The response of expansive clays towards cyclic wetting and drying cycles

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Background

As climate change has been getting more significant over the years, more extreme weather patterns are observed around the world. The intense rainfalls and droughts have been negatively affecting the geotechnical infrastructure as they have the potential to alter the soils' structure which could change the soils' behaviour.

Aim

To investigate the behaviour of the expansive clays under several wetting and drying cycles imitated in the laboratory by studying the soil water retention curves (SWRCs) and shrinking curves (SCs) of the soil samples.

Objectives

1. To evaluate the effect of sample preparation on the measured SWRCs and SCs.
2. To investigate the effect of cyclic wetting and drying on SWRCs and SCs.
3. To investigate the respective contributions of matric suction and osmotic suction for an expansive clays SWRC.

Methodology

1. The samples are prepared according to their targeted gravimetric water content (in-situ or saturated).
2. They are molded into a cylindrical shape with the dimension of 15 mm in diameter and 10 mm in height using a custom mold.
3. They are dried and wetted according to their type of testing using a wetting chamber and a desiccator.
4. Recorded data are then plotted into graphs of SWRCs and SCs.

Sample	Name of site	Gravimetric water content (%)	Type of testing
1	Attaclay (A1)	In-situ (29.34)	Initial wetting to approximately full saturation followed by a full cycle of drying and wetting
2	Attaclay (A2)	Saturated (35.84)	Full cycle of drying and wetting
3	Yellowstar at 5 m depth (Y5)	Saturated (30.83)	Full cycle of drying and wetting
4	Yellowstar at 3 m depth (Y3)	In-situ (20.62)	Cyclic wetting and drying cycles between 19.5% and 21.5% of water content

Results (Soil water retention and shrinking curves)

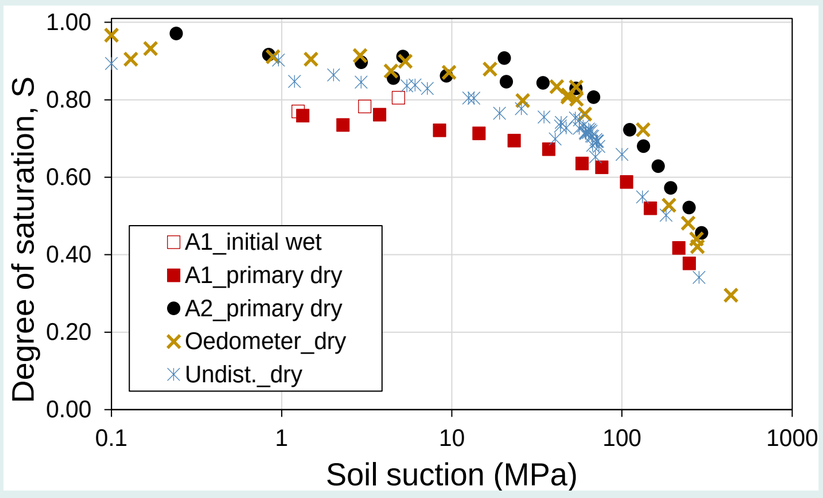

Figure 1- Drying curves for A1 & A2

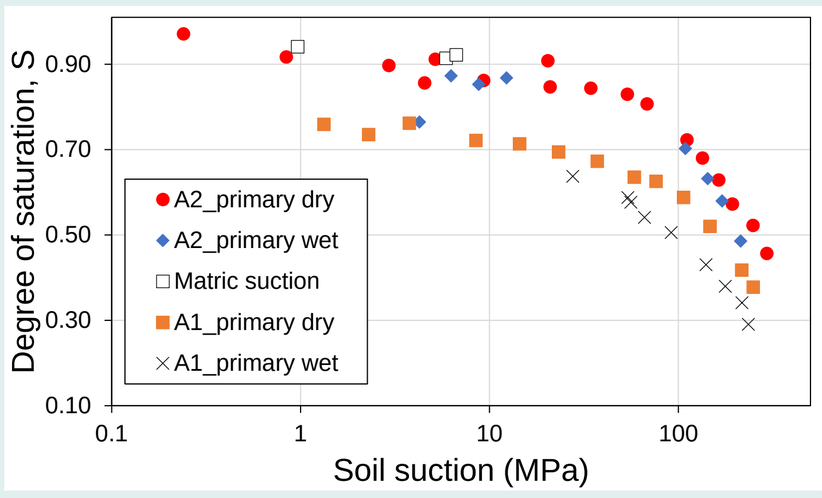

Figure 3- Drying and wetting curves (A1 & A2)

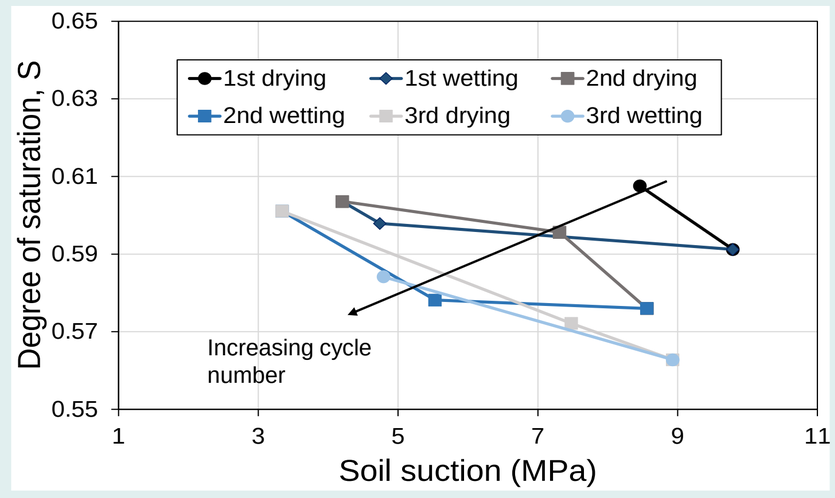

Figure 5- Cyclic drying and wetting curves for Y3

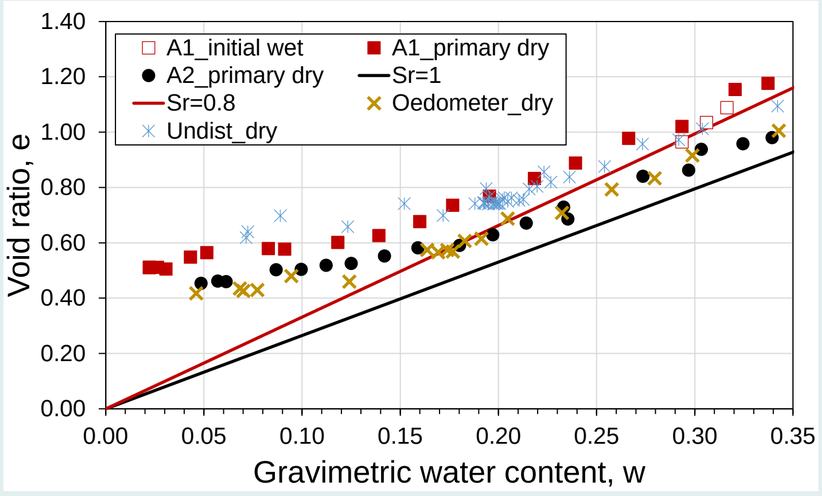

Figure 2- Drying SCs (A1 & A2)

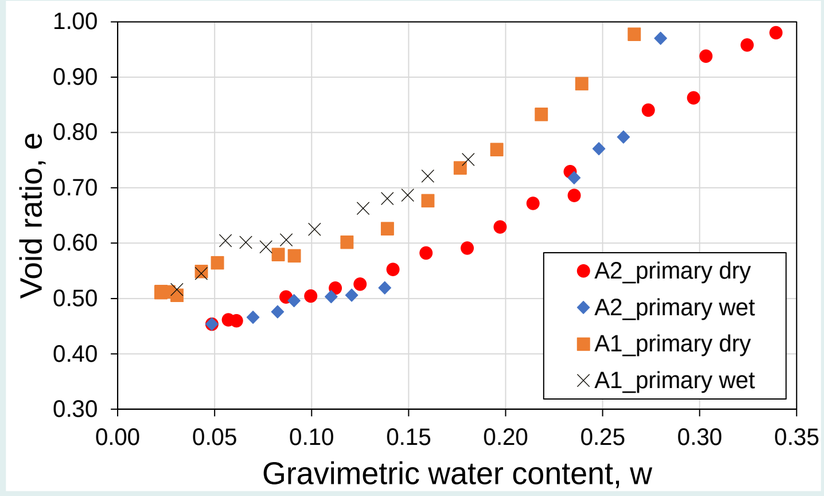

Figure 4- Drying and wetting SCs (A1 & A2)

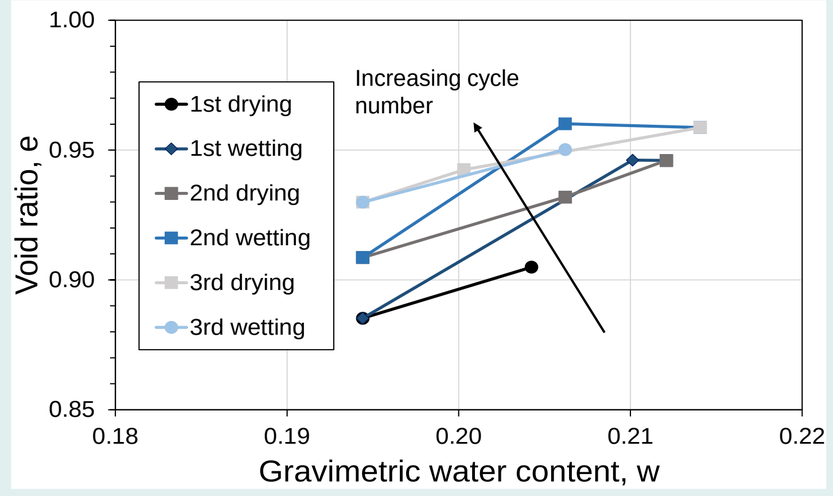

Figure 6- Cyclic drying and wetting SCs (Y3)

Conclusion

1. Comparison with previous literature indicates that soil fabric had no effect on the shape of SWRCs and SCs for Attaclay soil (Figs. 1,2,3,4).
2. With increasing cycle number, the suction at a given saturation decreases (Fig 5), with an increase in irreversible swell (Fig. 6).
3. Total suction of Attaclay sample is governed by matric suction with negligible osmotic contributions (Fig. 3).

Issues

- Samples are sensitive upon contact (crumbling at lower water contents).

References

Gaspar, T. A. V. (2020). *Centrifuge modelling of piled foundations in swelling clays*. Ph. D. Thesis. University of Pretoria.