

HS8.3.4: Soil hydrology and irrigation in arid environments



Solute movement through undisturbed calcareous and dry region soils under differing water flow velocities

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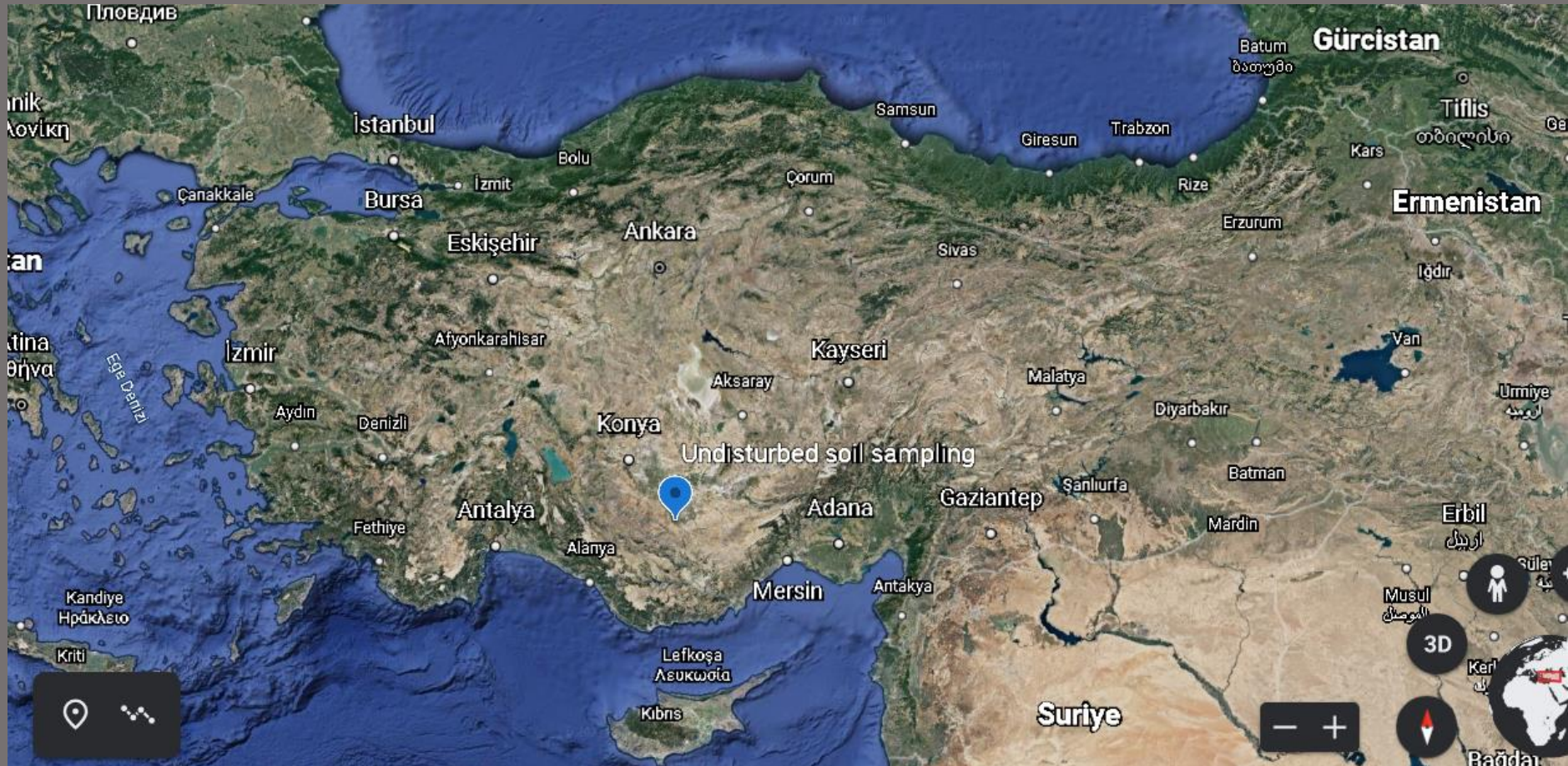
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Study area

Sampling location: Çakırbağ, Karaman, Turkey



Source: <https://earth.google.com/web/search>

Examination and description of the soil profile



Disturbed soil samples from every horizon of the profile were taken out and analysed for their initial physicochemical soil properties (Table 1).

Table 1. Basic physicochemical soil properties

Soil horizon	Depth, cm	pH	EC, dS/m	CaCO ₃ %	SOM, %	Clay, %	Silt, %	Sand, %
Ap	0 - 15	8.18	1.177	41.86	2.56	42.4	28.0	29.6
A2	15 - 23	7.88	0.841	43.78	2.64	40.2	27.9	31.9
Bt	23 - 50	8.00	0.791	43.54	1.92	42.6	26.1	31.3
BC	50 +							

Undisturbed soil column sampling



Undisturbed soil columns from soil surface to the depth of 40 cm, were taken out and transferred to Ankara University laboratories to analyses. A total of 13 undisturbed soil columns with 6.9 cm diameters were taken from the field by the Eijkelkamp percussion drilling set consisted of a gasoline driven mechanical hammer and a stainless steel soil column cylinder. The inner columns, in the steel cylinder were made of plexiglass.

Set up of undisturbed soil column leaching experiments



Leaching conditions:

Fast leaching with tap water: In this condition, it is aimed to simulate flooding irrigation conditions with good quality water, and water entry into the soil column is provided rapidly (1~ 4 hours)

Fast leaching with sodic water (ESP $\approx$ 20): In this condition, it is aimed to simulate flooding irrigation conditions with poor quality groundwater (ESP $\approx$ 20, *obtained by preparing solution from analytical pure NaHCO₃*), and water entry into the soil column is provided rapidly (1~ 4 hours)

Set up of undisturbed soil column leaching experiments



Leaching conditions:

Slow leaching with tap water: In this condition, it is aimed to simulate drip irrigation conditions with good quality water, and water entry into the soil column is provided slowly (4~ 8 hours)

Slow leaching with sodic water ($ESP \approx 20$): In this condition, it is aimed to simulate drip irrigation conditions with poor quality groundwater ($ESP \approx 20$, obtained by preparing solution from analytical pure $NaHCO_3$), and water entry into the soil column is provided slowly (4~ 8 hours)

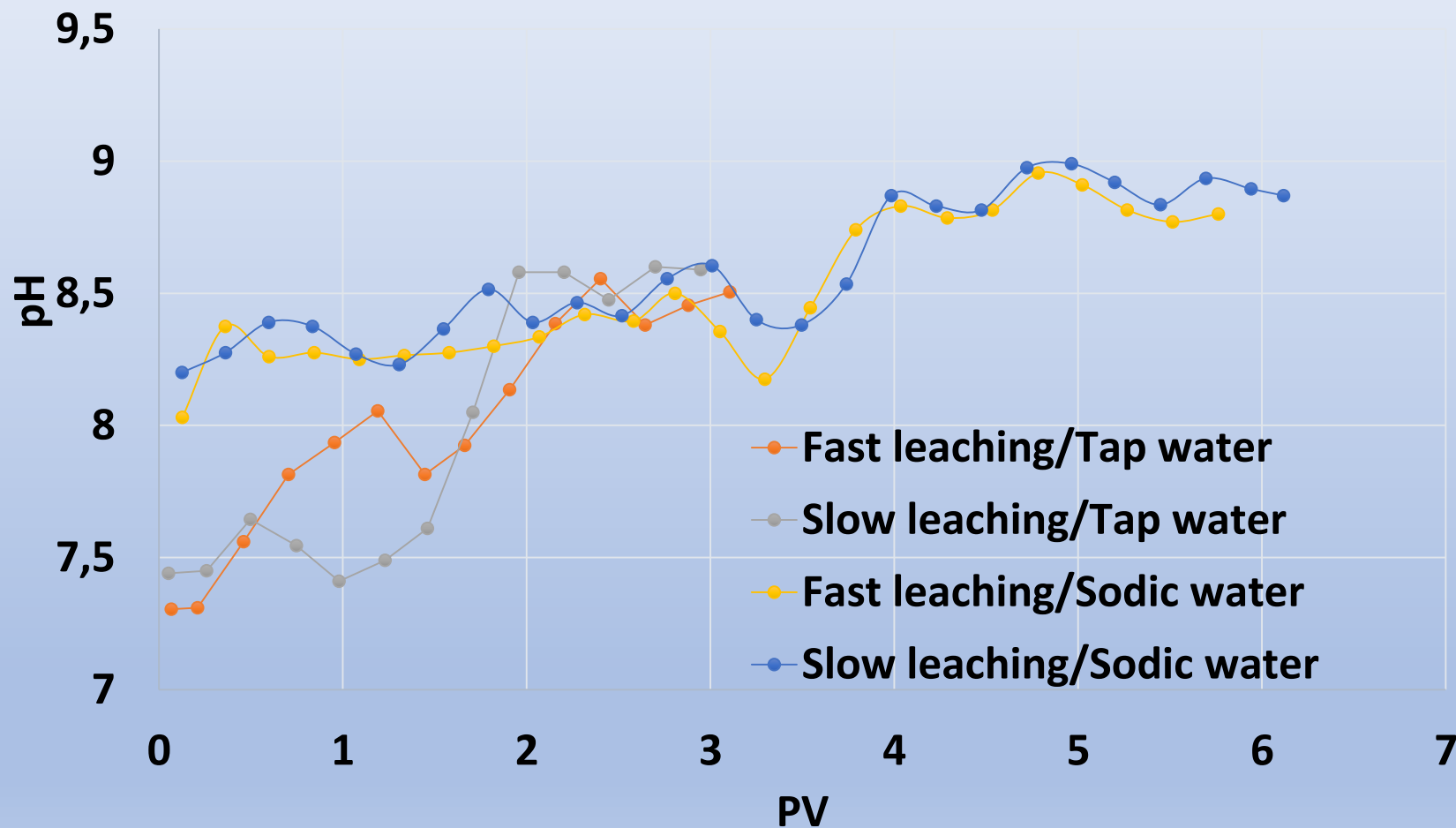
Collected leachates for pH-EC, water soluble ion analyses

Each leaching cycle was completed within 24 hours, and measurements of both pH and EC were determined immediately after the seepages ceased



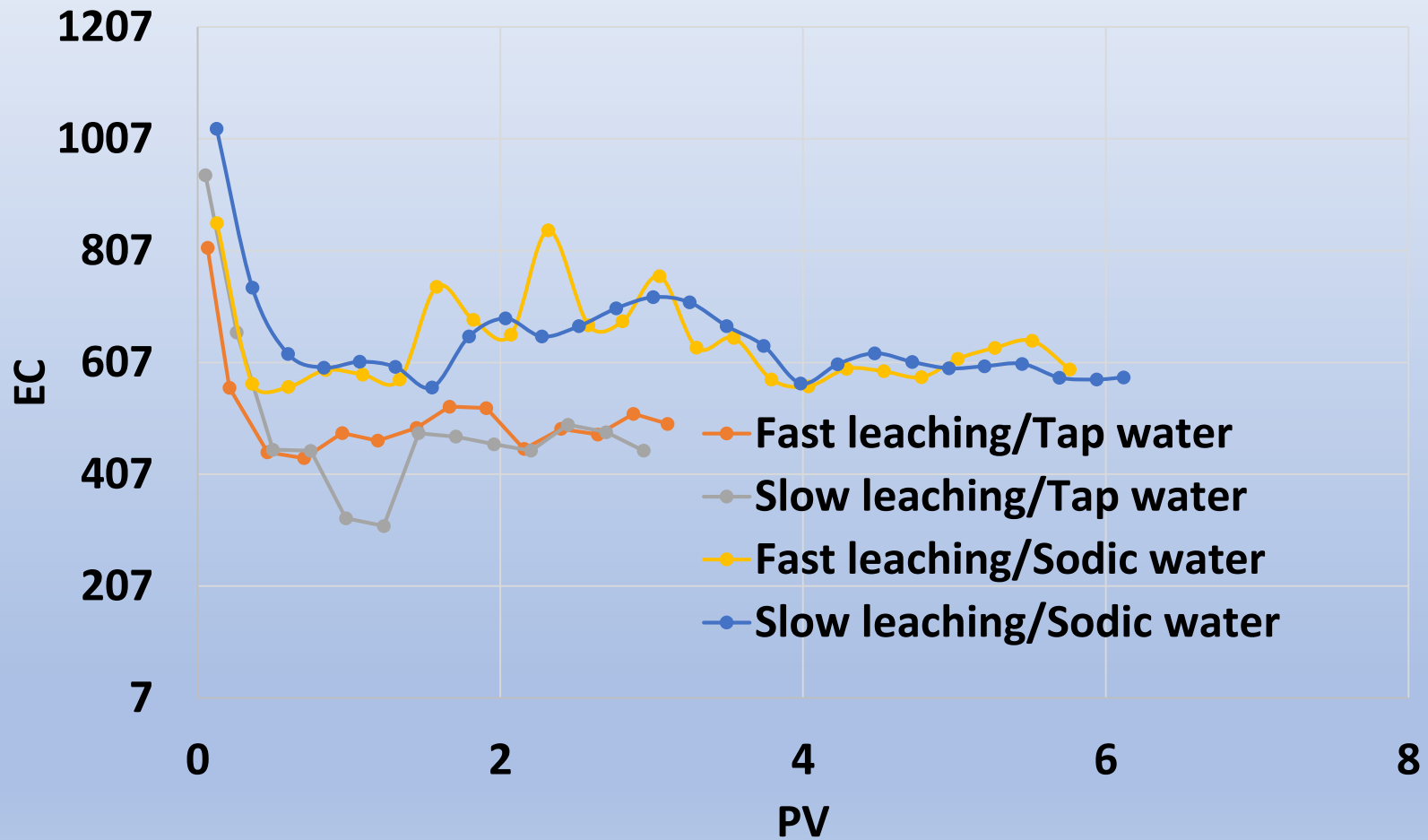
Results

Changes in pH values



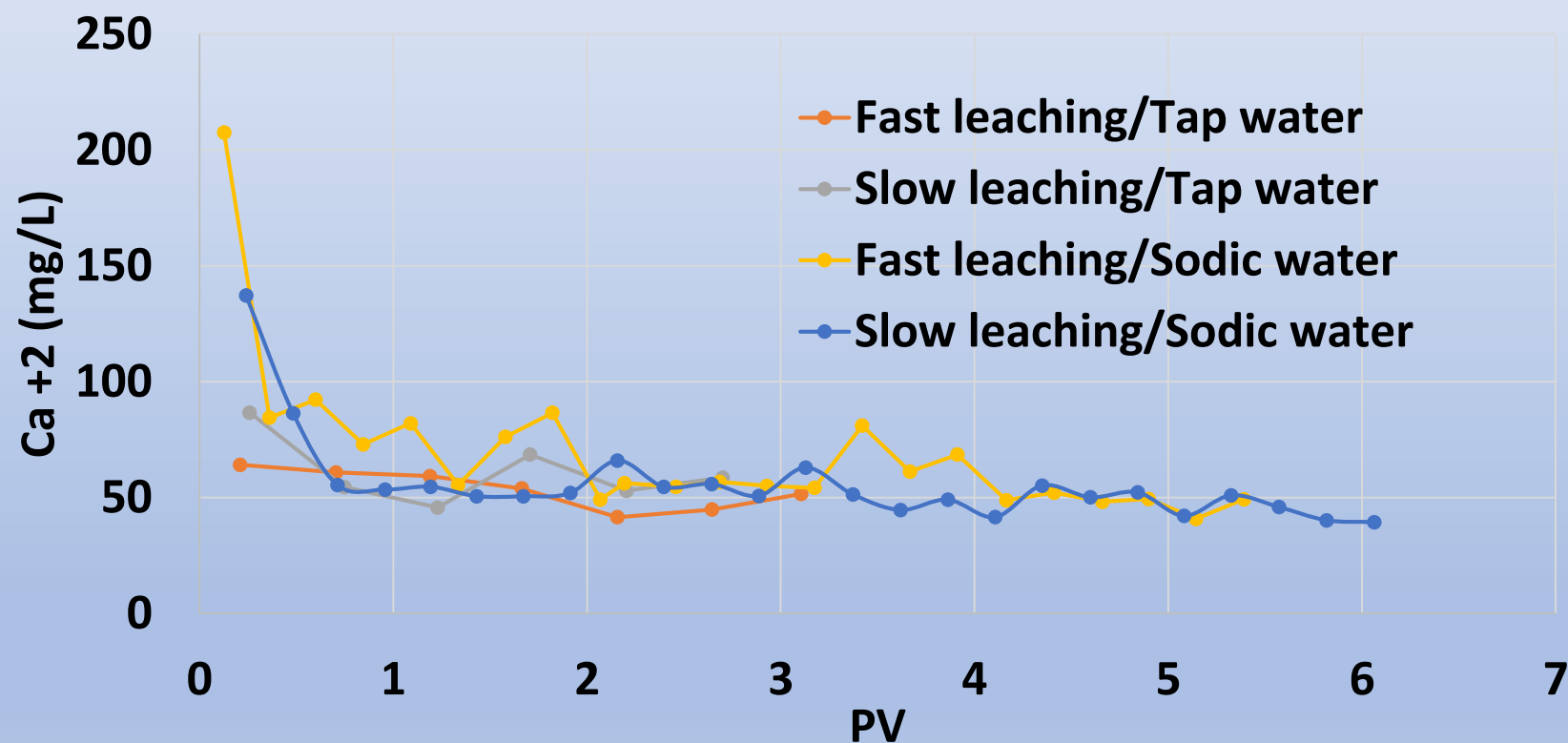
Results

Changes in EC (microsimemns/cm)



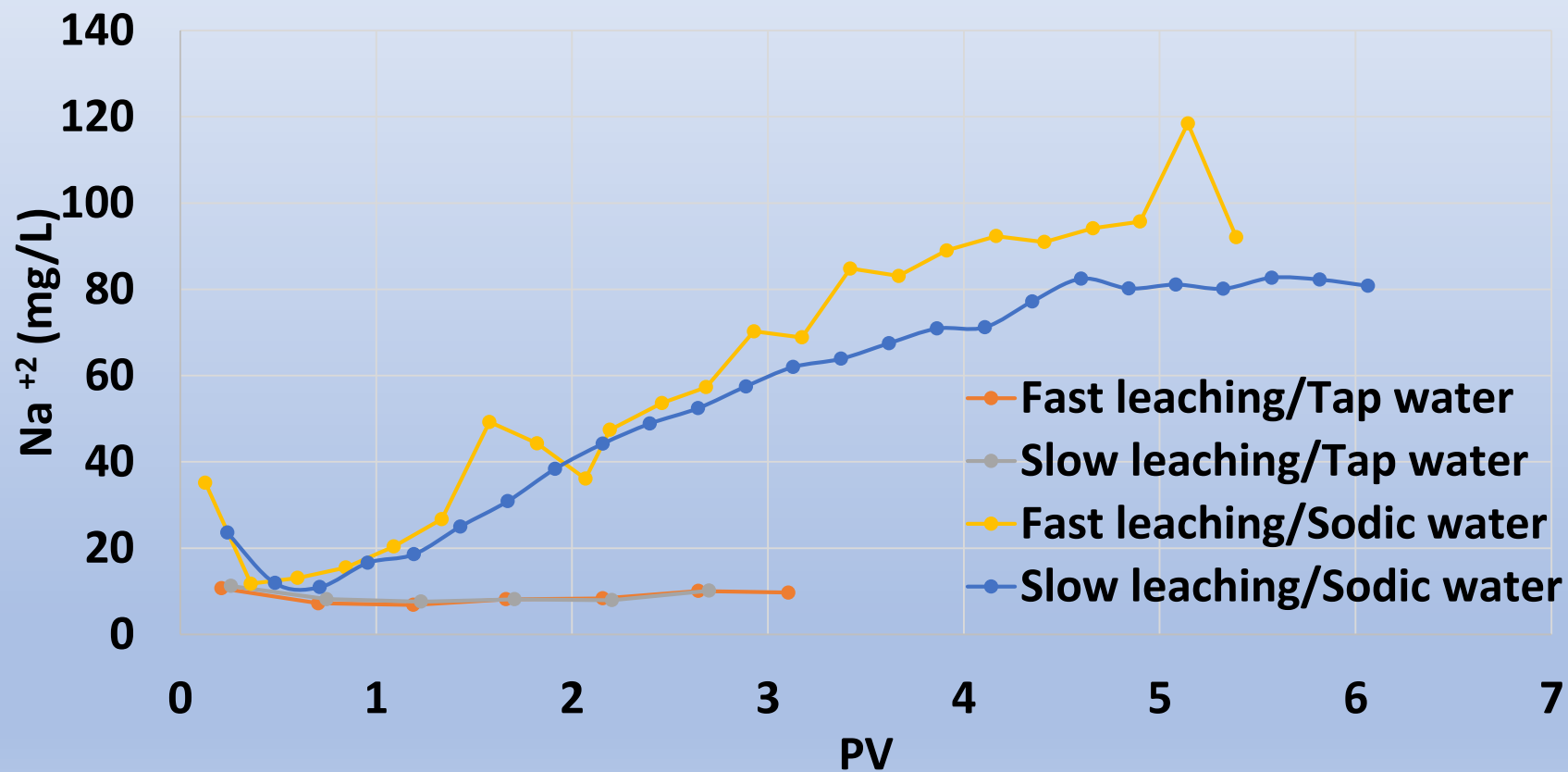
Results

Changes in Ca +2 values



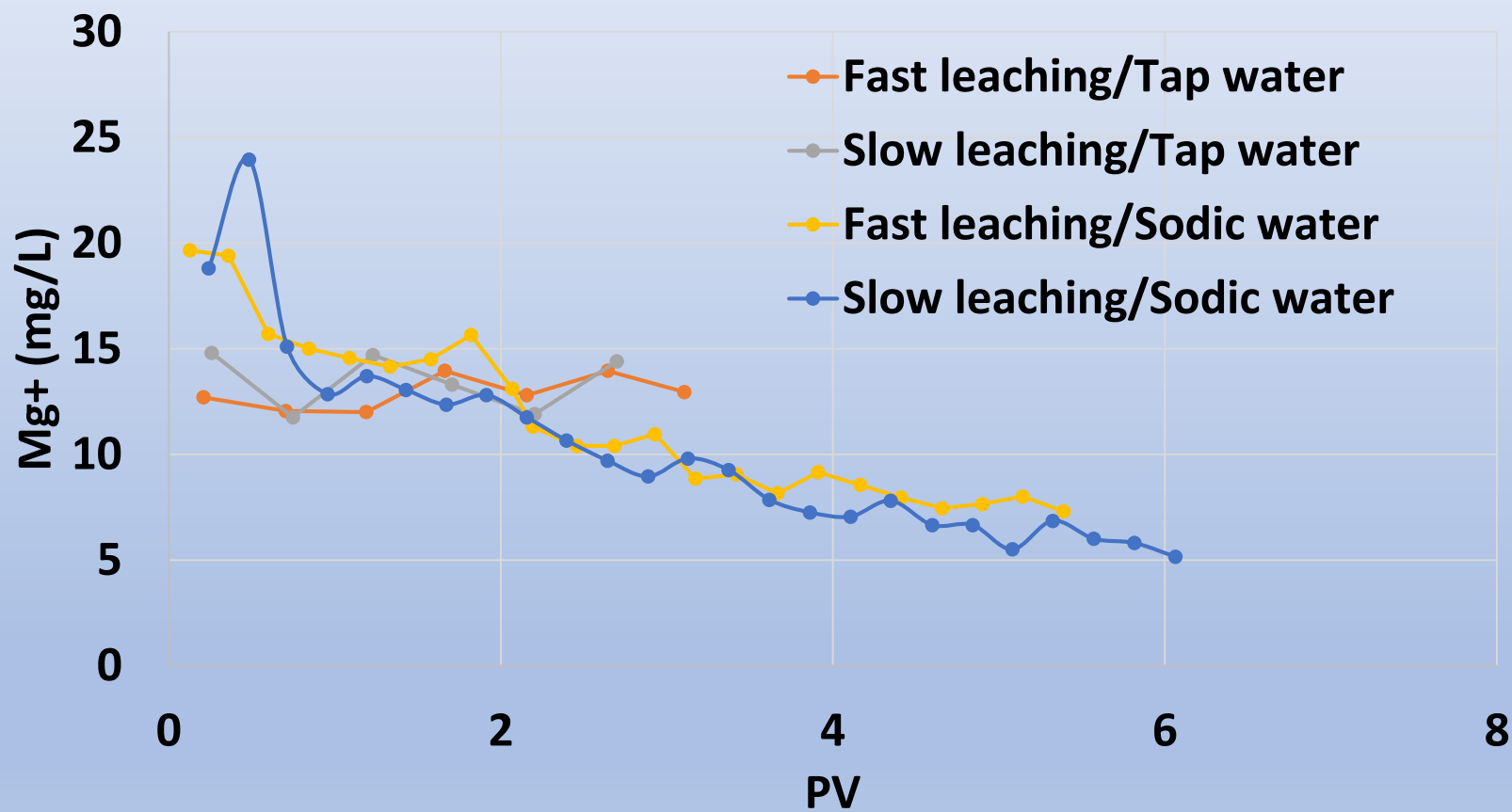
Results

Changes in Na⁺ values



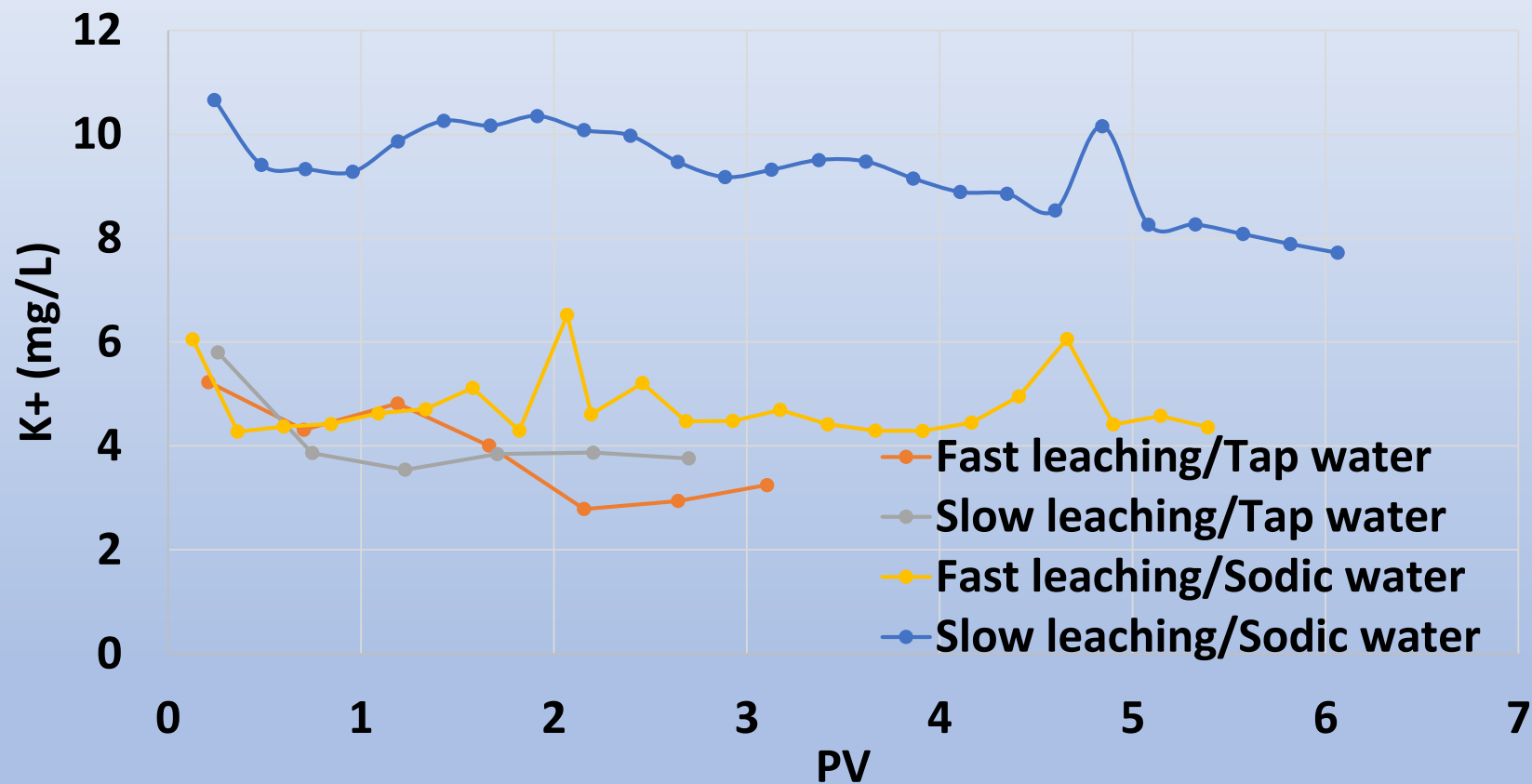
Results

Changes in Mg⁺ values



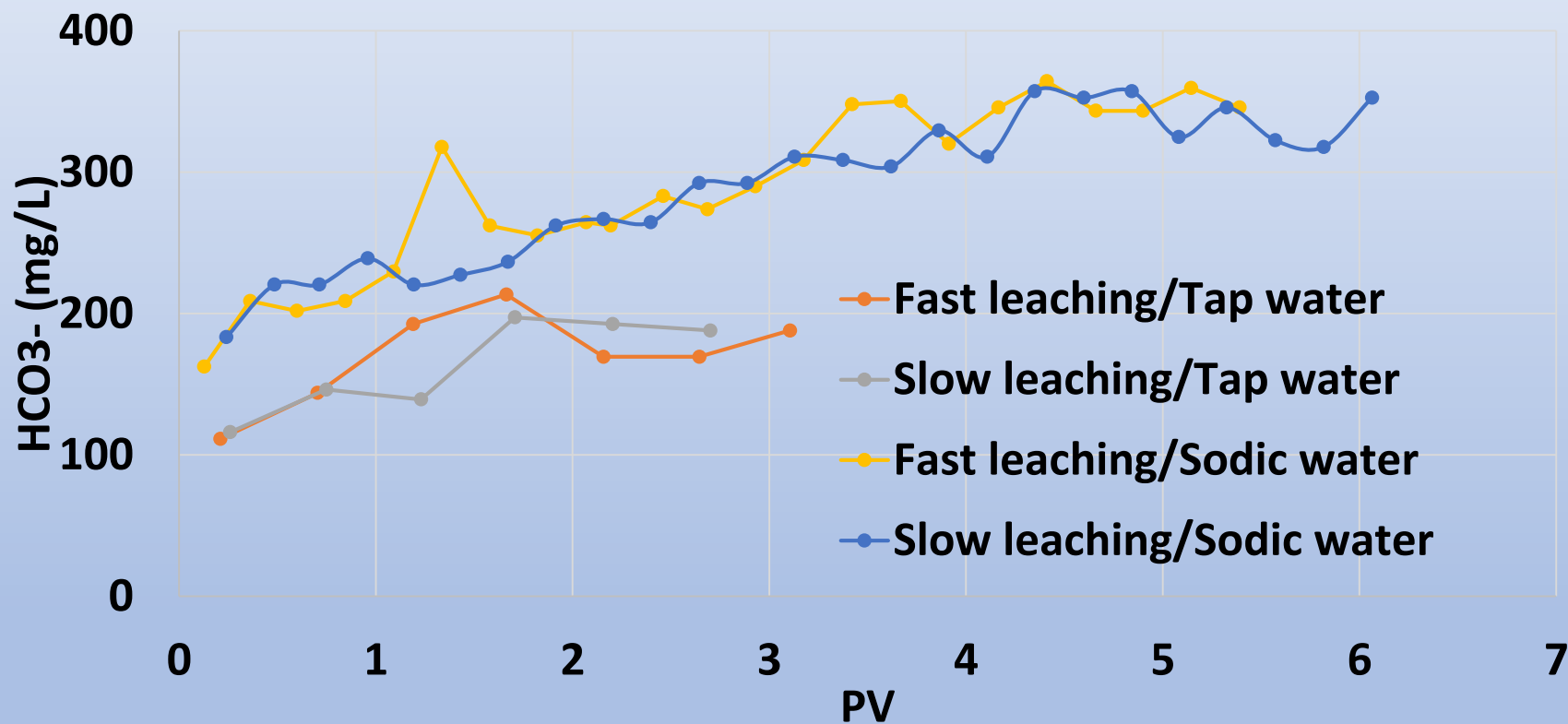
Results

Changes in K⁺ values

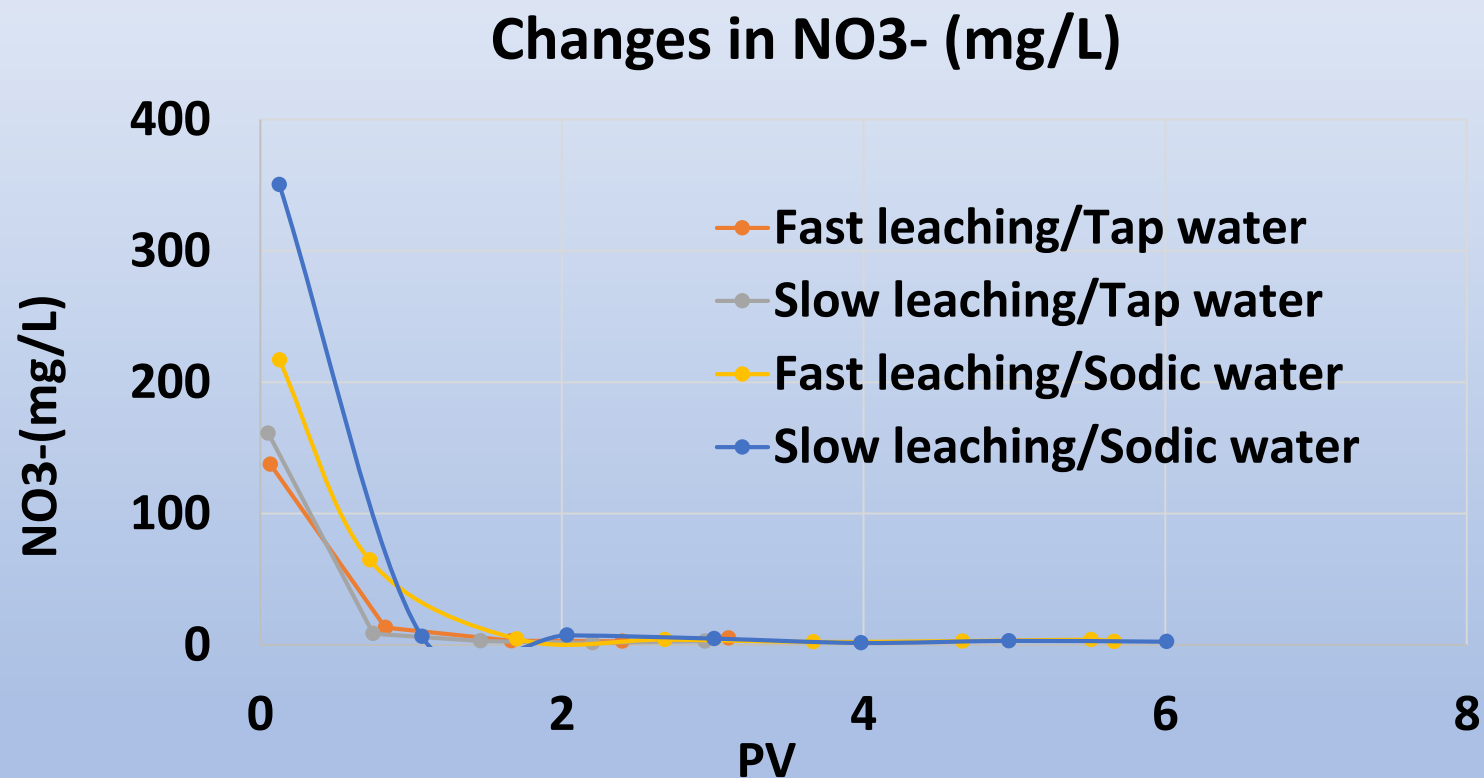


Results

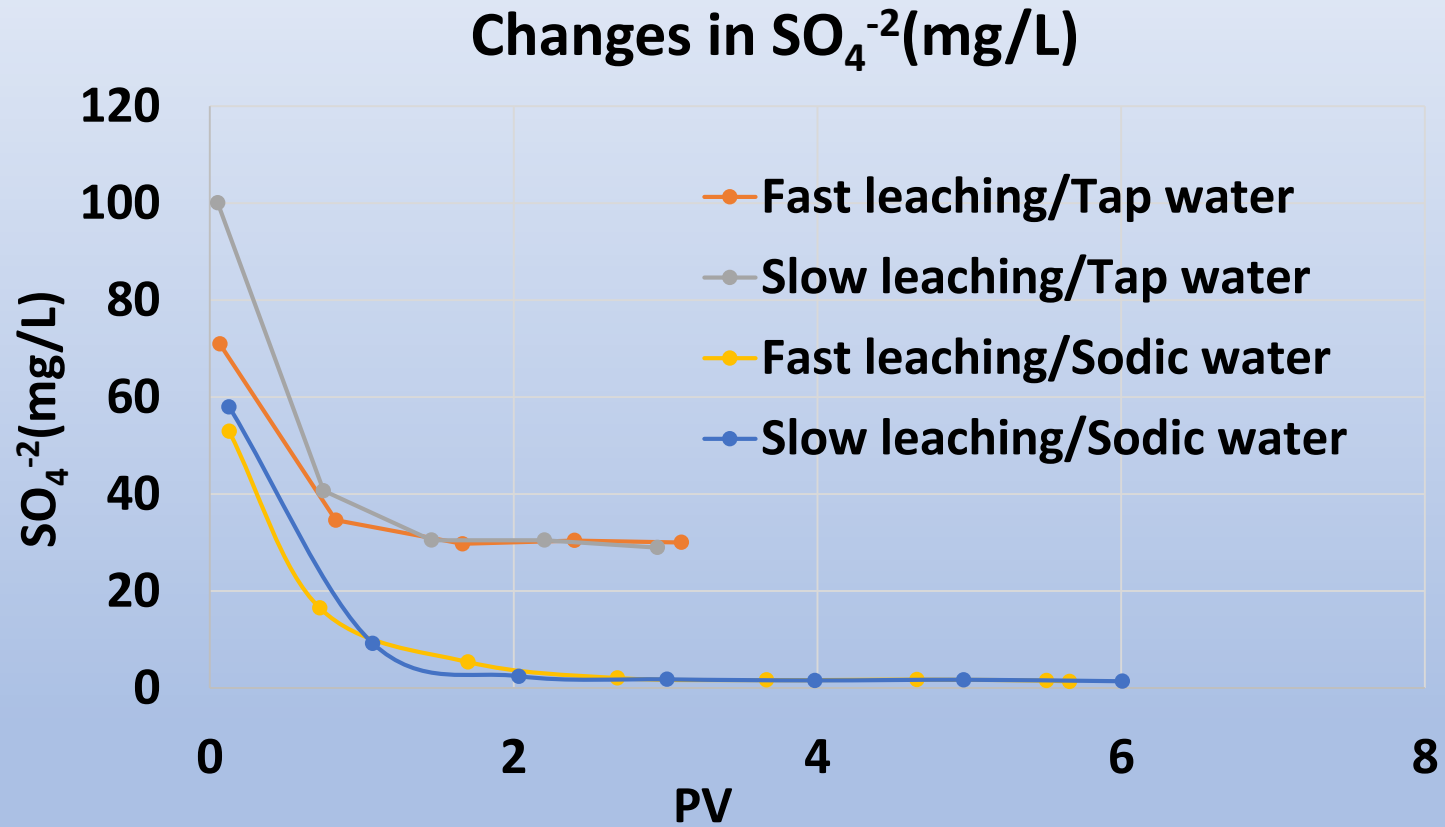
Changes in HCO_3^- values



Results

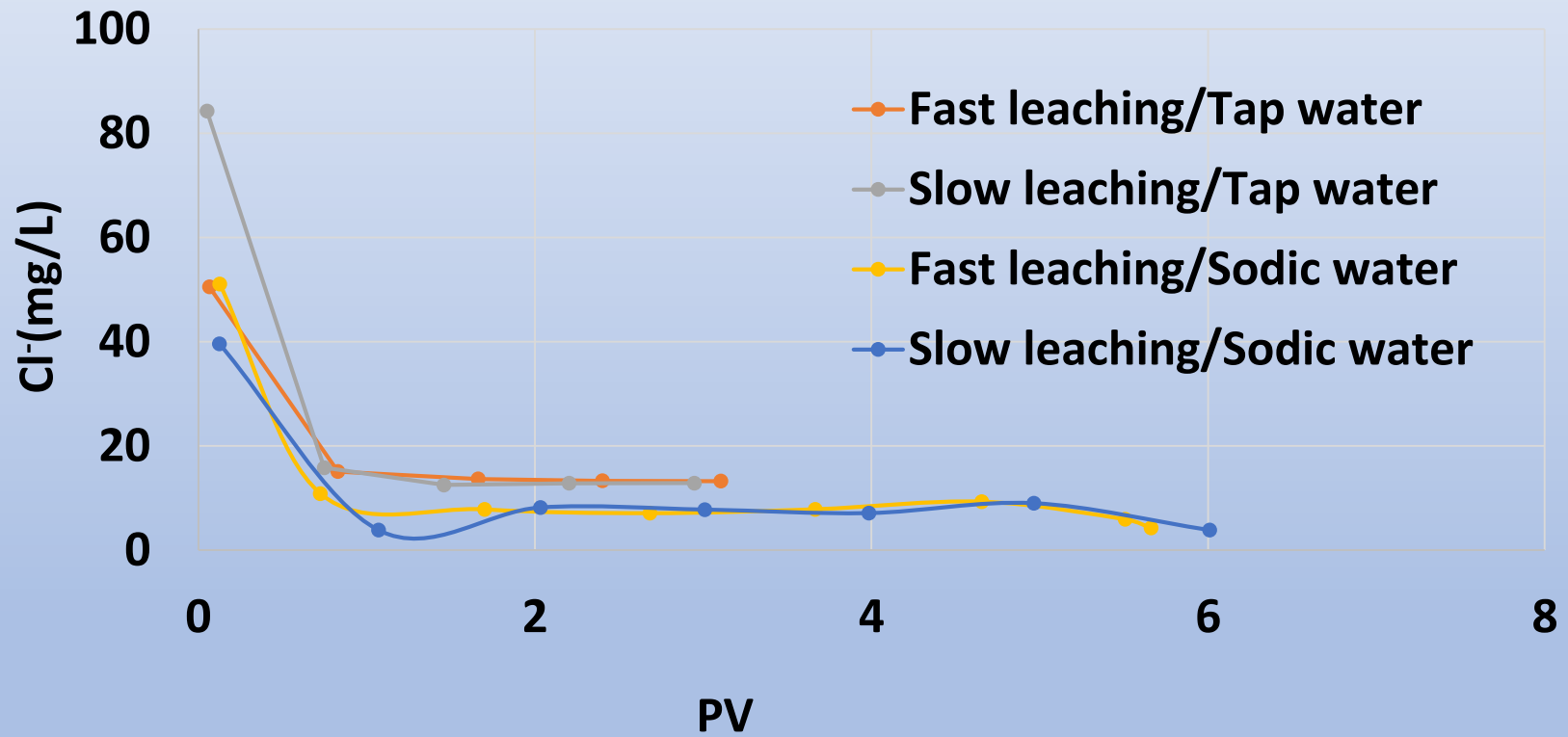


Results



Results

Changes in Cl^- (mg/L)



Conclusion

- The findings showed that velocity variation did not individually make any significant difference in terms of the solute concentrations of the collected leachates in this clay and lime-rich soil type. But, the change in water quality caused significant variations in pH, EC, and transported soluble anion and cation concentrations in time.
- In experiment it was detected that the pH values of the leachates gradually increased in both water quality and velocity experiments opposite to EC values, and then both of them became steady.
- No effect of tap water treatment on Ca^{+2} contents of the leachates was observed. However, sharp and remarkable decreases in Ca^{+2} concentration were detected at the beginning of sodic water application, and then remained constant.
- All sodic water applications caused an increase in Na^{+} concentration of leachates till the end of treatments. As the leaching progressed, transport of Ca^{+2} from the soil continued constantly due to the Na-Ca exchange processes.
- Consequently, sodic water application caused significant changes in the pH values of the soils with the effect of time, and this effect was expressively marked from the changes in the salt and sodium contents of the soils.



THANK YOU ANY QUESTIONS?

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