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Can the sustainable bio-based aldehyde be used for the synthesis of environmentally-friendly melamine resin retanning agent

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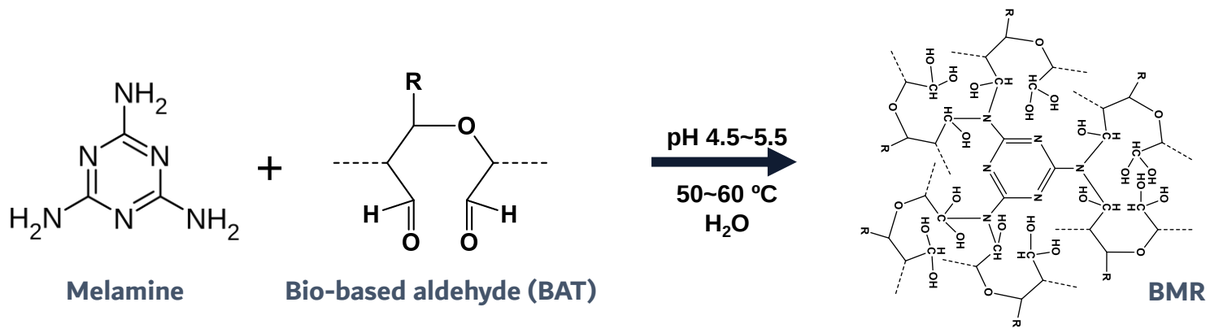
BACKGROUND

- **Leather industry:** faced with the challenge of sustainability due to the highly concerned chrome pollution.
- **Leather retanning:** endow leathers with diversified and excellent physical and organoleptic (Xie et al.).
- **Melamine resin retanning agent (MR):** one of the most widely used functional retanning agent synthesized from formaldehyde and melamine, suffering from the problem of free formaldehyde (Xie et al.).
- **Biobased MR (BMR):** using a kind of green and sustainable crosslinker (BAT) derived from plant biomass (Ding et al.) to potentially replace formaldehyde for preparing eco-friendly MR.

How about the possibility for preparing BMR based on BAT ?

HYPOTHESIS



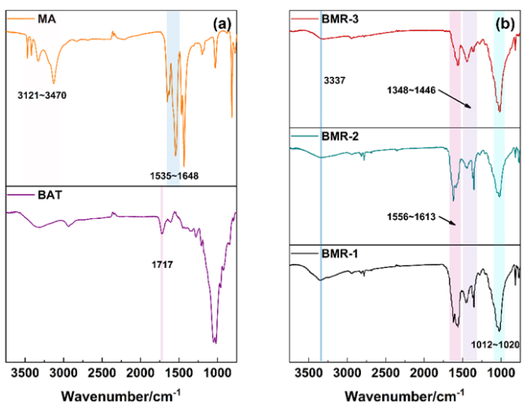
SYNTHESIS RESULTS

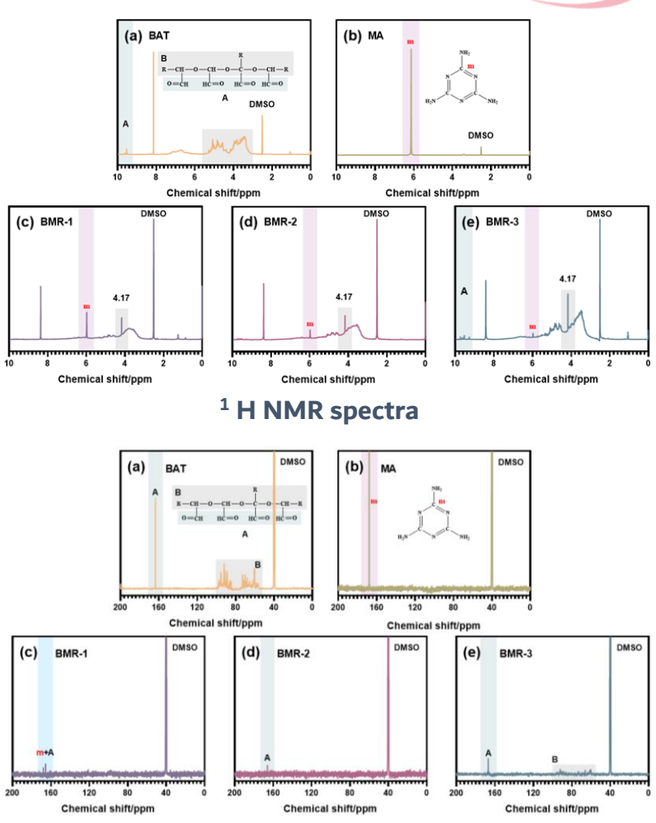
Three kinds of BMR with different mole ratio between BAT and Melamine (B/M).

BMR-1: mole ratio was 1.0:1 (B/M)

BMR-2: mole ratio was 1.5:1 (B/M)

BMR-3: mole ratio was 2.0:1 (B/M)





^{1}H NMR spectra

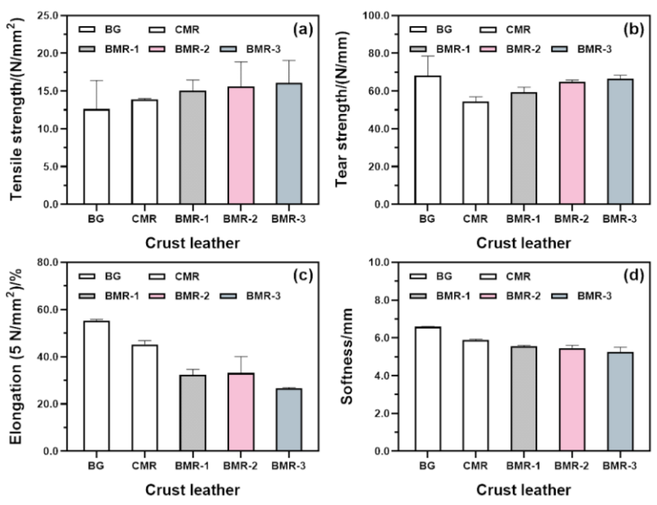
^{13}C NMR spectra

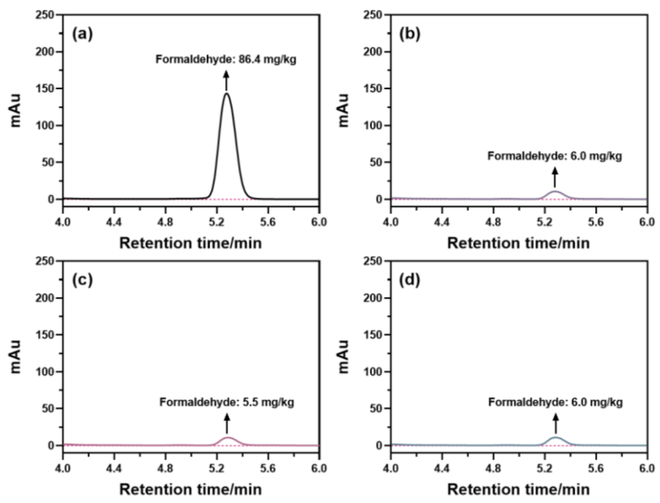
- FTIR spectra indicated the reaction between the aldehyde group of BAT and the amino group of melamine.
- FTIR spectra also shows the glycosidic bond structure of BAT was introduced into BMR .
- NMR spectra confirmed the results from FTIR measurement.
- Excessive BAT would cause its incomplete reaction and remain in the BMR.
- In light of the results of FTIR, NMR and molecular weight test, the BMR was successfully synthesized, and its molecular weight could be regulated via controlling the BAT dosage.

Sample	M_w/(mol/g)	M_n/(mol/g)	M_w/M_n
BMR-1	2335	1377	1.696
BMR-2	4849	1965	2.468
BMR-3	983	888	1.107

- The molecular weight test proved that the polycondensation reaction had occurred.
- Affected by steric hindrance, excessive BAT would hinder the progress of the condensation reaction.

APPLICATION RESULTS





- BMR was used in the retanning of chrome-tanned leather, and its retanning performance was investigated in comparison with that of commercial MR (CMR) retanned crust leather.
- BMR retanned crust leather had higher mechanical strengths that those of CMR retanned crust leather except the elongation.
- BMR retanned crust leather had comparable softness to that of CMR retanned crust leather.
- In comparison with the crust leather without MR retanning, BMR retanned crust leather had higher tensile strength, comparable tear strength as well as lower elongation and softness.
- CMR retanned crust leather had a high formaldehyde content, while the BMR retanned crust leather had a formaldehyde content no higher than 6.0 mg/kg, showing better eco-friendliness.

CONCLUSIONS

- **BMR was successfully synthesized based on BAT, confirming that BAT has the capability to replace formaldehyde for the fabrication of eco-friendly melamine resin retanning agent.**
- **BMR retanned crust leather has favorable mechanical strengths and very low formaldehyde content, suggesting the great potential of BMR to be used in the eco-leather manufacturing.**

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