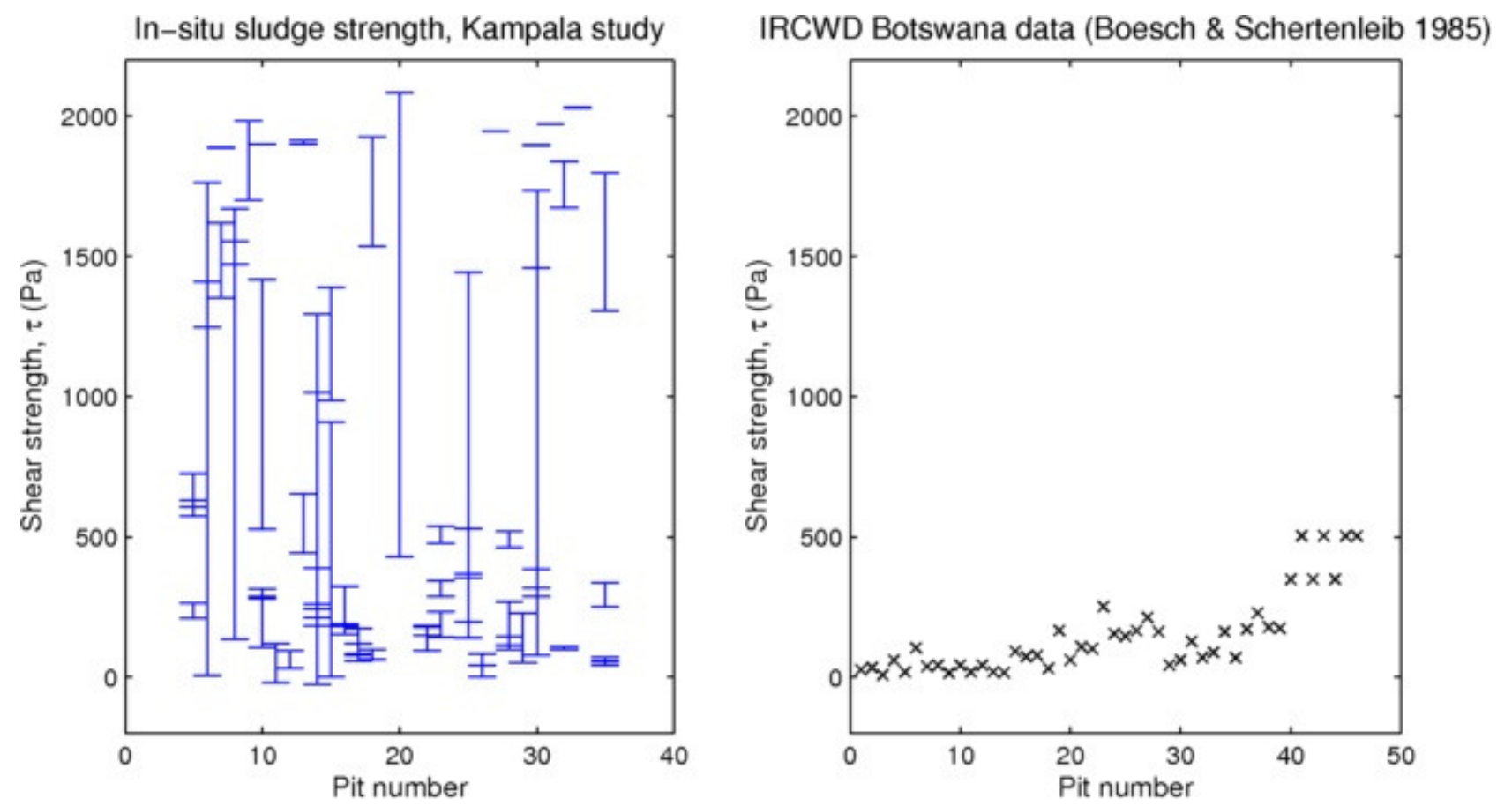
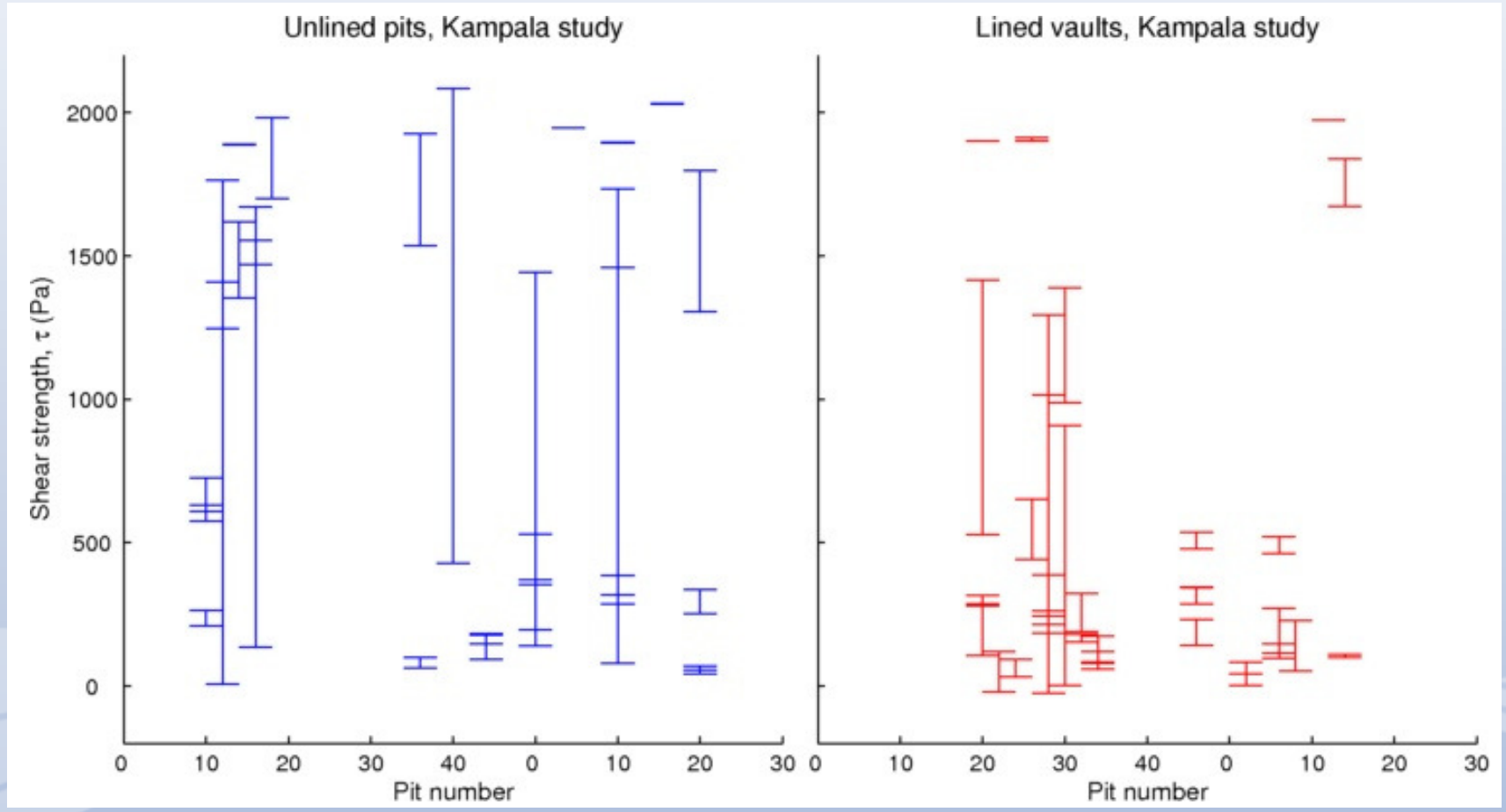
Shear strength profiles



Shear strength: comparison with literature



Shear strength: pits -vs- vaults



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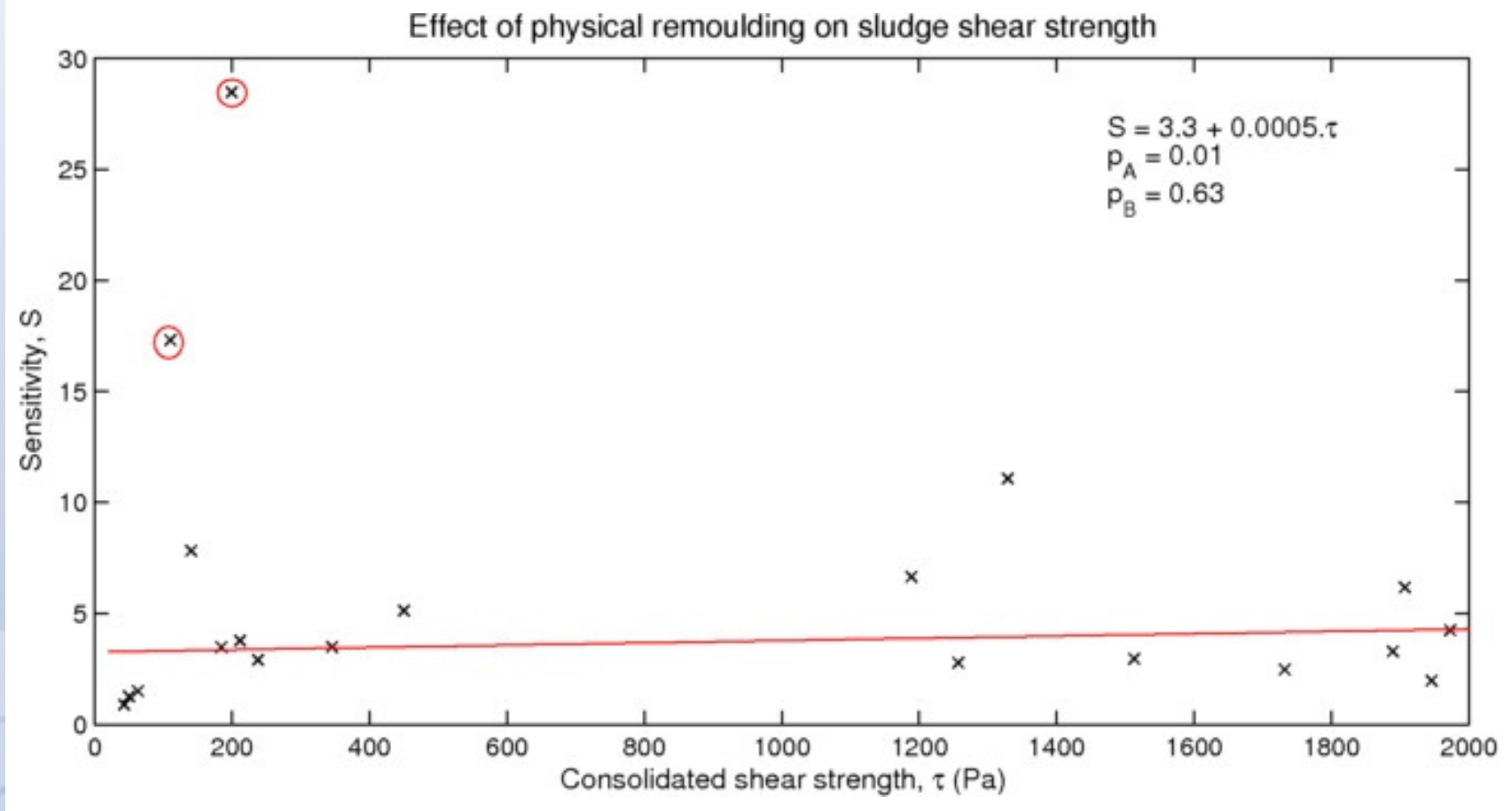
Shear strength: sensitivity



Density: testing samples

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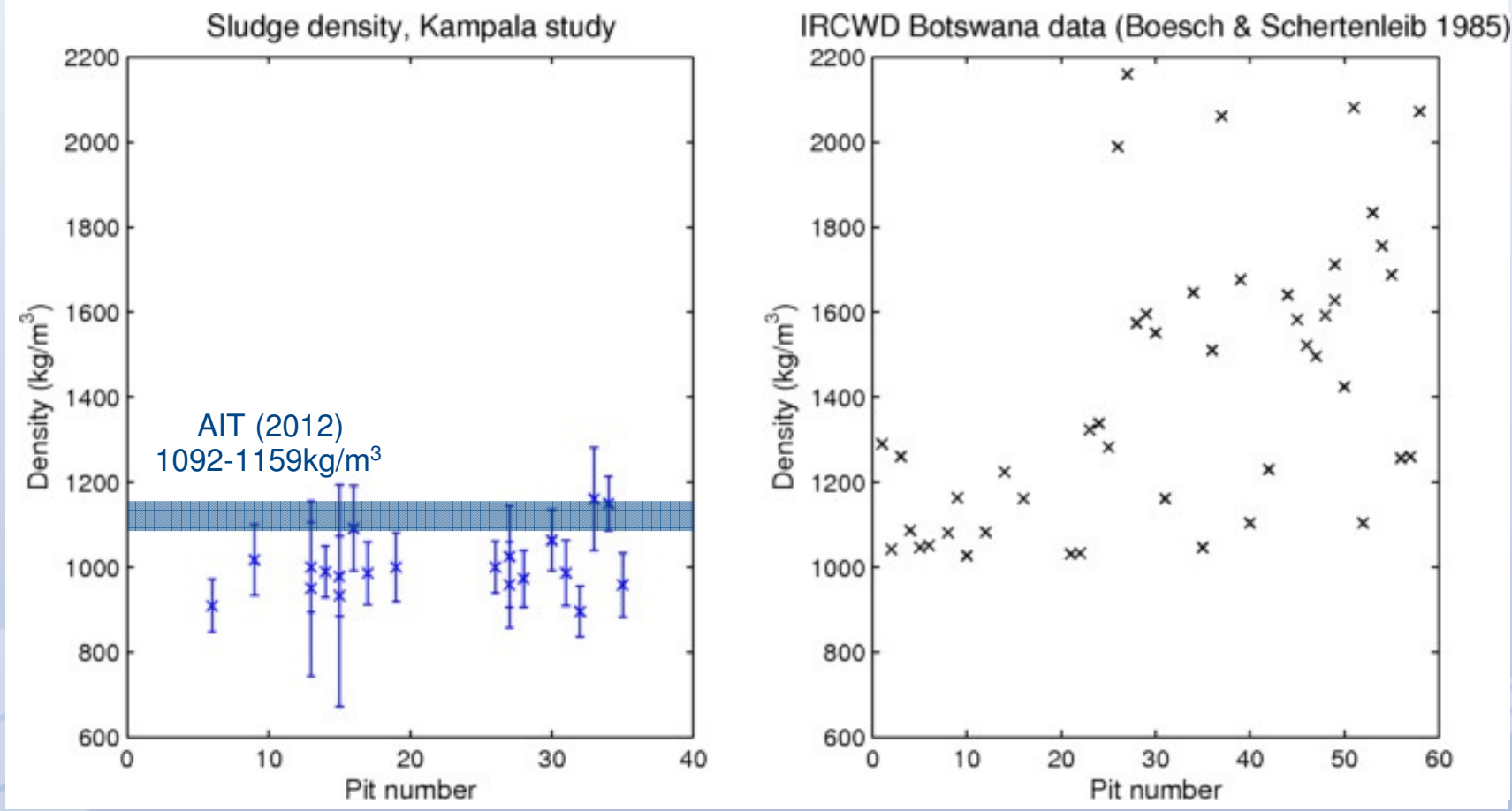
Density: comparison with literature



Conclusions

- Pit latrine sludge 4x stronger than previously reported, >2kPa
- Pit contents highly variable – within and between pits
- Strong surface crust is common
- Strong sub-surface layers also encountered
- Remoulding reduces strength by a factor of >3
- Density in range 1000 – 1200kg/m^3 for 'pure' faecal sludge

Future work

- Portable penetrometer: multi-city baseline study
- Chart performance of different pit emptying technologies

Performance benchmarking

Photos: M.Coffey, PID, S.Sugden, M.O'Riordan

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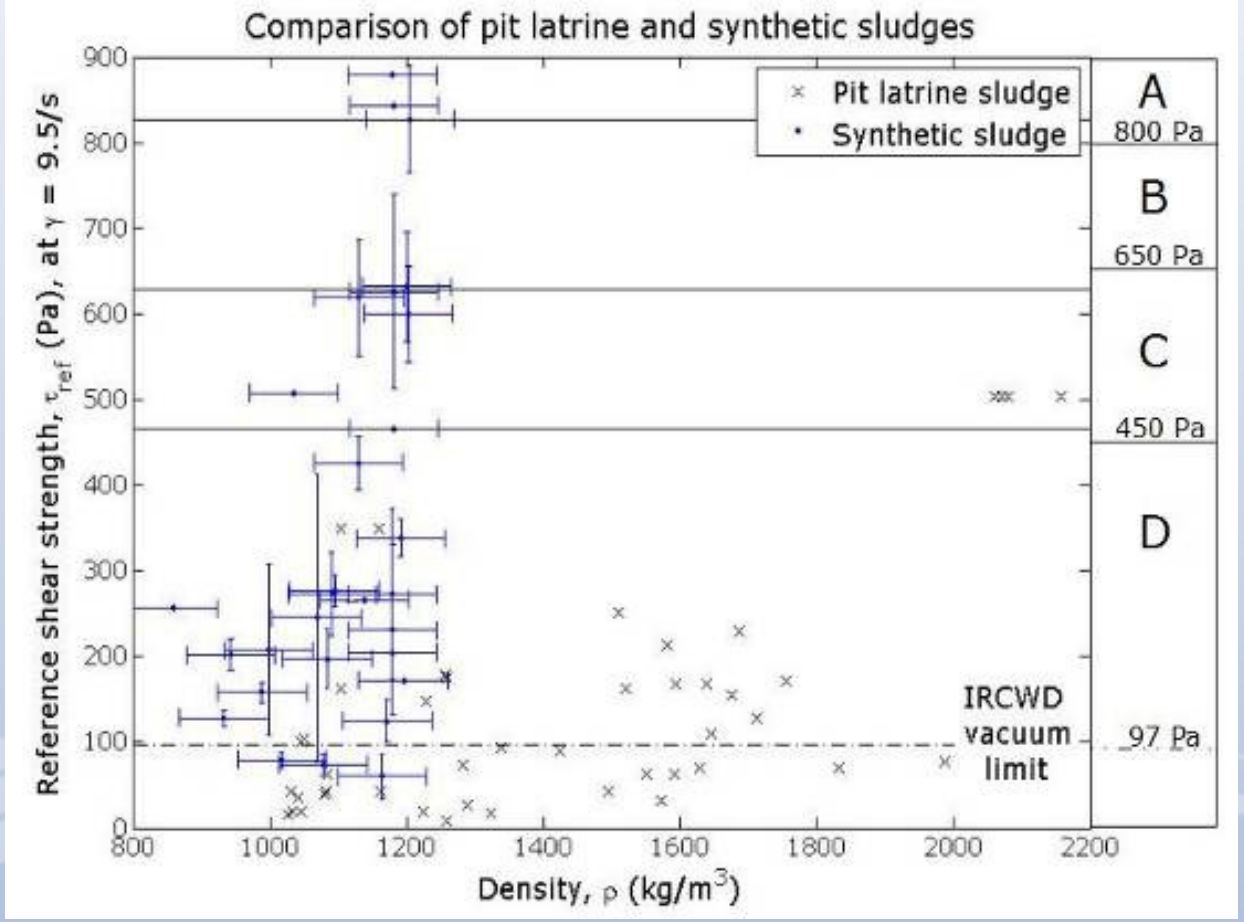
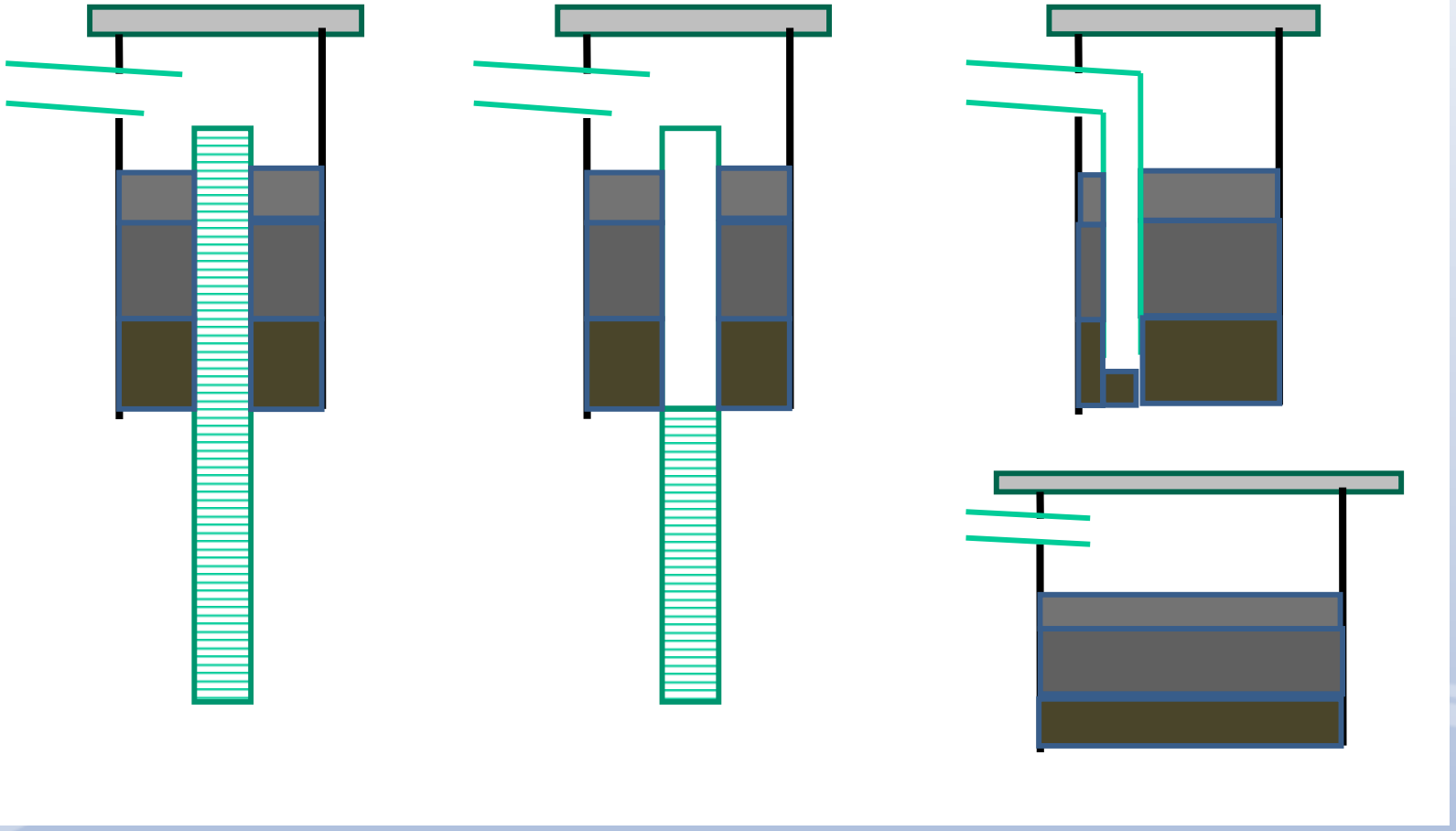
Future work: sludge classification



Future work

- Portable penetrometer: multi-city baseline study
- Chart performance of different pit emptying technologies
- Factors affecting pit function: longitudinal studies

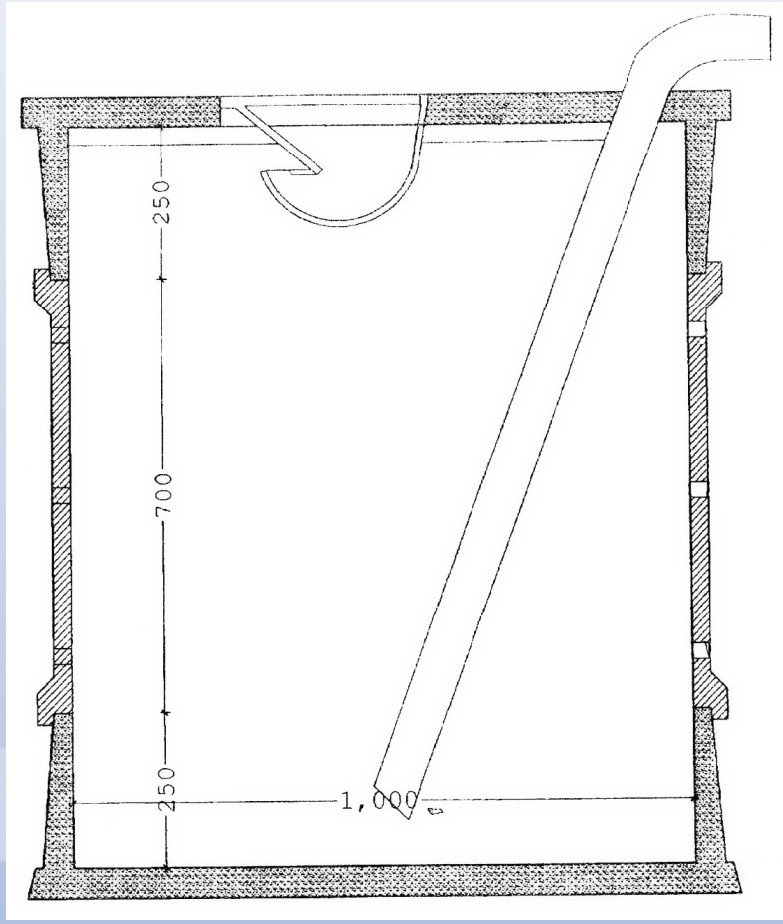
Future work: factors affecting pit function



Future work

- Portable penetrometer: multi-city baseline study
- Chart performance of different pit emptying technologies
- Factors affecting pit function: longitudinal studies
- Fluidisation: Overconsolidated simulant, full-scale tests

Sludge fluidisation: proof of concept



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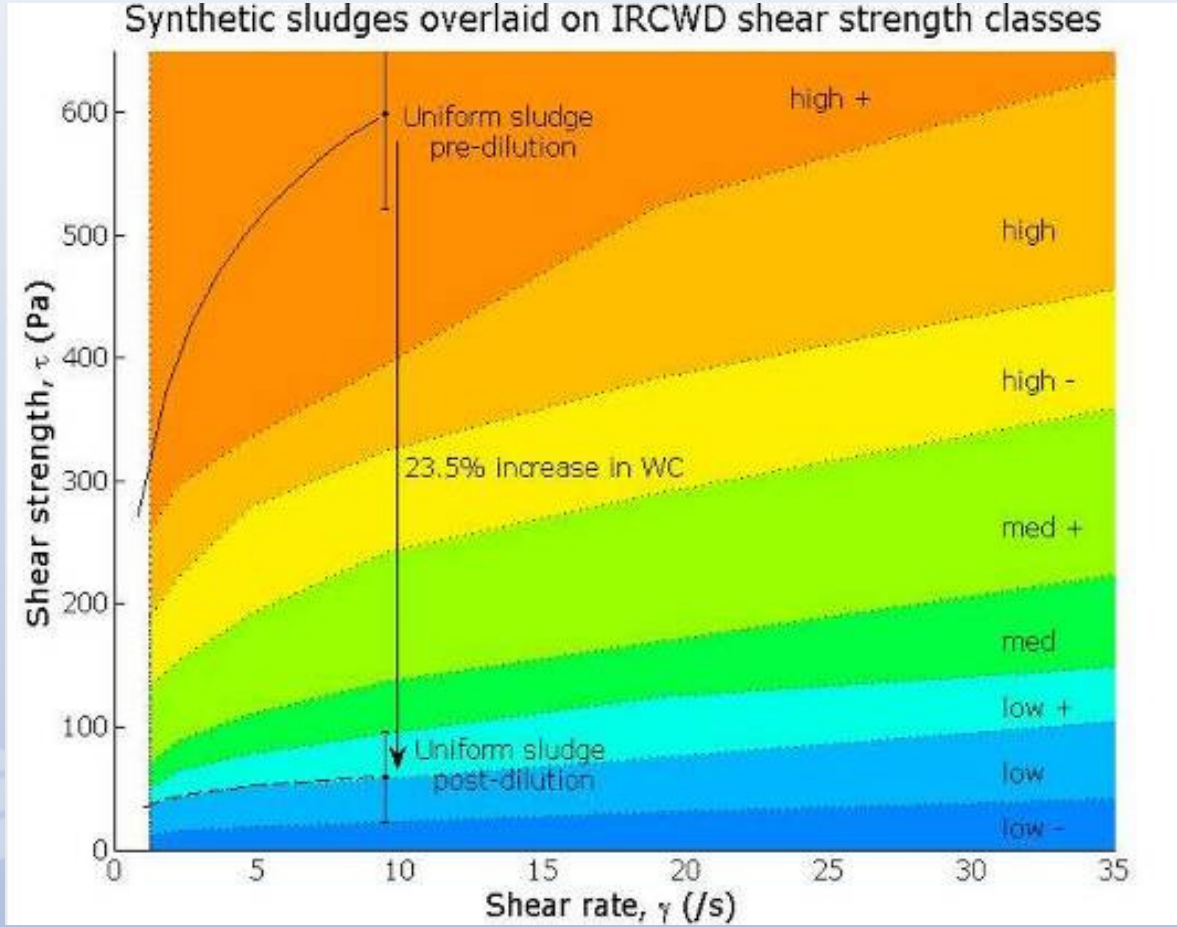
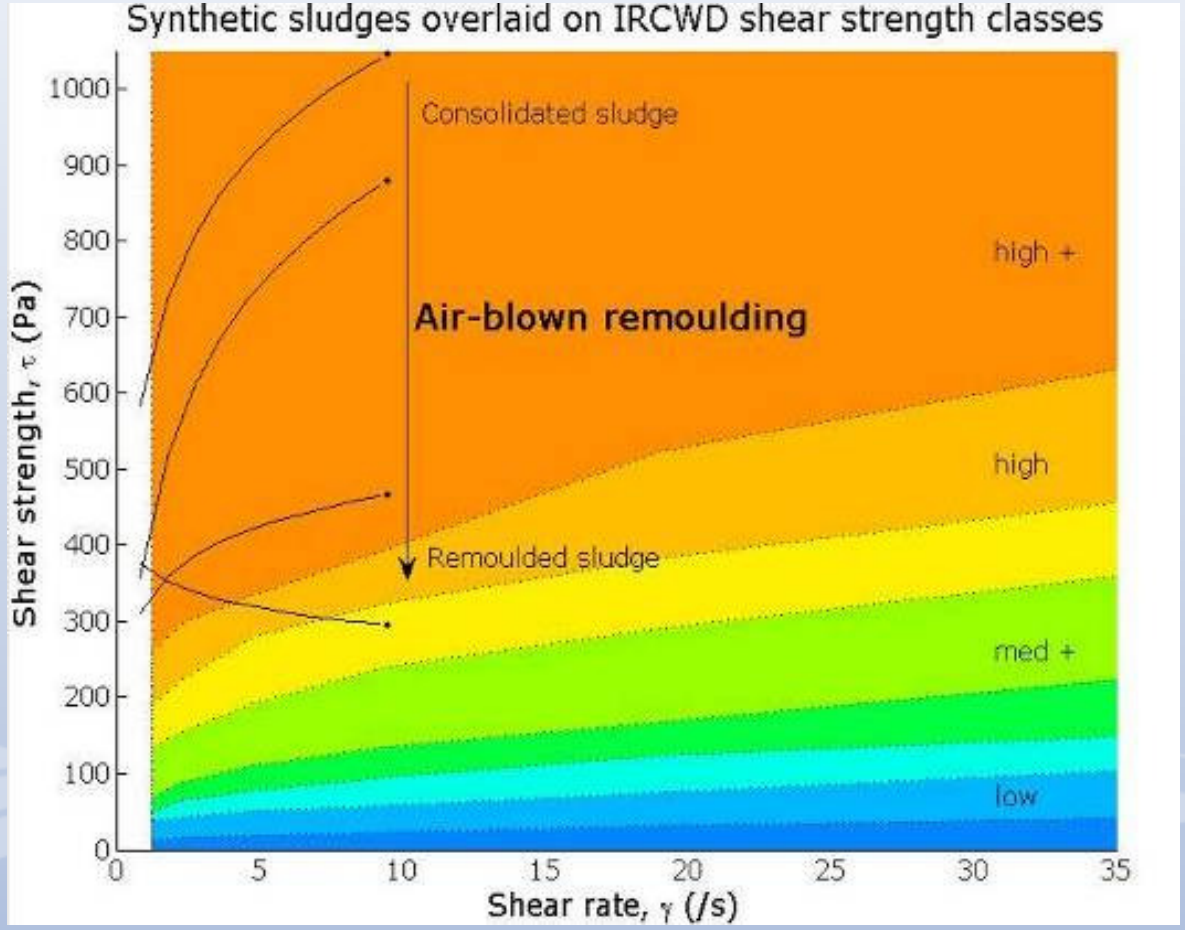
Sludge fluidisation: dilution



Sludge fluidisation: remoulding



Future work: full scale fluidisation

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Future work

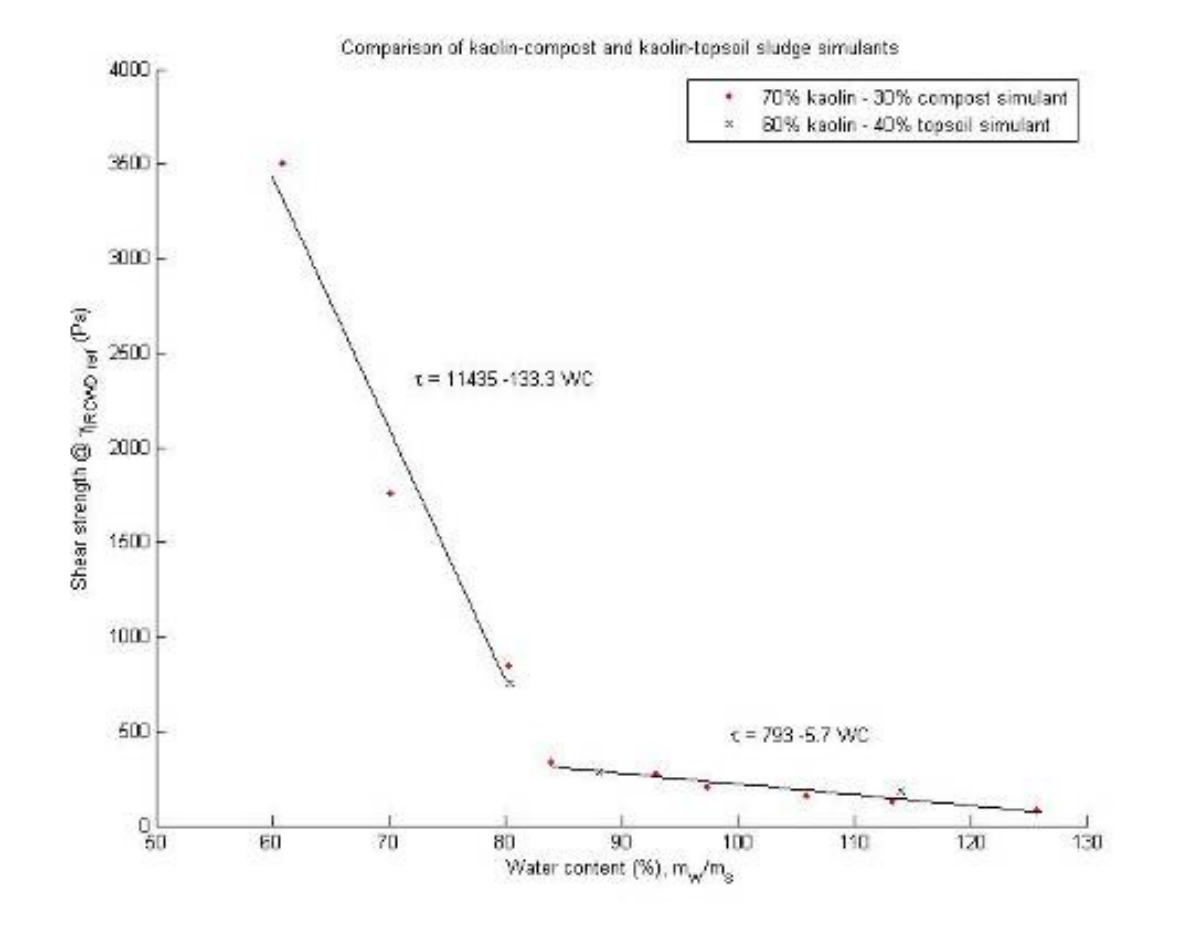
- Portable penetrometer: multi-city baseline study
- Chart performance of different pit emptying technologies
- Factors affecting pit function: longitudinal studies
- Fluidisation: Overconsolidated simulant, full-scale tests
- Synthetic sludge: Higher strength, extraneous matter

Future work: synthetic sludge

- Kaolin clay
- Topsoil
- Water

- 'Extraneous matter'
  - Sand, gravel
  - Newsprint
  - Plastics
  - Textiles

Synthetic sludge: higher strength



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Future work

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- Factors affecting pit function: longitudinal studies
- Fluidisation: Overconsolidated simulant, full-scale tests
- Synthetic sludge: Higher strength, extraneous matter
- Low cost sludge characterisation tools

Acknowledgements

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