



Evaluation of a heat-triggered adhesive as a reversible solution for horseshoeing

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Introduction

Traditional horseshoeing relies on nailing the shoe to the hoof, which can damage the hoof wall, increase the risk of infection, and make removal physically demanding. Glue-on systems offer alternatives, but commercial paste adhesives often overflow during application, generating waste. They require significant time to reach full strength and lack a debonding-on-demand mechanism, making removal challenging. To overcome these limitations, an epoxy-thermoplastic film adhesive (ETA) is proposed as a reversible alternative and compared to a commercial horseshoeing glue (MMA). This work presents its bulk viscoelastic characterization, joint performance assessment through static shear testing, and debonding capability evaluation under thermal activation.

Benefits of the candidate adhesive



Joint performance

Comparing in-joint behavior of the candidate adhesive with the commercial solution

Despite a 17% higher peak load in ETA joints, both adhesives showed comparable energy absorption, demonstrating that the thermoplastic film matches the commercial adhesive in mechanical performance and confirming its potential for glue-on horseshoeing.

Comparing bulk viscoelastic behavior of the candidate adhesive against a commercial MMA adhesive

Thermomechanical response across the service range

Both adhesives were characterized across the service temperature range (-10 to 50°C). While ETA remains within its glassy plateau, with E' essentially constant, confirming a stiff, elastic and temperature-insensitive response, the commercial MMA adhesive is already within its broad α relaxation, with E' dropping ~75% and energy dissipation increasing significantly across the same window.

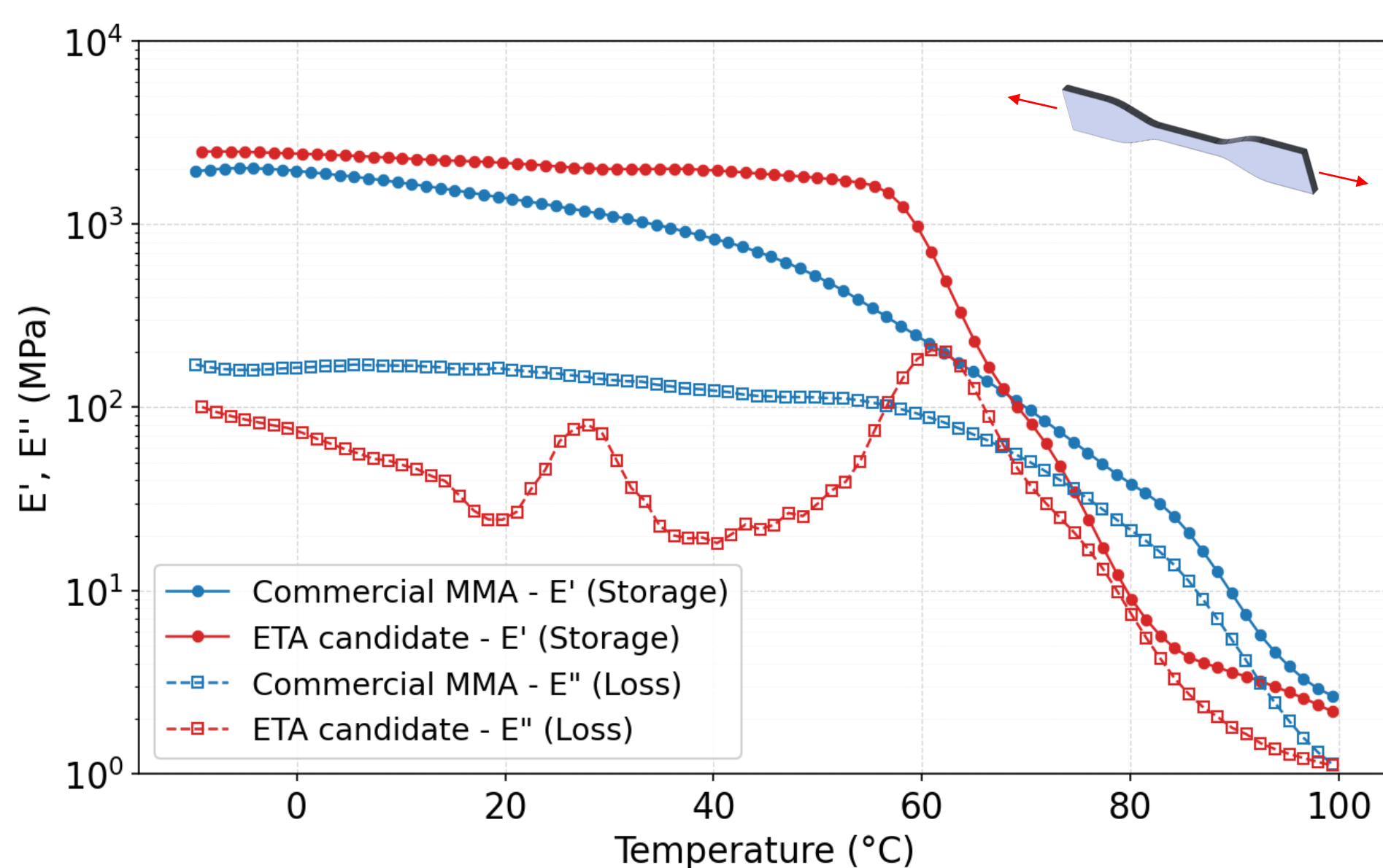


Figure 1: Thermomechanical behavior of candidate and MMA adhesive

Within the service frequency range (0.86–3 Hz) at room temperature, ETA also exhibits negligible frequency dependence, confirming purely elastic behaviour within service conditions. However, MMA adhesive shows marked frequency sensitivity, reflecting its viscoelastic character which introduces rate-dependent mechanical behaviour under the variable loading frequencies of equine locomotion.

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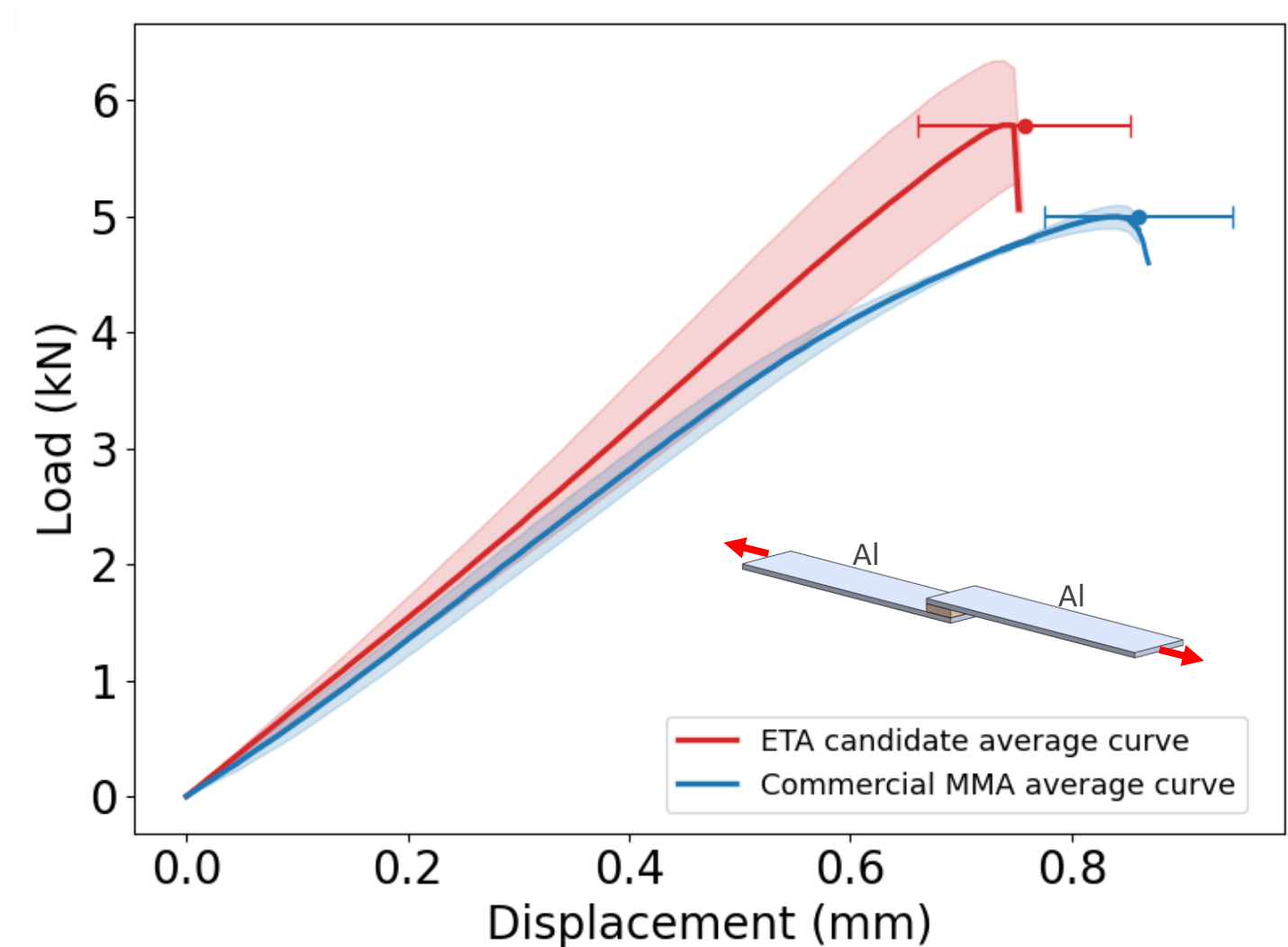


Figure 2: Comparison of quasi-static SLJ responses.

Hot press manufacturing, despite being more controlled and practical than hot air gun (Figure 2), produced void-containing bondlines (Figure 3.a) due to moisture release, trapped as the adhesive was confined between substrates. A sequential heated-mold technique resolved this by allowing free moisture release before applying the top substrate, yielding void-free joints with equivalent lap shear strength.

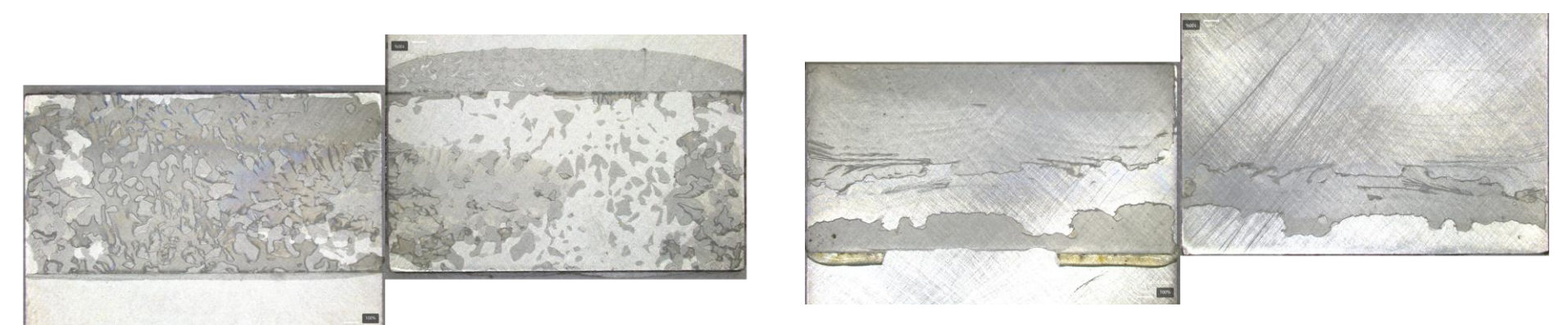


Figure 3: a) Failure mode of hot-press ETA joints and b) Failure mode of sequential-heated mold ETA joints.

Conclusions

The thermoplastic film matched the commercial MMA adhesive in viscoelastic behavior and energy absorption, with ETA joints showing 17% higher peak load. Void-free joints were achieved through a sequential heated-mold technique. Re-heating reduced residual strength to ~2%, confirming effective thermal debonding and full reversibility.