Treatment and Resource Utilization of Cr(III)-Containing Tannery Effluents Based on Natural Biomass Hydrogel

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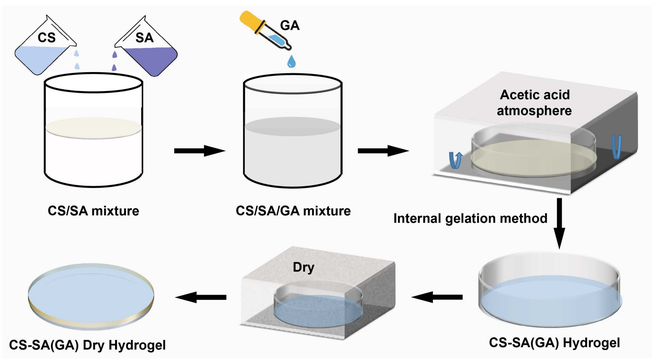
BACKGROUND

- Strict discharge limit for Cr(III) in tannery wastewater has been instituted to ensure long-term sustainability of the leather-processing industry.
- Adsorption technology is experiencing a surge in popularity among various physicochemical technologies treating Cr(III)-containing effluents. Despite efficiency, there are still some limitations
- Therefore, development of alternatives circumvention traditional chemical desorption as well as realizing thorough reutilization of discarded adsorbents have been and will remain to be a research hotspot.

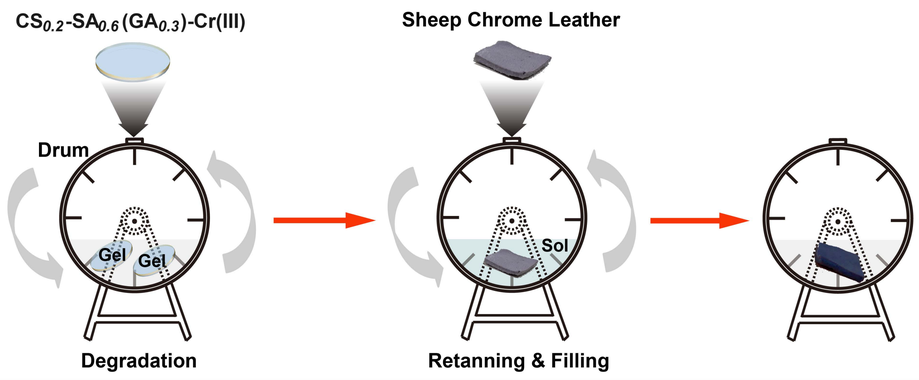
DESIGN

- We prepared a chitosan(CS)-sodium alginate(SA) hydrogel by combining the semi-dissolution acidification sol-gel transition strategy with the internal gelation method, and glutaraldehyde (GA) acted as a cross-linking agent, bridging amino groups of CS chains (Scheme 1).



Scheme 1. Synthesis procedure of CS-SA(GA) dry hydrogel.

- After adsorption Cr(III)-containing tannery effluents, the adsorbent-adsorbate ($CS_{0.2}$-$SA_{0.6}$($GA_{0.3}$)-Cr(III)) was degraded and application to sheep chrome leather retanning/filling (Scheme 2)



Scheme 2. The processing of degradation and retanning/filling.

RESULTS

- CS-SA(GA) hydrogel gelated by both electrostatic (between SA and CS) and covalent interactions (connected amino groups of CS) (Figure 1).
- CS-SA(GA) hydrogel was successful synthesis with porous structure (Figure 2).
- The chemical and physical properties of sheep chrome leather were improved by CS/SA/GA/Cr(III) sol retanning and filling (Figure 3).

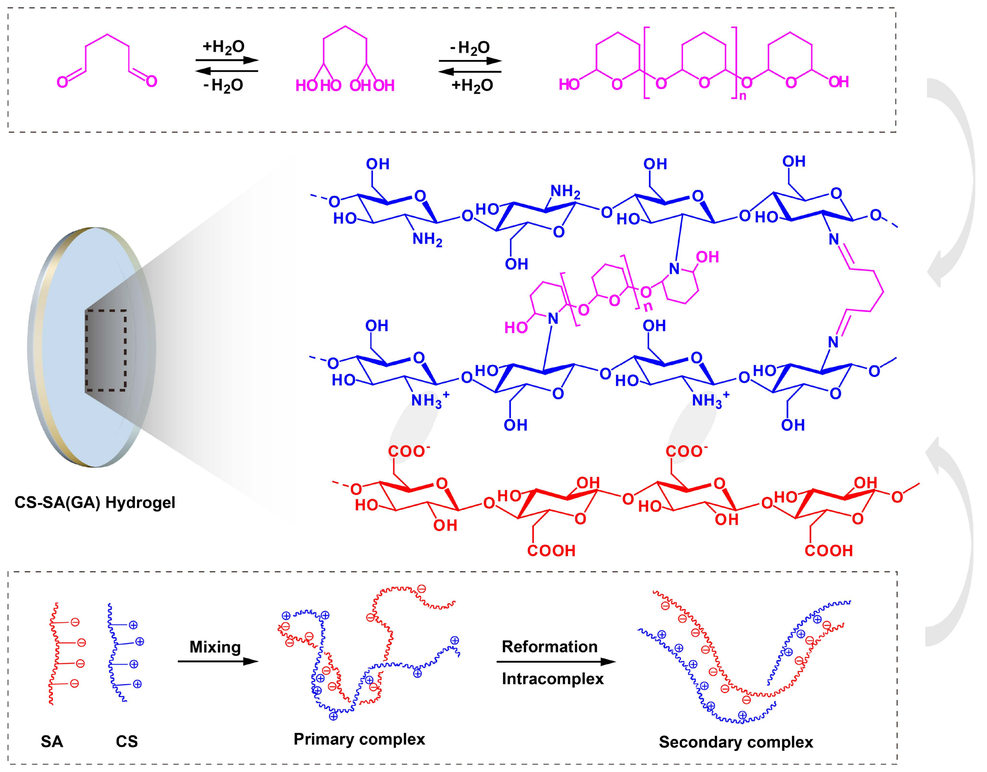


Figure 1. Proposed gelation mechanism of CS-SA(GA) hydrogel.

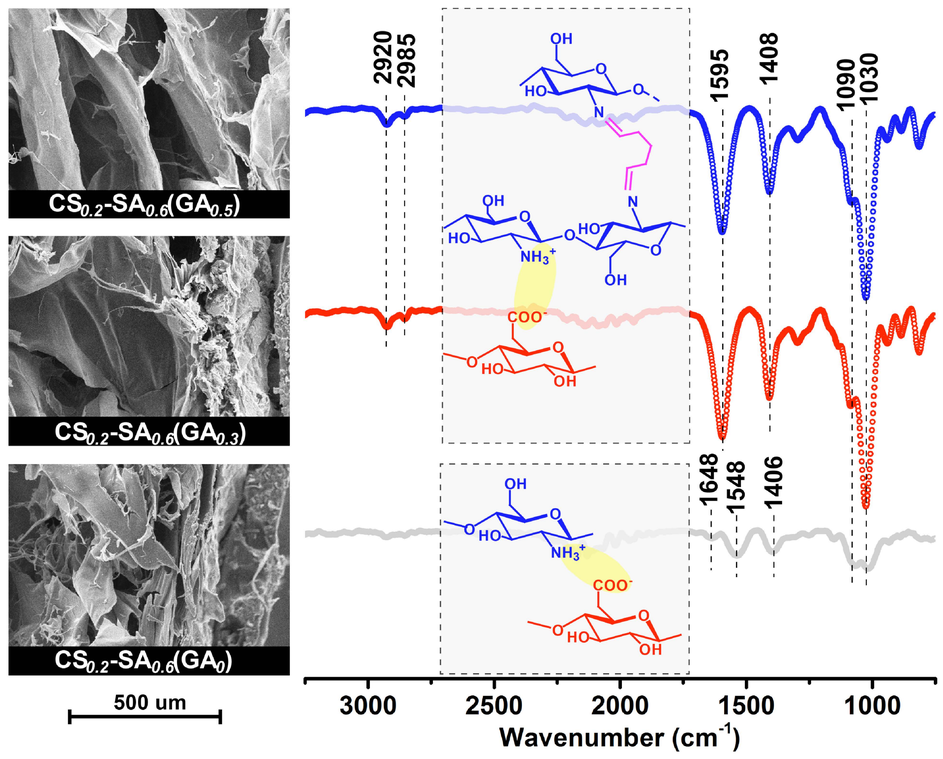


Figure 2. SEM and the corresponding FTIR spectra of the dry hydrogel.

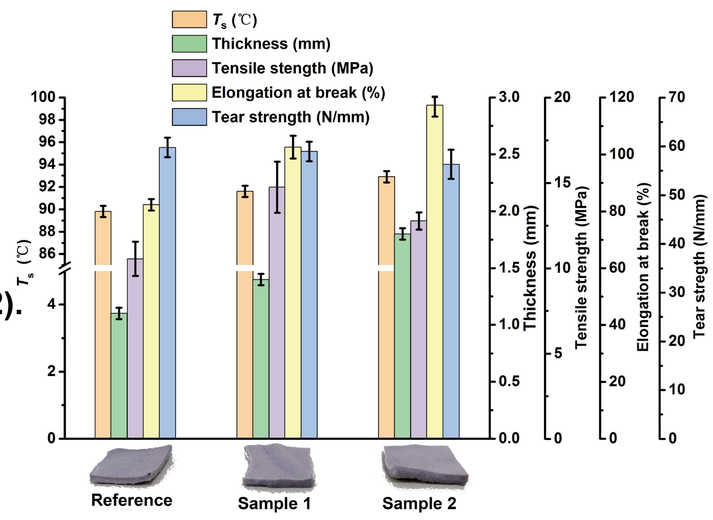


Figure 3. T_s, thickness, and mechanical performances of three leather samples (Reference: original chrome leather; Sample 1: after retanning and filling by CS/SA/GA/Cr(III) sol, where Cr(III) came from simulated Cr(III) solution; Sample 2: after retanning and filling, where Cr(III) came from tannery effluents).

CONCLUSION

- On account of tanning effects of CS, SA, GA and Cr(III), the thermal stability of the finished leather was improved while due to the filling performance of CS, SA, and GA, the physical and mechanical properties were amendatory too.
- We provide a strategy that realizes the integration of chromium (III) containing tanning effluent treatment and retanning/filling resource utilization of adsorbent/adsorbate, which circumvents traditional chemical desorption as well as makes thorough reutilization of discarded adsorbents come true.

ACKNOWLEDGEMENT

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