

# Hydration Behavior of Geosynthetic Clay Liners (GCLs) Manufactured with Laboratory Type Needle Punching Equipment

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# CONTENT

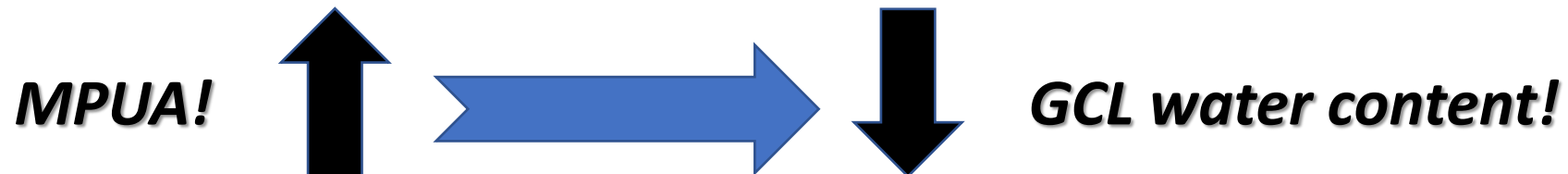
1. INTRODUCTION
2. RESEARCH AIM
3. MATERIALS and METHODS
4. RESULTS
5. CONCLUSIONS
6. REFERENCES



# 1. INTRODUCTION



- Hydration of GCL from underlying subsoil is widely investigated in the literature.
  - Subsoil and environmental conditions
  - GCL properties
  - Bentonite type
  - Mass per unit area (MPUA)
- Rayhani et al. (2011), Karakuş et al. (2022) and Ören et al. (2022) showed the effect of mass per unit area (MPUA) on water content of GCL.



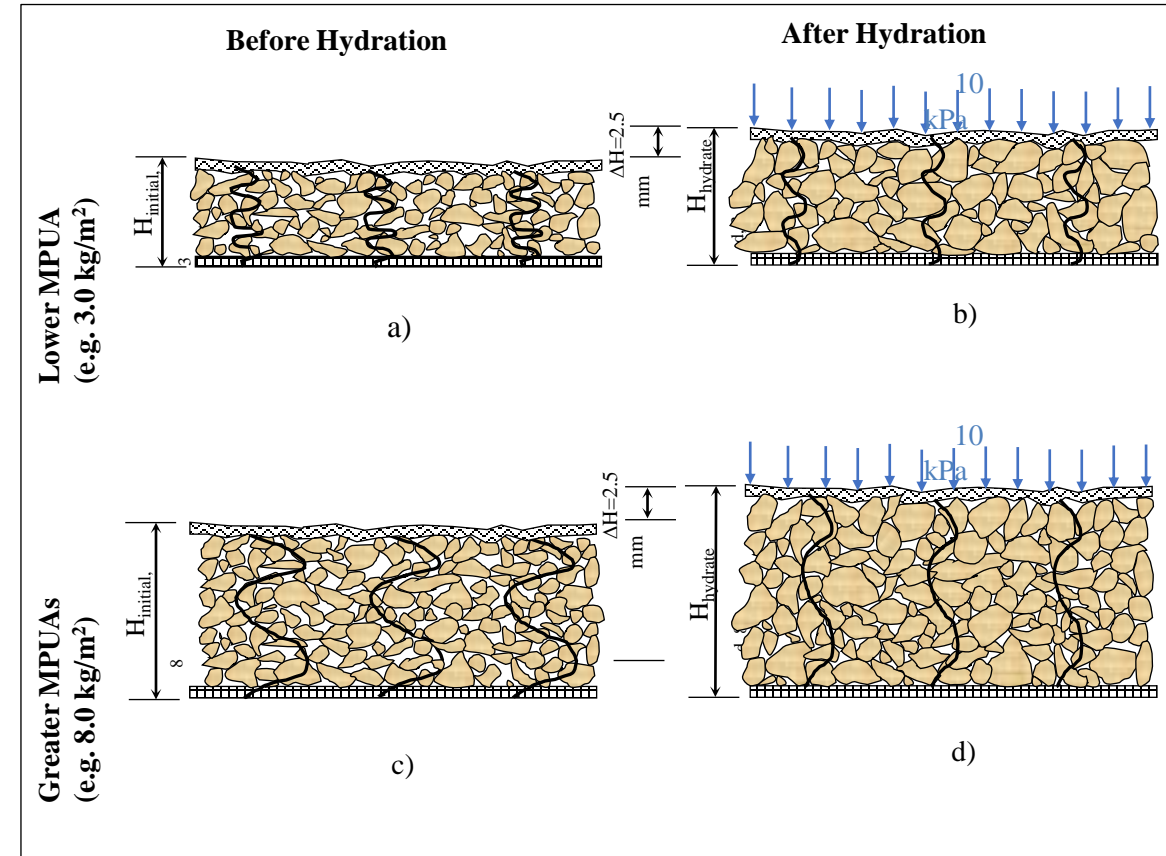
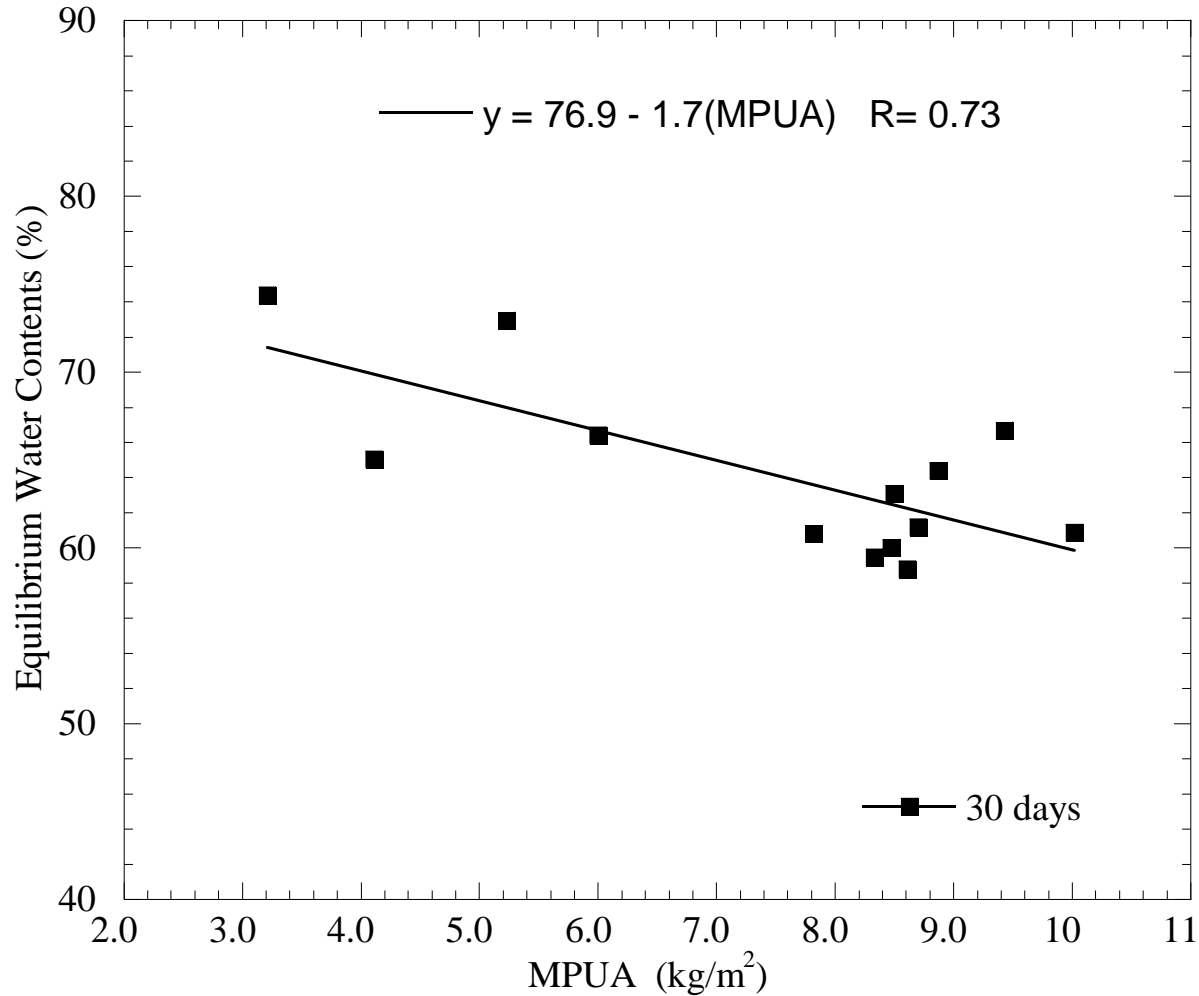
# 2. RESEARCH AIM



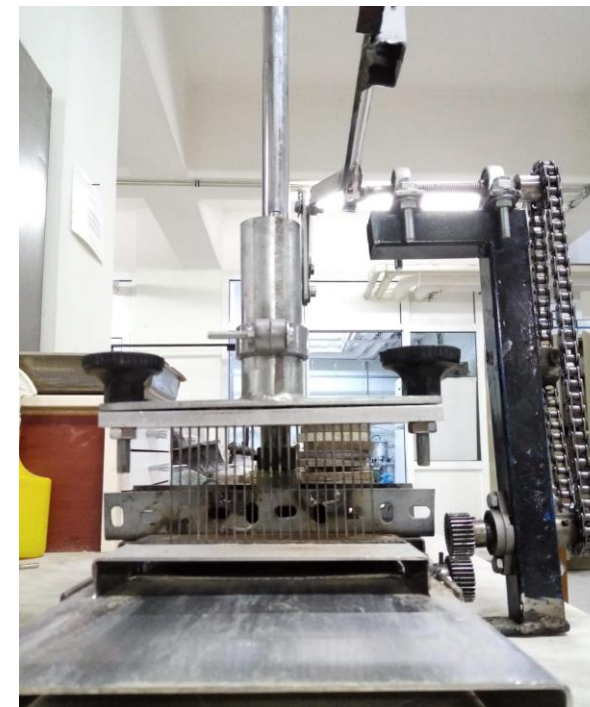
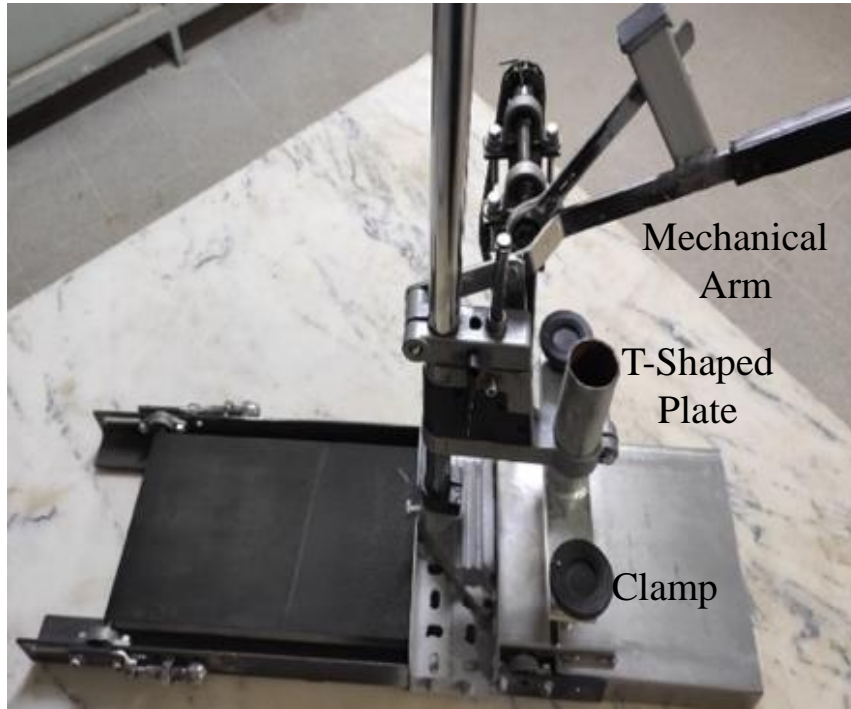
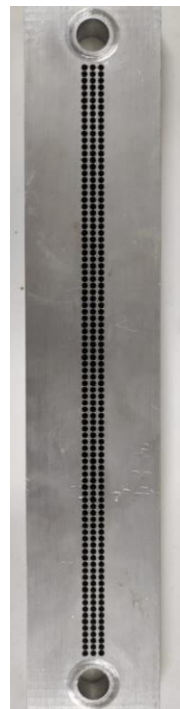
- The aim of this study is to investigate the influence of mass per unit area on the hydration behavior of GCL.
- MPUA of GCL deployed to the laboratory is within a narrow range throughout the GCL roll.
- To examine the hydration performance of GCL over a wider MPUA range, laboratory type needle punching equipment was developed.

## 2. RESEARCH AIM

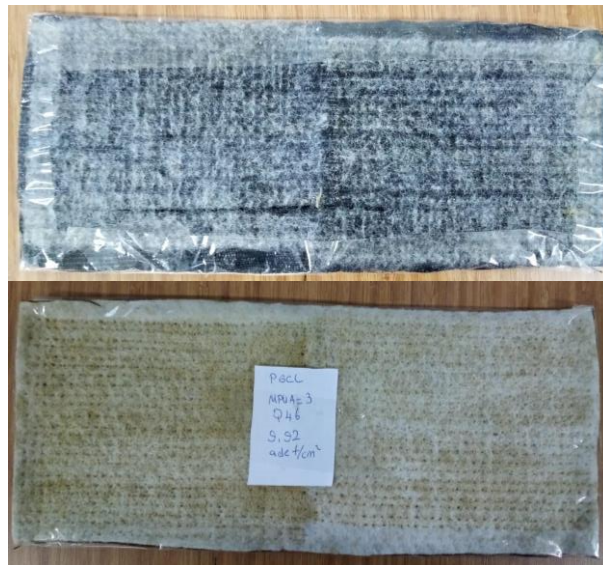
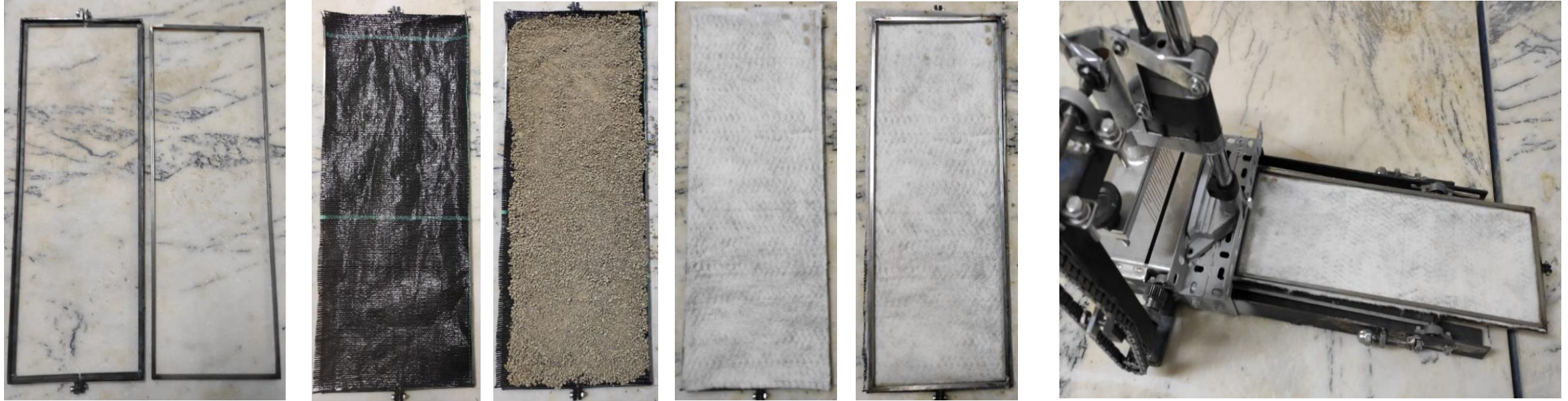
# Latest Study About Hydration and Hydraulic Performance of GCL (ÖREN ET AL.,2022)



# Laboratory Type Needle Punching Equipment



# Manufacturing Process of Artificial GCL (A-GCL)



# 3. MATERIALS & METHODS

## *Material properties*

- Polymer modified GCL (P-GCL) were used.
- They were hydrated over compacted silty sand.
- Properties of GCL and silty sand subsoil were determined following ASTM methods.

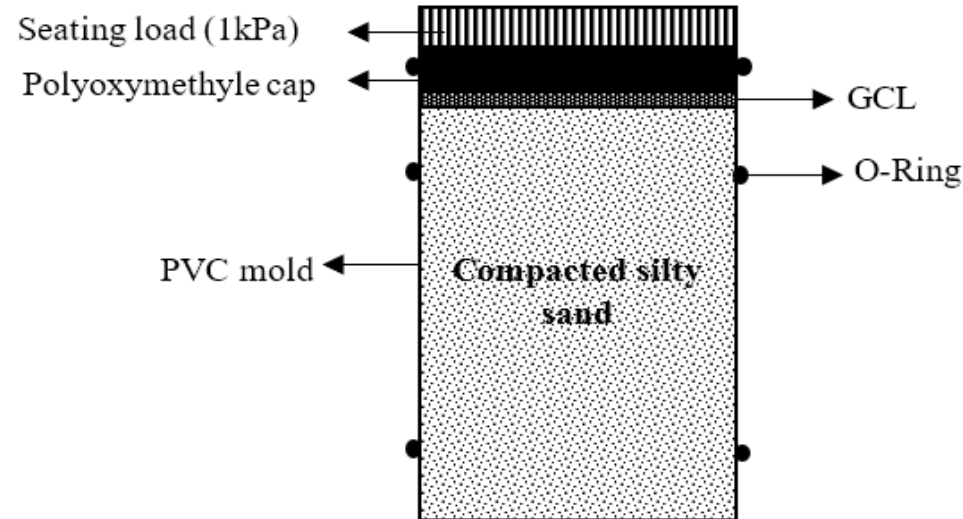
Materials	P-GCL	Subsoil
<b>MPUA (kg/m<sup>2</sup>)</b>	4.0-4.5	
<b>Carrier geotextile</b>	Woven	
<b>Cover geotextile</b>	Non-woven	
<b>Specific gravity</b>	2.71	2.67
<b>Plastic limit (%)</b>	51	NP
<b>Liquid limit (%)</b>	222	31
<b>Clay content (%)</b>	73	1
<b>Swell index (mL/2g)</b>	26.5	



# Hydration Setup of GCL



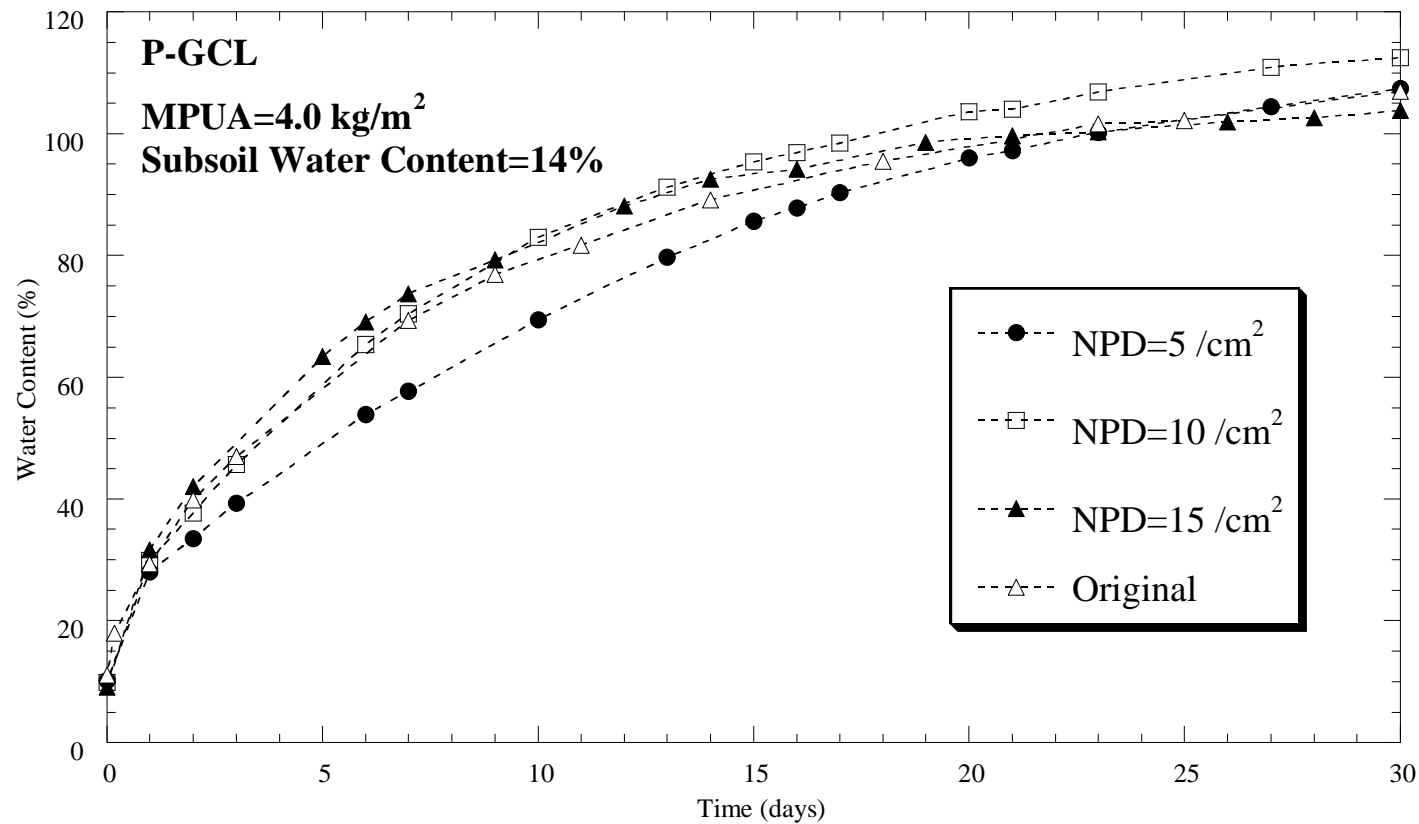
- ❖ Standard Proctor Energy
- ❖  $w_{opt} = \%12$  ve  $\gamma_{dmaks} = 18.3 \text{ kN/m}^3$ .
- ❖ Subsoil were compacted on 2% wet side of optimum water content (i.e 14%).
- ❖ Non-woven side of GCL was in contact with subsoil during hydration.



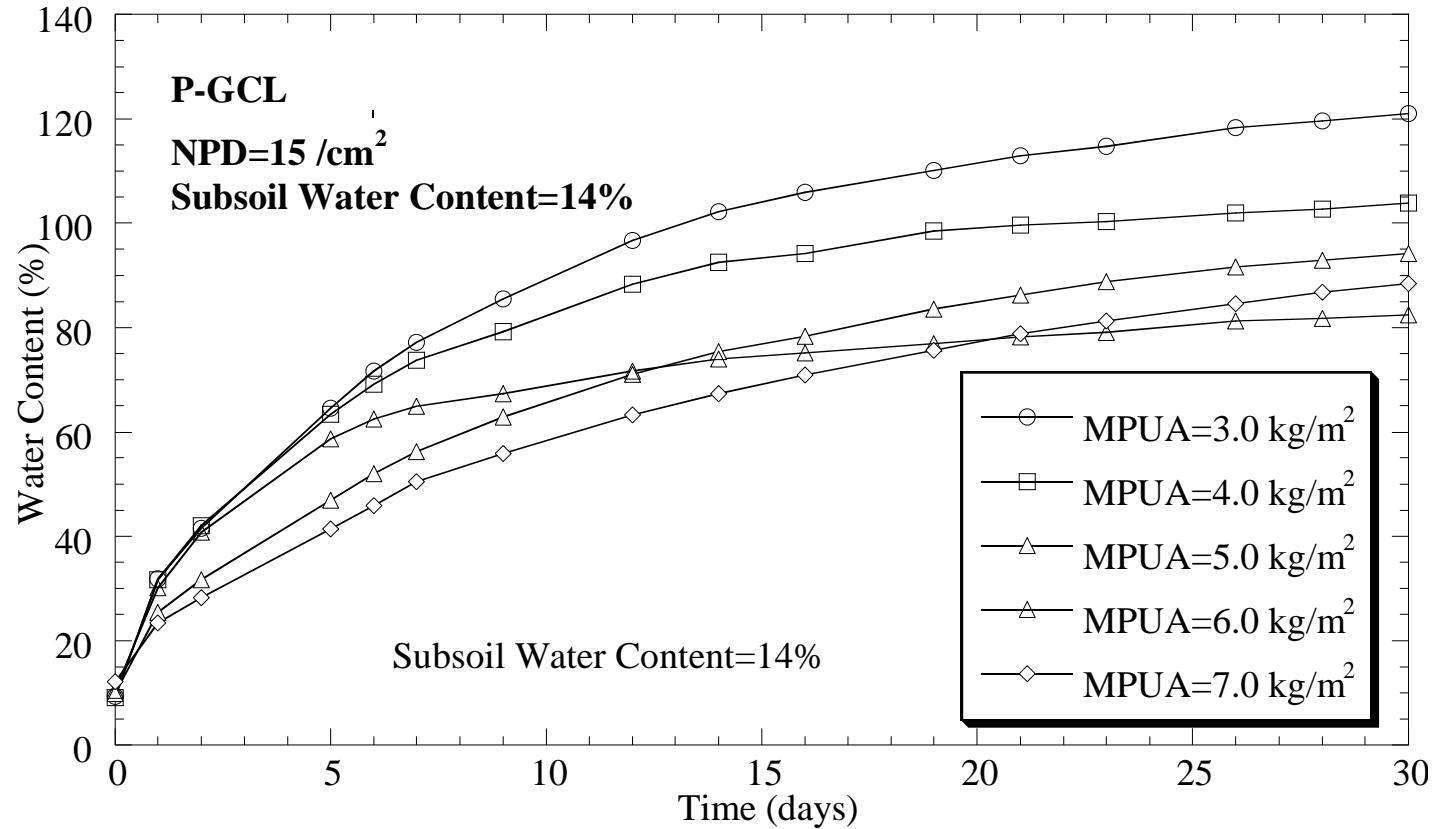
# 4. RESULTS



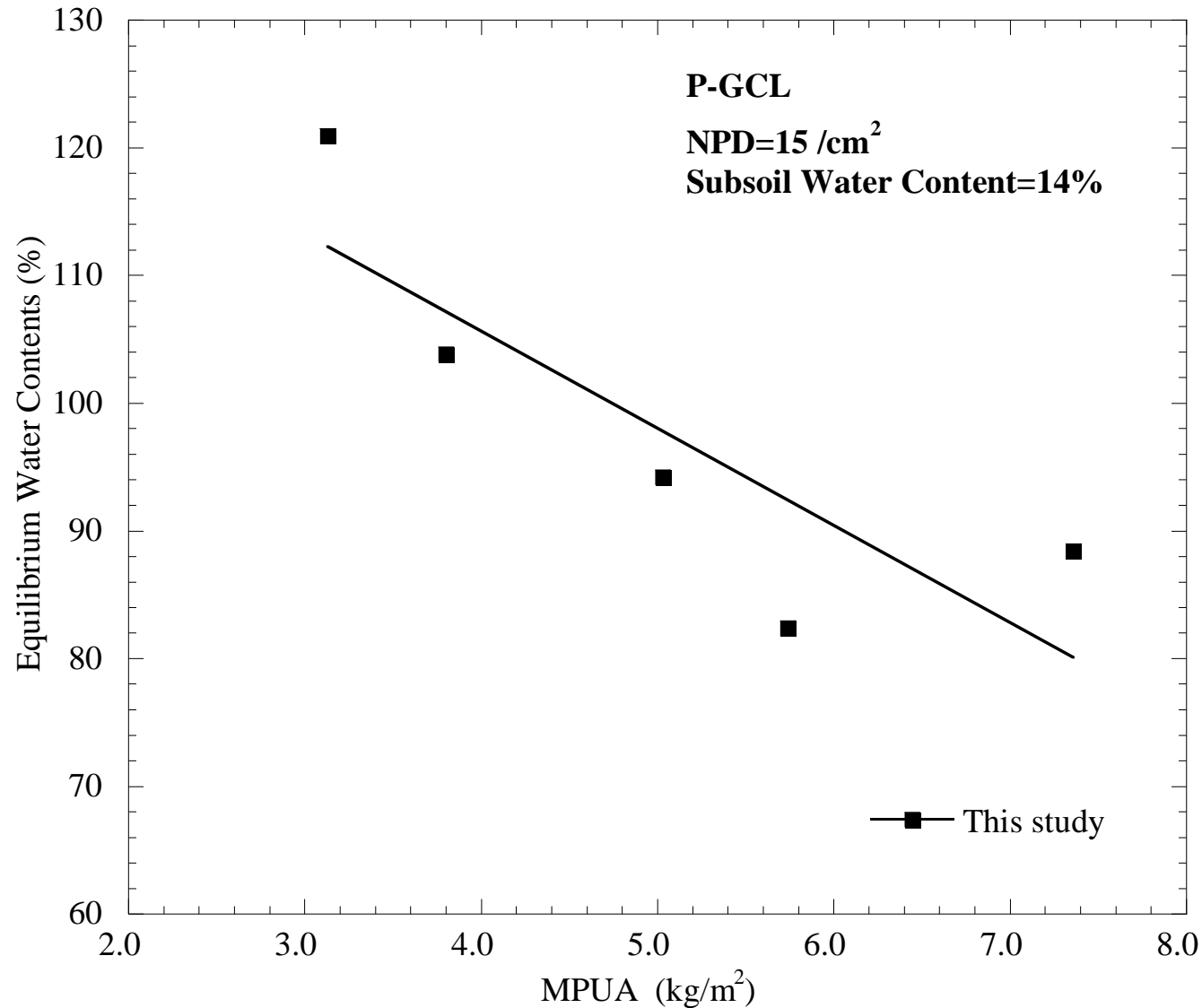
Comparison of Hydration Behavior of Factory Manufactured GCL with those of A-GCLs with different needle punched densities.



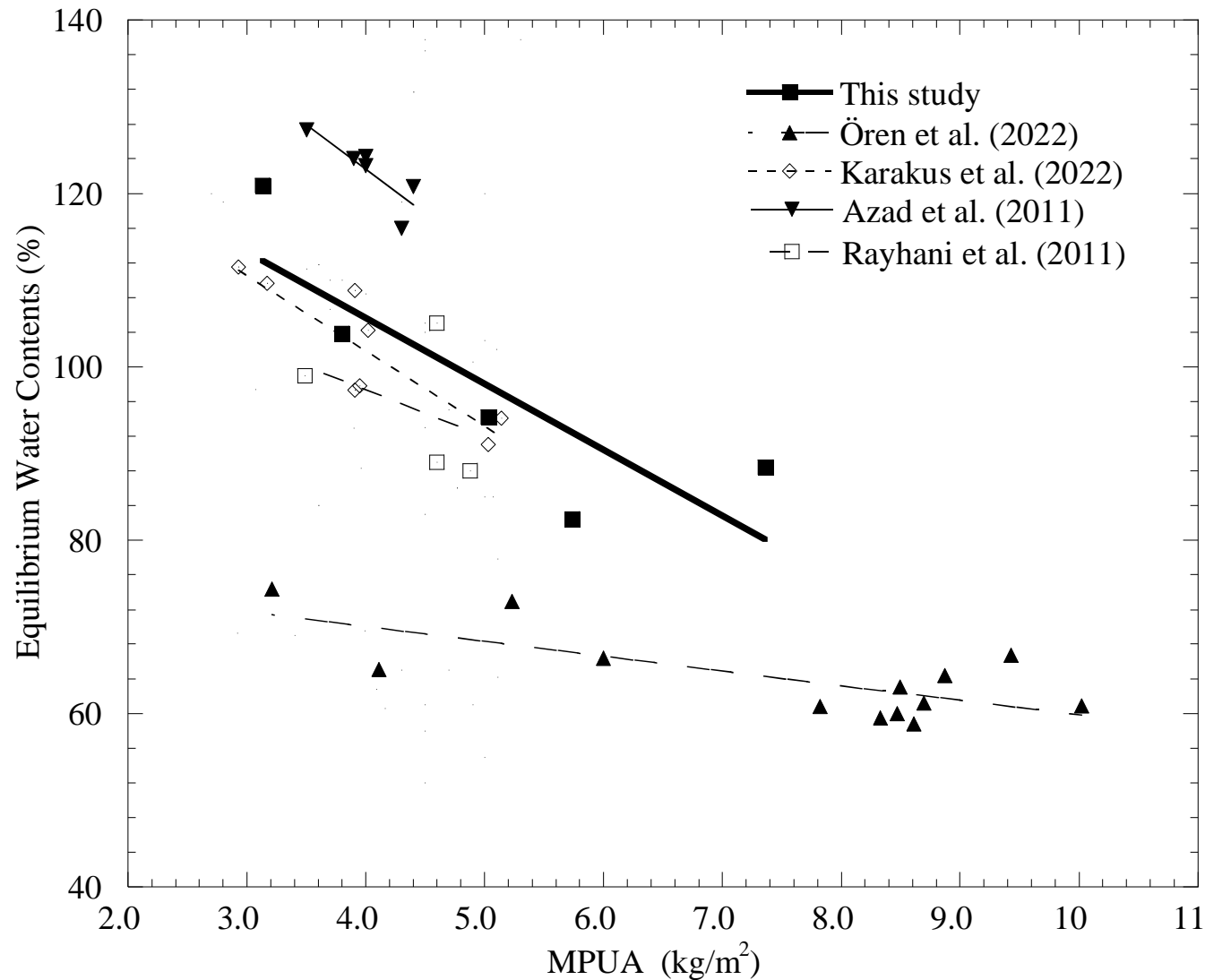
# Hydration Behavior of A-GCL with those of A-GCLs with different MPUAs.



# The effect of MPUA on the equilibrium water content of A-GCL



# Comparison of equilibrium water content obtained in this study with those reported in the literature as a function of MPUA



# 5. CONCLUSIONS

- Needle punching density of factory manufactured GCL was determined by comparing GCLs with same MPUA manufactured at different NPD values (5.0, 10 and 15/cm<sup>2</sup>).
- It was observed that factory manufactured GCL followed the same hydration path as GCL manufactured at 15/cm<sup>2</sup> in the lab. Therefore, MPUA effect over wider range was investigated on GCL manufactured at 15/cm<sup>2</sup> in the lab.
- GCL manufactured at 5/cm<sup>2</sup> had lower water contents when compared to those at other NPDs.
- Higher water contents were achieved by GCL with MPUA of 3.0 kg/m<sup>2</sup> while lower water contents were achieved throughout 30 days as MPUA increases.
- It was seen that equilibrium water contents decreased as MPUA increased.
- Obtained results are consistent with those reported in the literature.



# ACKNOWLEDGEMENT

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**TÜBİTAK**

# 6. REFERENCES



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# Questions are welcome