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Castor Oil-based Polyurethane Adhesives: Effect of Cross-Linker on the Bond Strength

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Abstract

Adhesives are important for binding diverse materials, promoting structural integrity and functional versatility in countless daily life applications. An enormous obstacle remains in the development of polyurethane (PU) adhesives exhibiting excellent bonding strength. Designing a chain extender with appropriate molecular structures is critical to improving the bonding strength of polyurethane-based adhesives. In this work, polyurethane-based adhesive was prepared using castor-oil-based polyol and diisocyanate. The bonding strength of the adhesive was improved by adding chain extenders such as N, N-bis (2-hydroxyethyl) thiophene-2, 5-dicarboxamide (ETP) and N, N-Bis (2-hydroxyethyl)-terephthalamide (ETAM). The modified adhesive showed high bonding strength after the addition of chain extenders due to the presence of the di-carboxamide group, which served as a center for hydrogen bonding. The bonding strength of PU adhesive increased to 7.22 and 9.68 MPa from 5.0 MPa after the addition of 7.5 wt. % of ETP and 5.0 wt. % of ETAM, respectively. The bonding strength of the adhesives was tested on both wood (oak) and metal (stainless steel) coupons. The bonding strength of 9.68 MPa on oak wood and 6.73 MPa on stainless steel coupon was observed for the 5.0 wt. % of ETAM-based PU adhesive. The bonding failure was observed to be due to wood failure. The reason behind the good bonding is noncovalent bonds which are formed between the functional group of the PU molecular chain and the surface of the substrate. In addition, no major changes in FT-IR after keeping these adhesives in different solvents were observed. Good crosslinking is also confirmed by studying the gelling and swelling data of the adhesives.

Objective



Save Earth

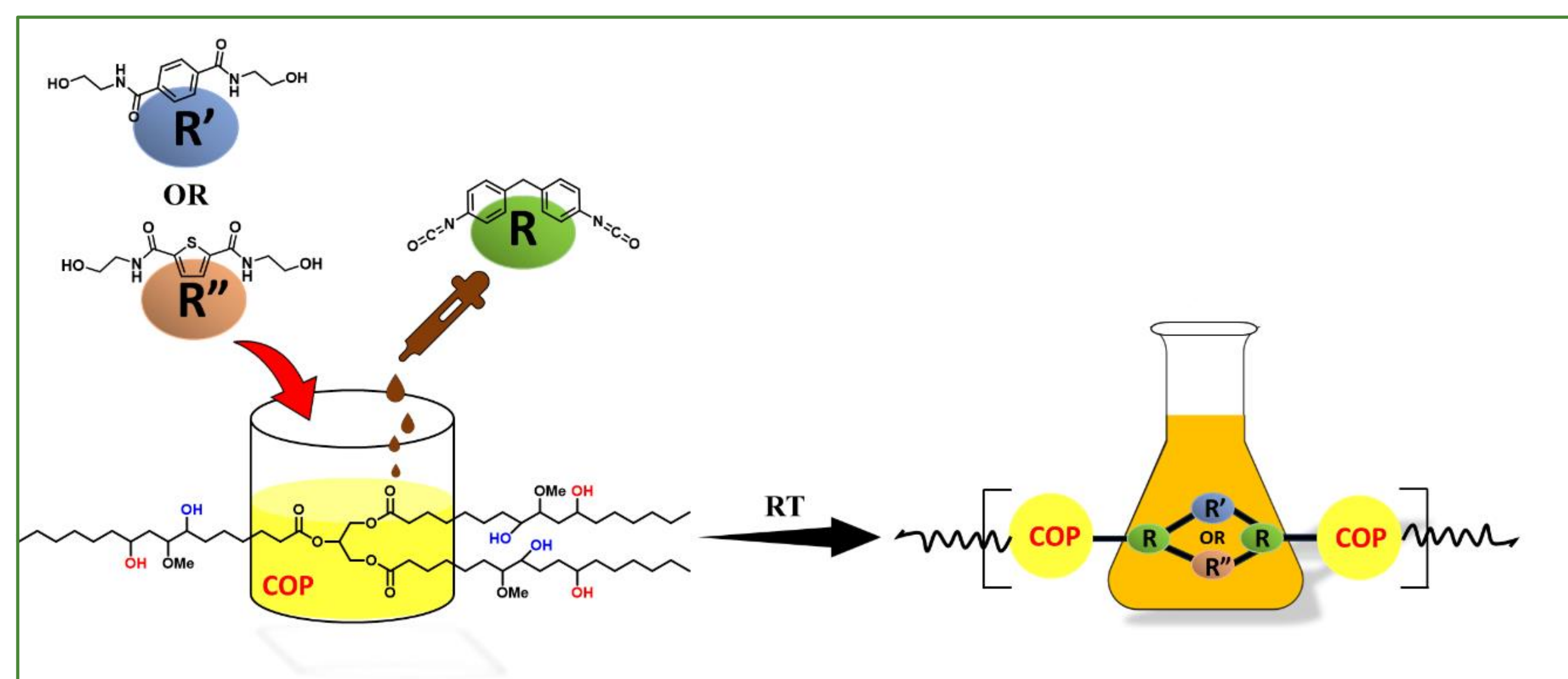


Plant based Polyol (Castor)

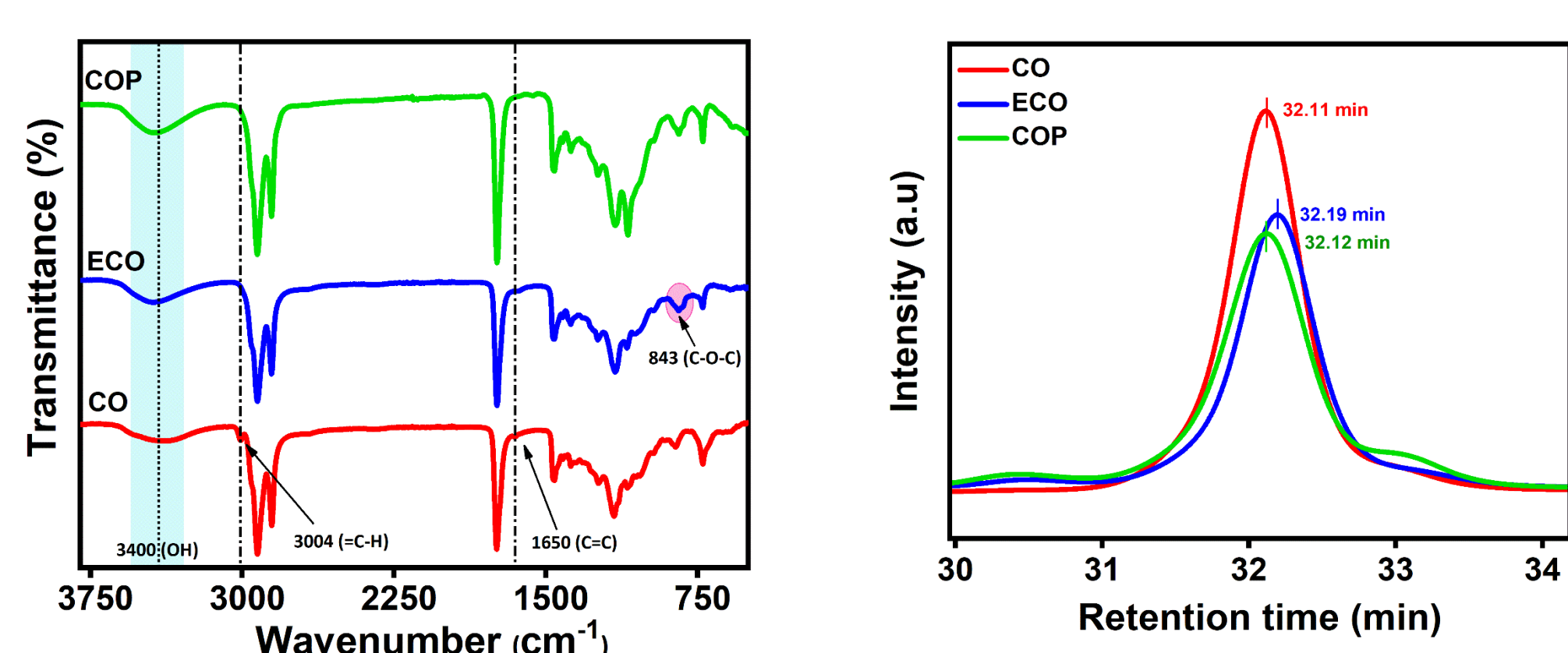


Scarcity of Fossils and global environmental issues

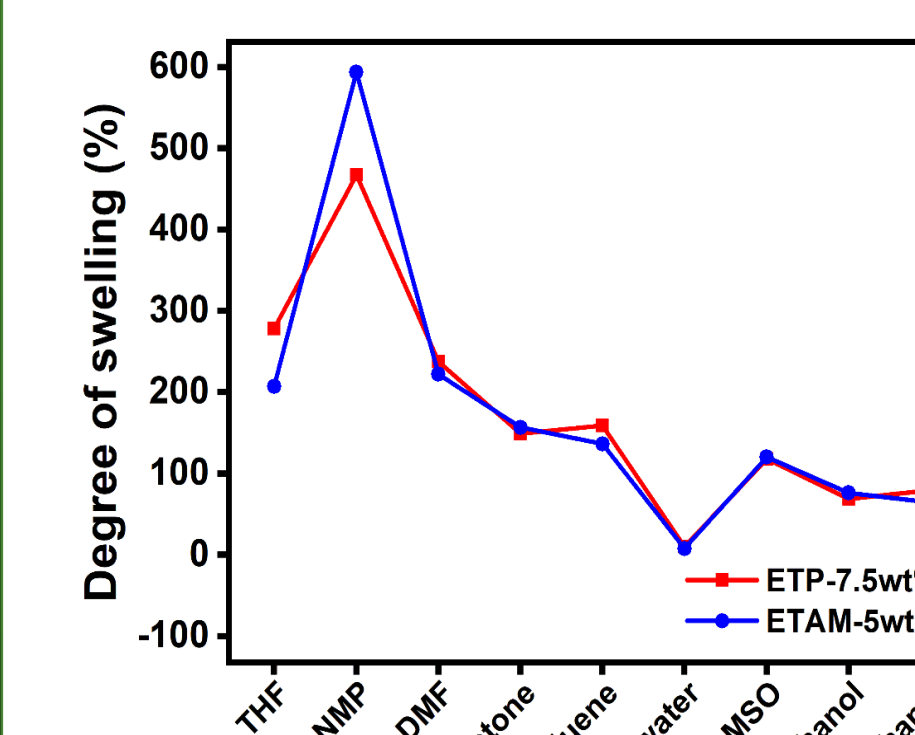
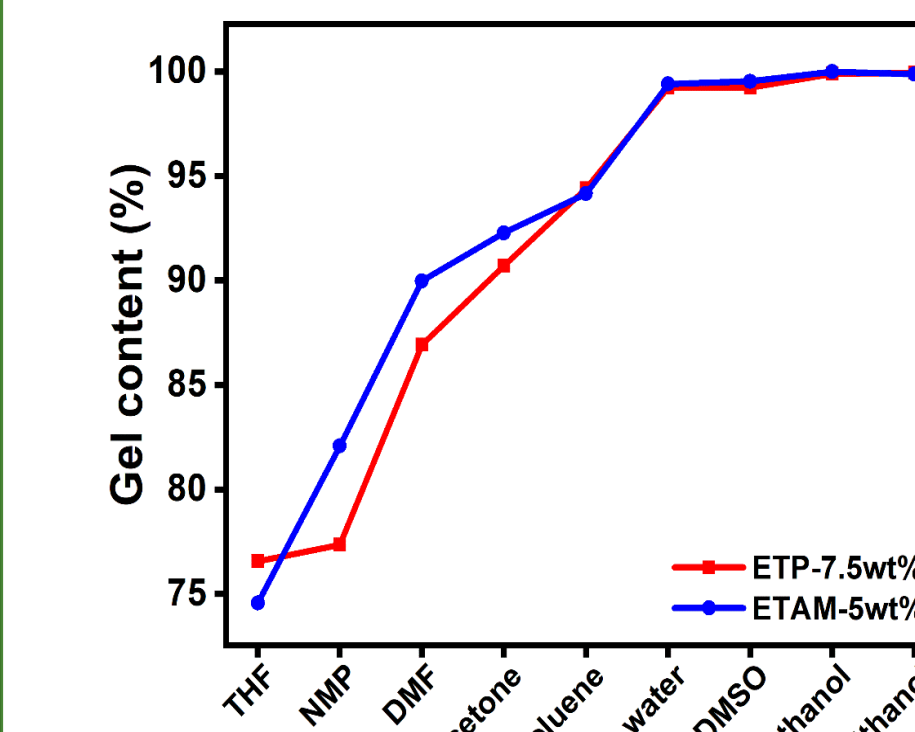
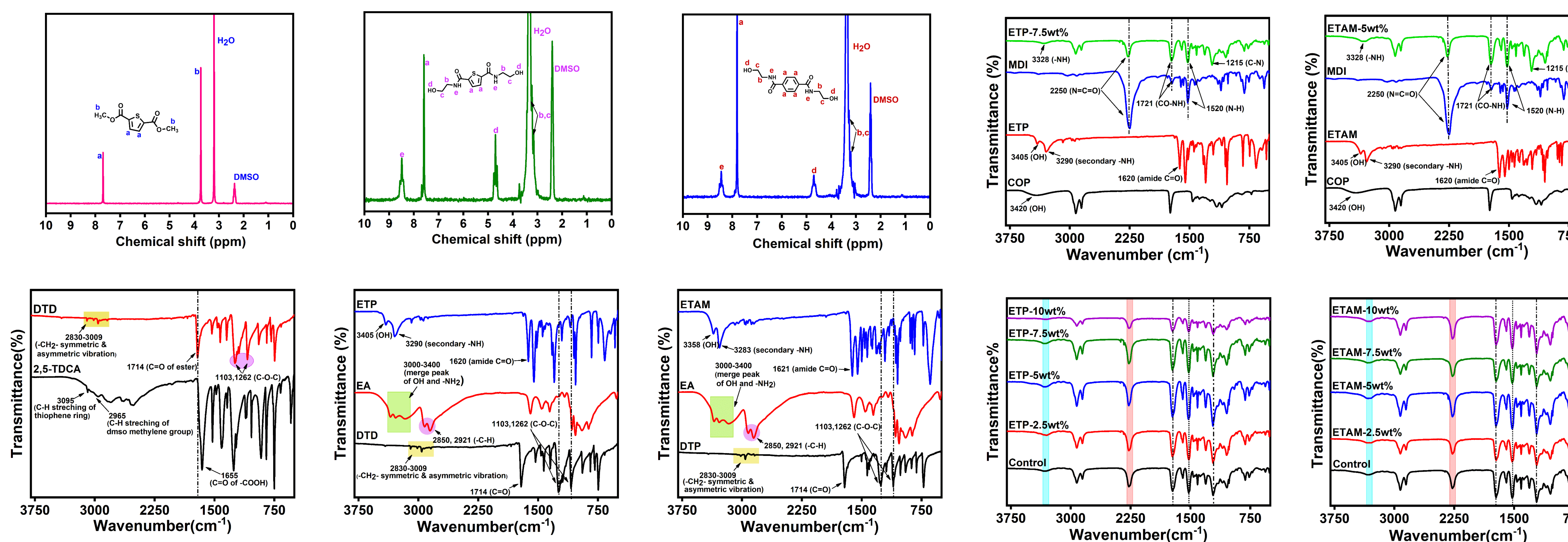
Preparation Of Adhesive



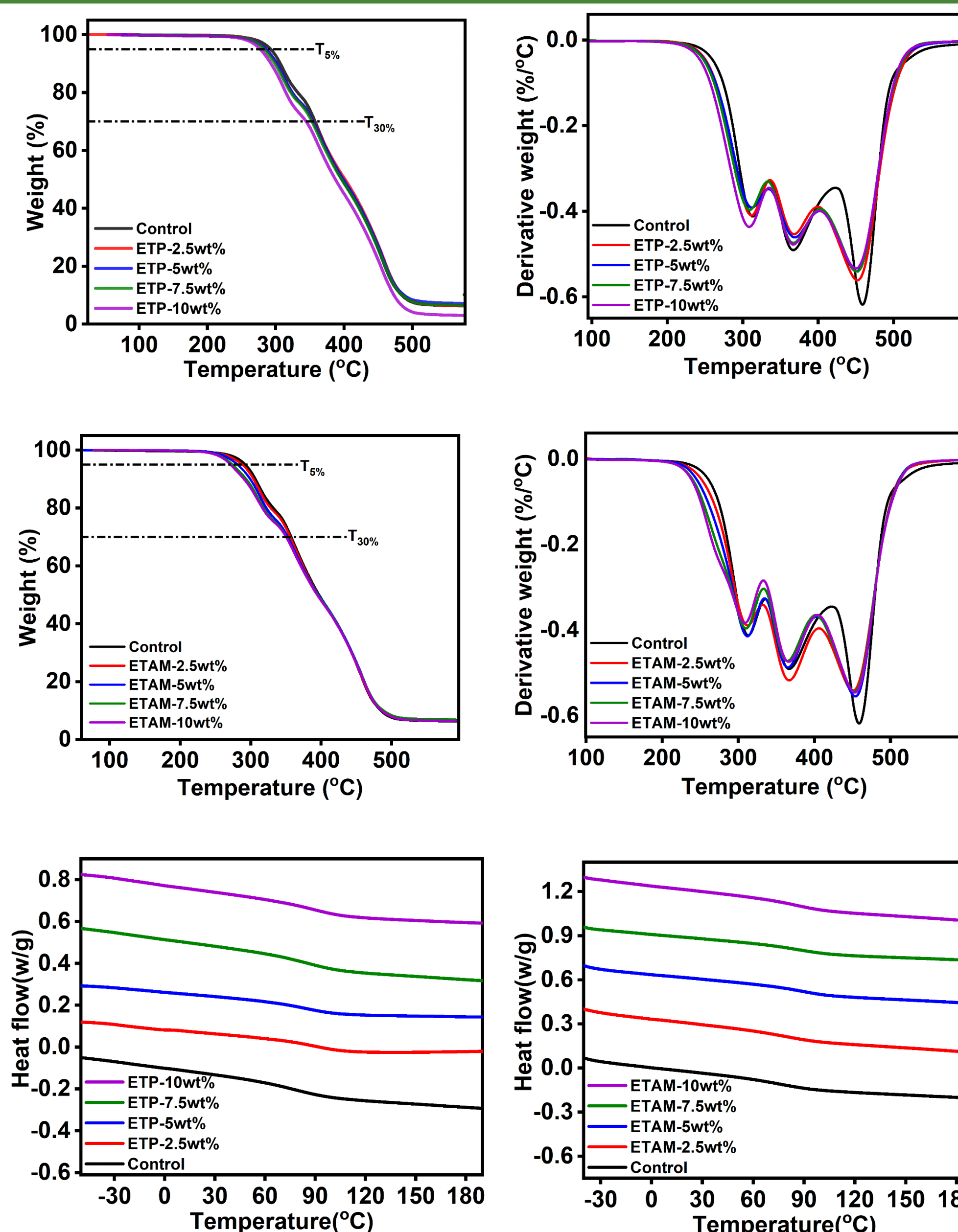
Characterizations of polyol



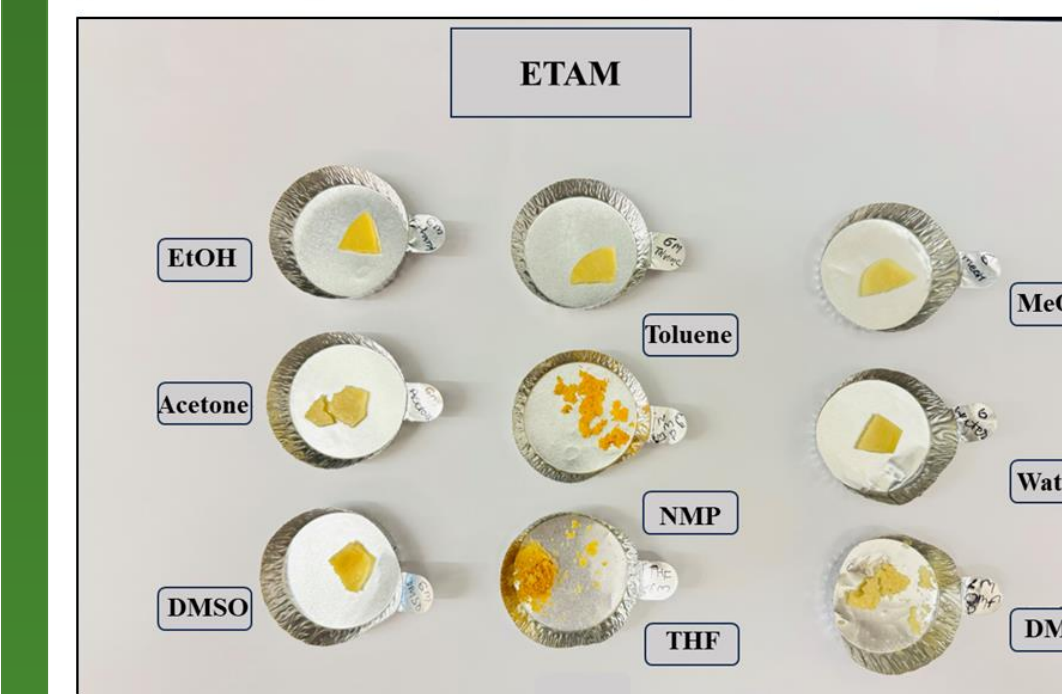
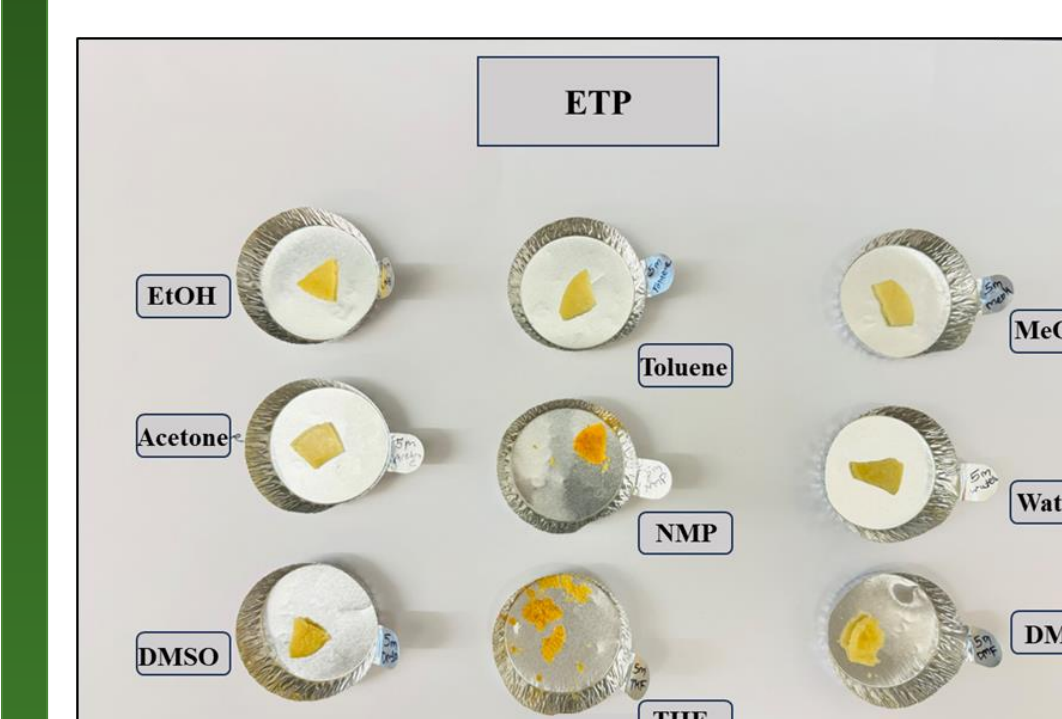
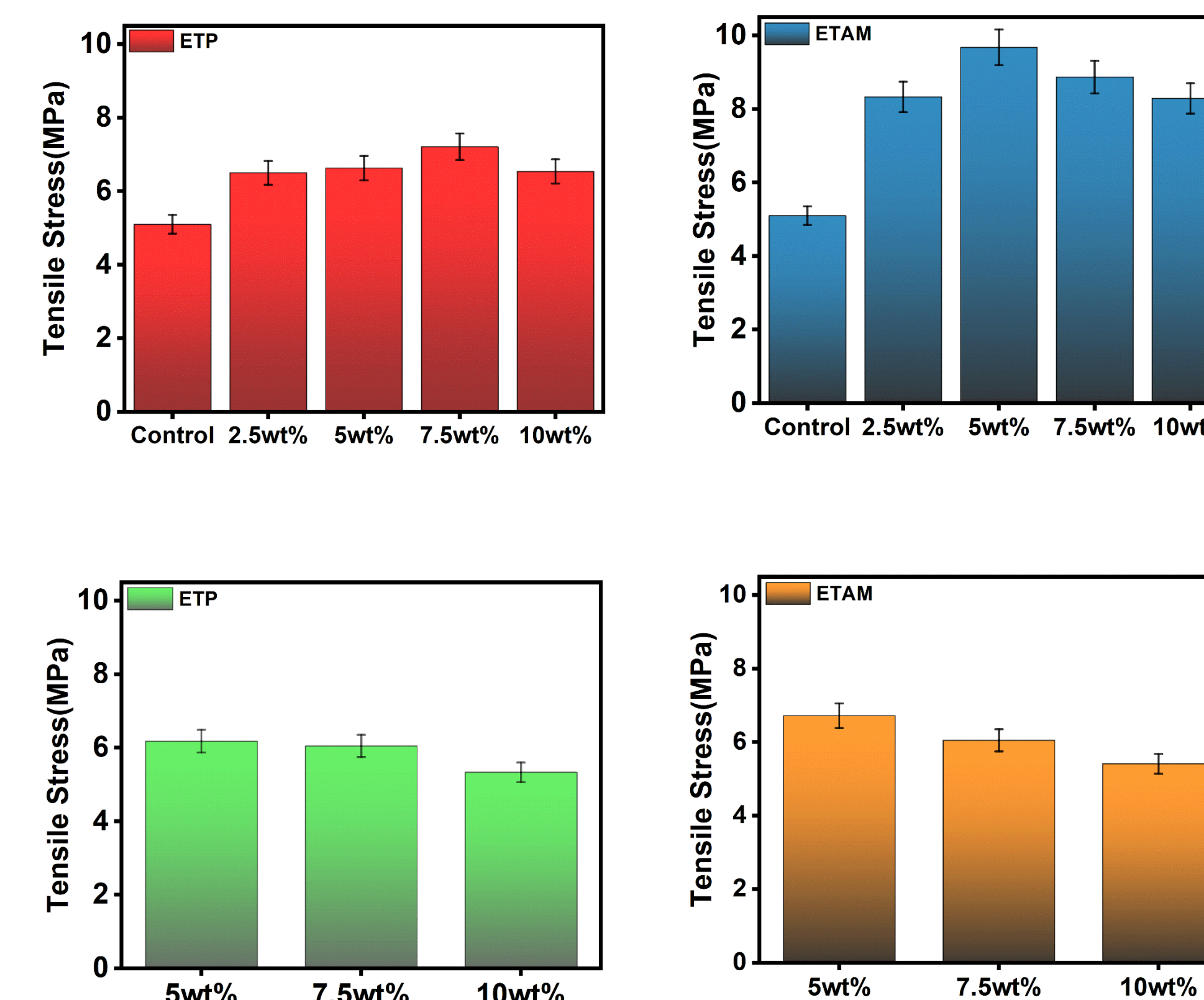
Results



Thermal Property



Mechanical Property



Conclusions and Future Work

- After increasing weight percentage of chain extender, tensile strength was increased at 9.61 MPa of ETAM adhesive material, and mechanical strength was also good on metal coupons (6.73 MPa).
- Higher concentrations of ETP and ETAM crosslinkers led to increased Tg temperatures, indicating enhanced cross-linking and reduced polymer mobility.
- The adhesive samples incorporating ETP and ETAM crosslinkers exhibited hydrophobic behaviour, as indicated by contact angles exceeding 90° in water so, hydrophobic nature of the adhesive materials makes them better to use in kitchen furniture.

Acknowledgements

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- Pittsburg State University

Contact angle of adhesives

