IOCPS 2025 Conference
The 3rd International Online Conference on Polymer Science
19–21 November 2025 | Online
MDPI

Gelation kinetics of chitosan-based hydrogels using different crosslinking agents

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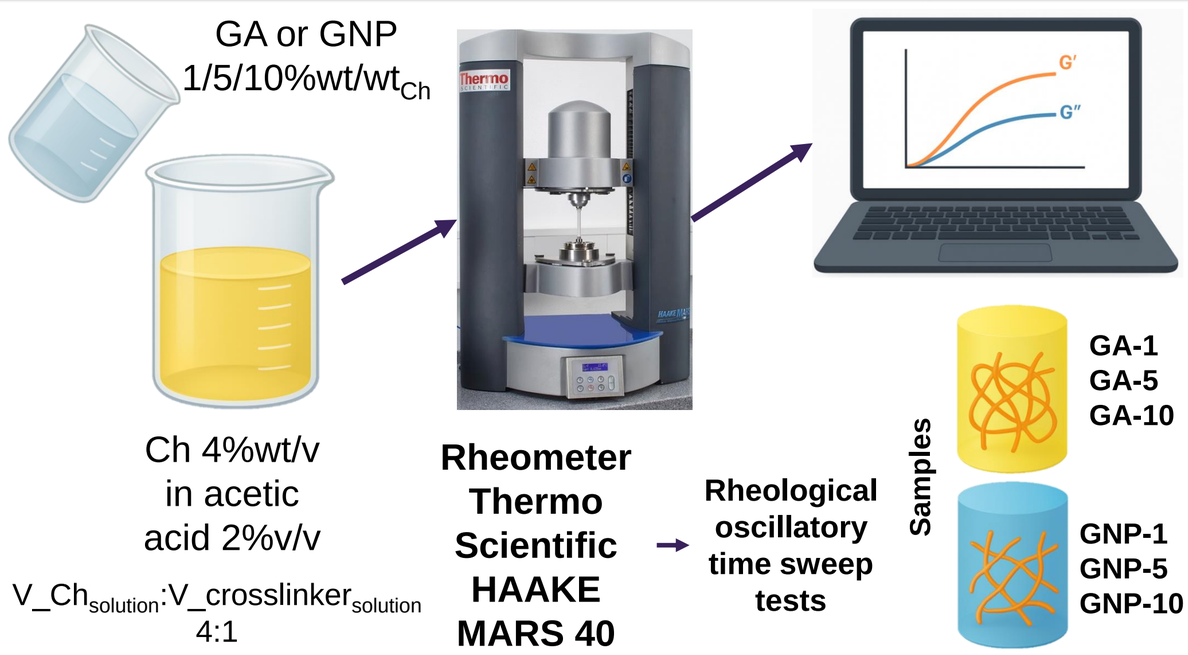
INTRODUCTION & AIM

The **crossover time (tc)** between the **storage modulus (G′)** and **loss modulus (G″)** is a key rheological parameter for characterizing the **sol–gel transition** in **hydrogel systems**. This metric provides valuable insight into gelation kinetics and is directly related to the **processability** of polymeric materials.

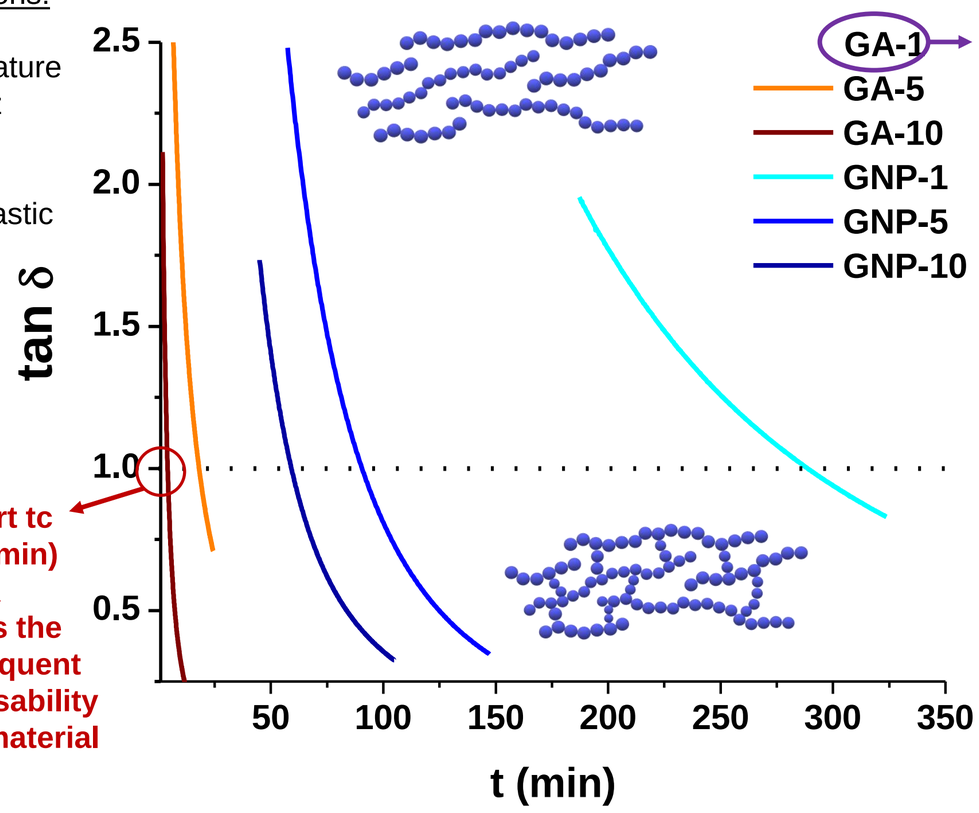
The aim of this work is to study the **gelation kinetics** of bio-based hydrogels prepared from **chitosan (Ch),** a natural polysaccharide, using two different crosslinking agents: **glutaraldehyde (GA)**, a synthetic dialdehyde, and **genipin (GNP),** a natural crosslinker derived from *Gardenia jasminoides*.

METHOD

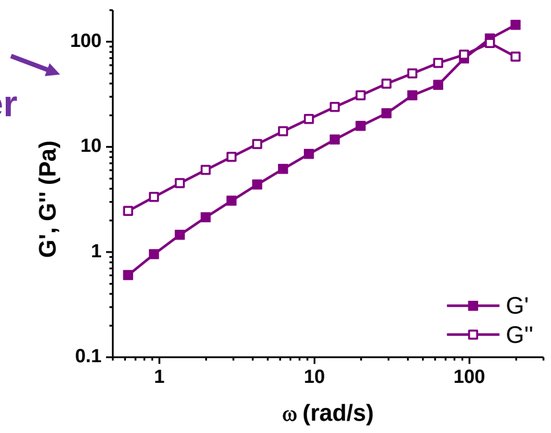


RESULTS & DISCUSSION

Conditions:
Room temperature
f = 1 Hz
Within Linear viscoelastic range



tc → ∞
Liquid-like behavior after 24 h



$$\tan\delta = \frac{G''}{G'} = 1$$

Crossover time

transition from viscous to elastic phase
↓
3D interconnected network

- ✓ Increasing the amount of crosslinker used leads to shorter tc values.
- ✓ **GA** is the **faster** crosslinking agent but requires **higher concentrations** to form gels, while **GNP** forms gels **slowly** but is effective at **lower dosages.**

Sample	tc (min)
GA-1	→∞
GA-5	18.6 ± 1.0
GA-10	< 5
GNP-1	269 ± 28
GNP-5	91.2 ± 9.4
GNP-10	57.6 ± 4.7

CONCLUSION

Both the **chemical nature** and **concentration** of the crosslinker significantly influence the **gelation time** and the mechanical evolution of bio-based chitosan hydrogels. Moreover, genipin represents a suitable substitute for glutaraldehyde in the development of **aldehyde-free hydrogels**, enabling **longer processing times.**

FUTURE WORK / REFERENCES

Future work aims to evaluate the potential of these materials as efficient **adsorbents** for **water remediation**.

Stojkov, G., Niyazov, Z., Picchioni, F., & Bose, R. K. (2021). Relationship between structure and rheology of hydrogels for various applications. *Gels*, *7*(4), 255.

Kloster, M., Mosiewicki, M. A., & Marcovich, N. E. (2024). Removal of dyes from aqueous media using environmentally friendly aerogels based on chitosan. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, *687*, 133597.

ACKNOWLEDGMENTS

This work was supported by Universidad Nacional de Mar del Plata (Projects 15/G686-ING690/23 and # 800 202405 00029 MP), Consejo Nacional de Investigaciones Científicas y Técnicas (PIP 991 and Ph.D. Completion Scholarship), the European Union (superbiOmAT project 101105413, MSCA-PF-2022), Asociación Universitaria Iberoamericana de Posgrado (AUIP, Beca de movilidad entre universidades Andaluzas e Iberoamericanas), and Red CYTED 3232RT0142 IBERO-CIRCULAR.