

Crosslinked Polyethylene (XLPE) Recycling via Foam Engineering

Mohammed Bawareth, Mechanical Engineering System

Mentor: Dr. Kenan Song, Assistant Professor

The Polytechnic School

Introduction:

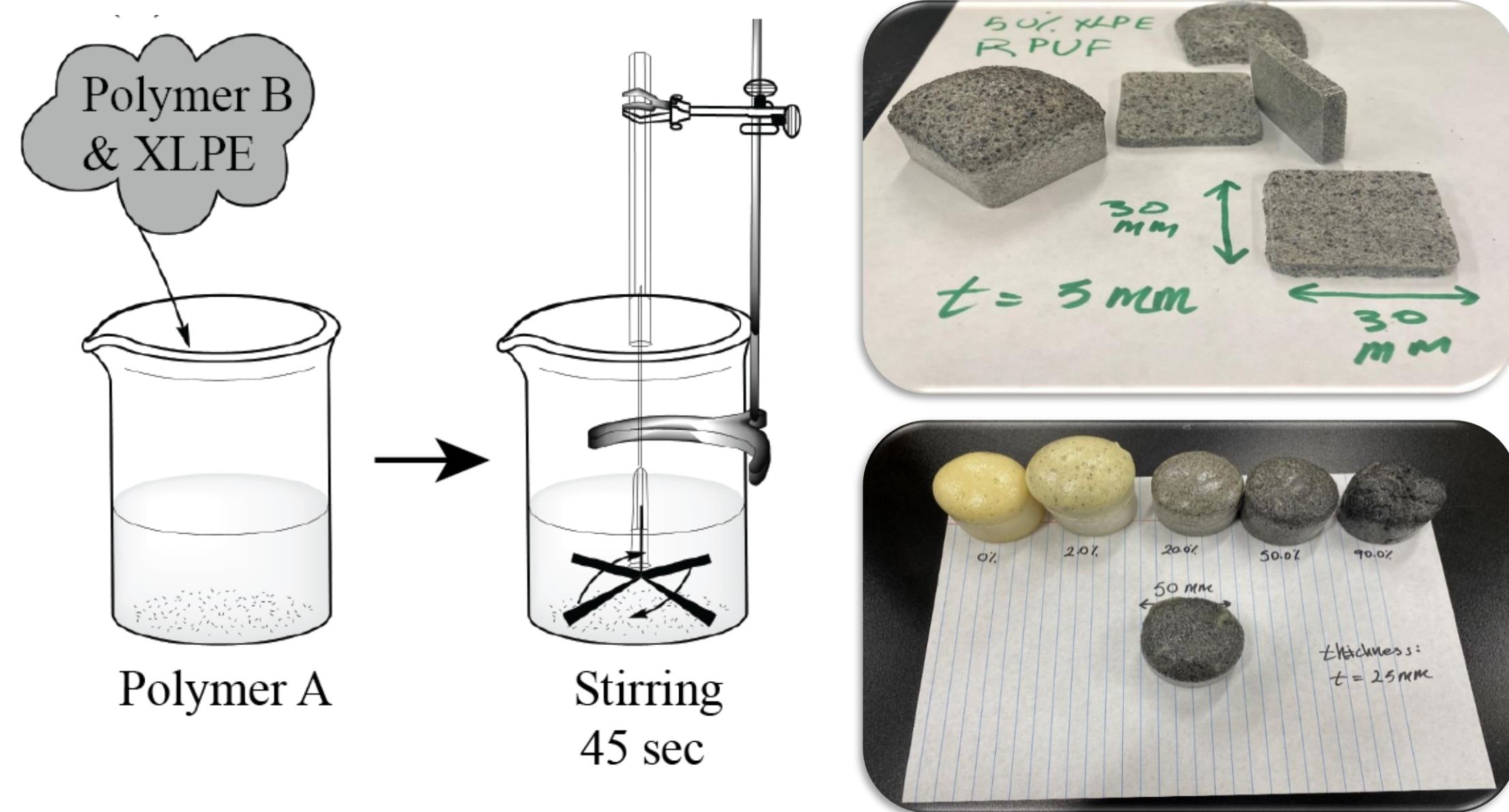
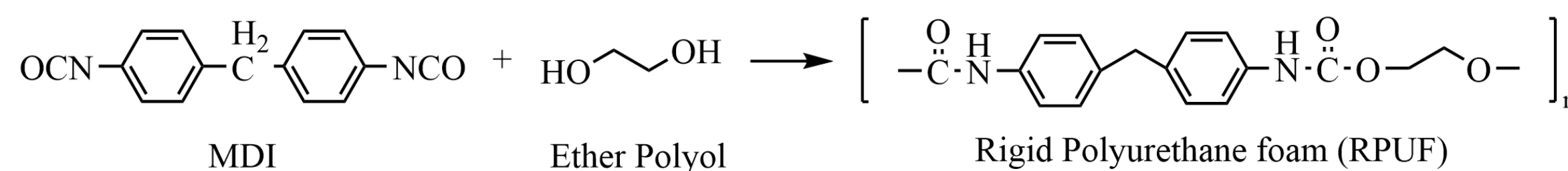
- Crosslink Polyethylene (XLPE) is a thermoset that degrades to CO₂ before reaching its melting point, so it is difficult to directly recycle it in a cost-effective method.
- Annually, SRP disposes 540 tone of XLPE that ends up in landfills.
- The aim is to design sustainable processes for recycling XLPE by understanding thermal and mechanical properties, and structure characterization. As a result, the process of recycling the XLPE might be utilized with other thermosets.

Foaming Process and Our Method:

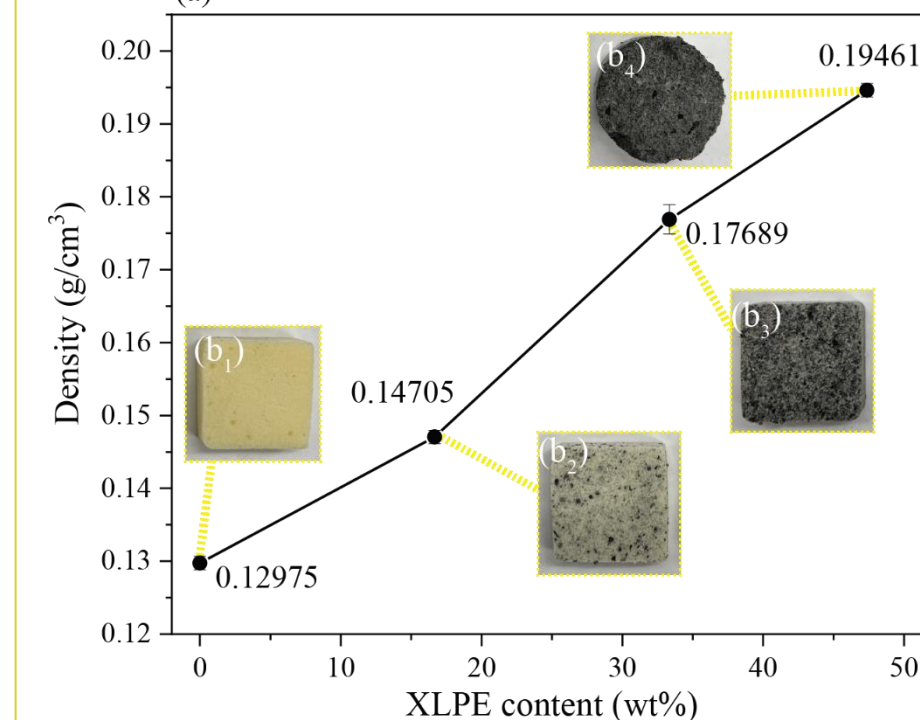
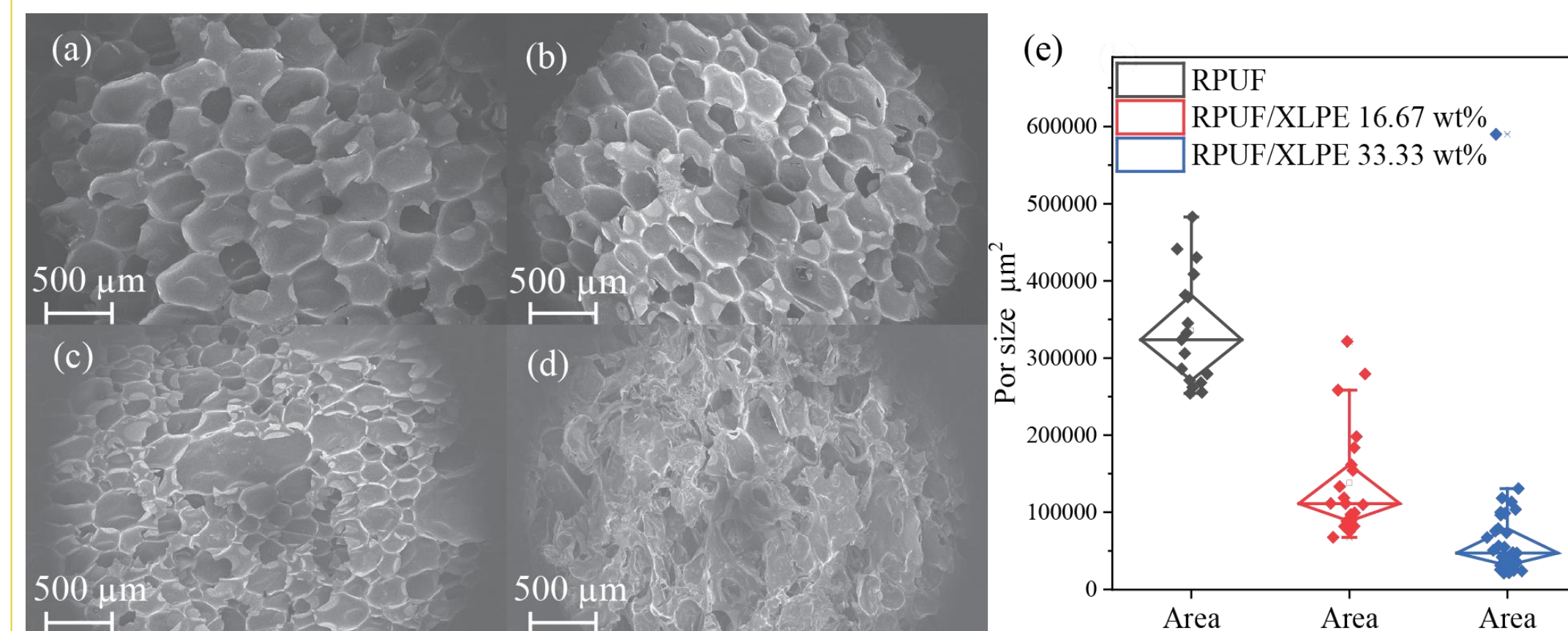
In foaming manufacturing methods, there are three classifications of foaming: mechanical, physical, and chemical foaming process.

Our method:

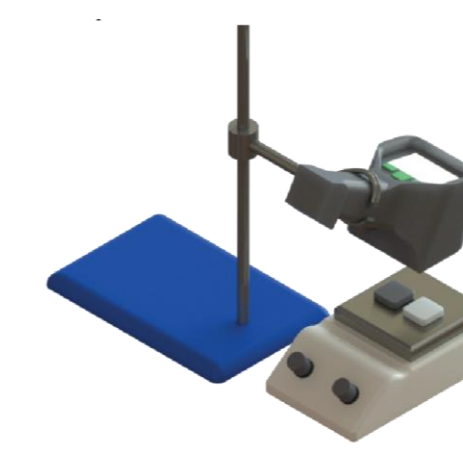
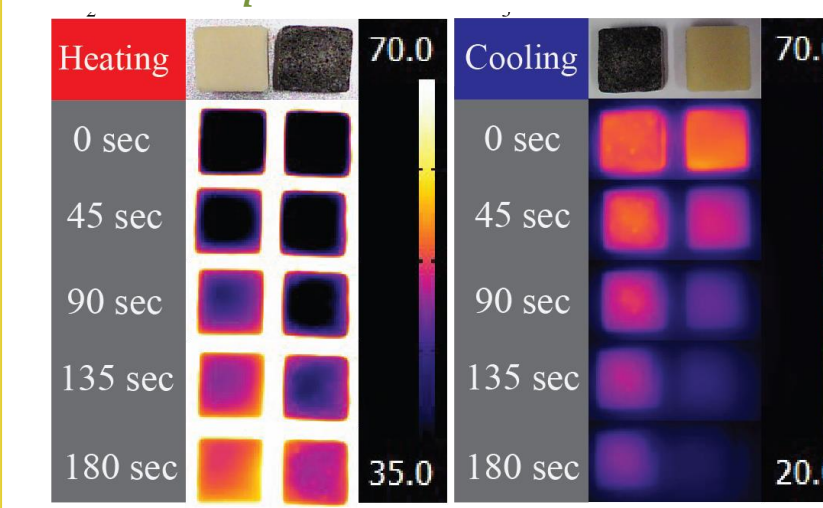
We mixed two polymers: 4,4' methylene bis(phenylisocyanate) (MDI) and Ether polyols to make rigid polyurethane foam (RPUF). first, we used the in-situ dispersion method of mixing XLPE micron particles during the RPUF foaming reaction. then, we poured the mixture into different molds and let it cure for 2 hours, as shown below.



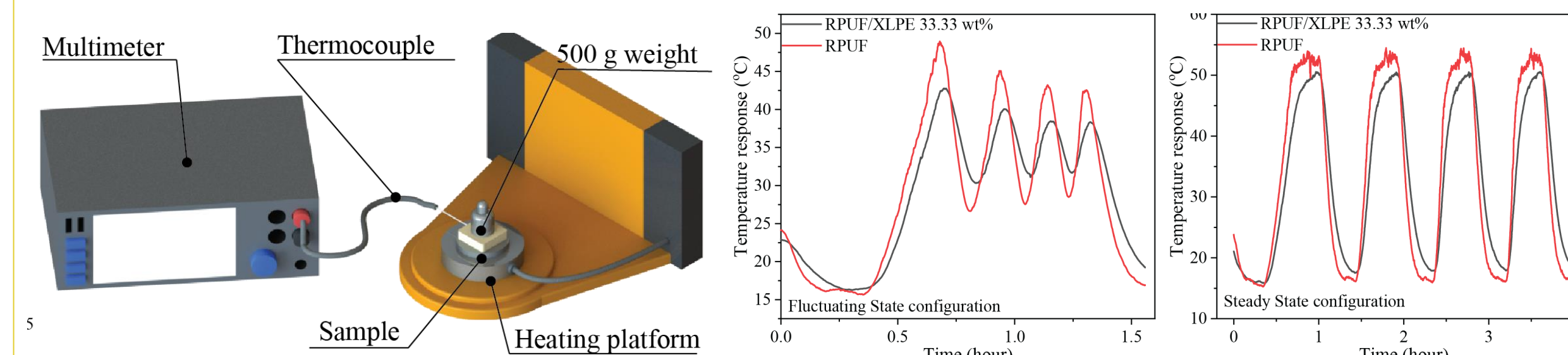
Morphology and Density



$$a = \frac{K}{\rho C_p} \quad K = \frac{Qd}{A\Delta T} \quad C_p = \frac{Q}{m\Delta T}$$



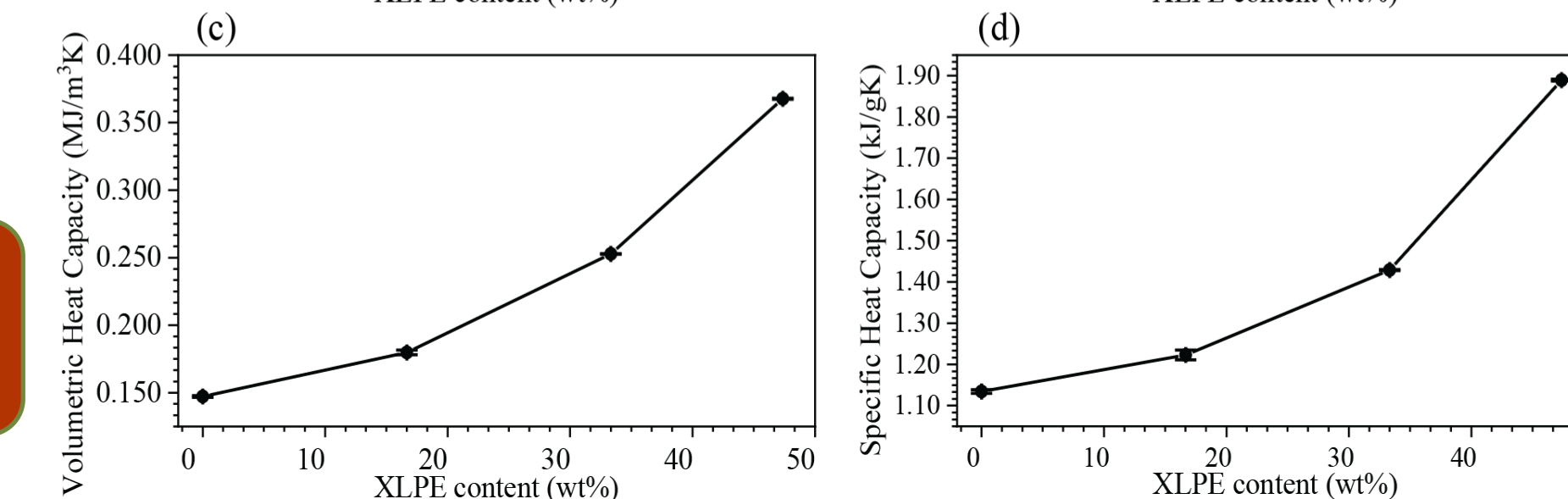
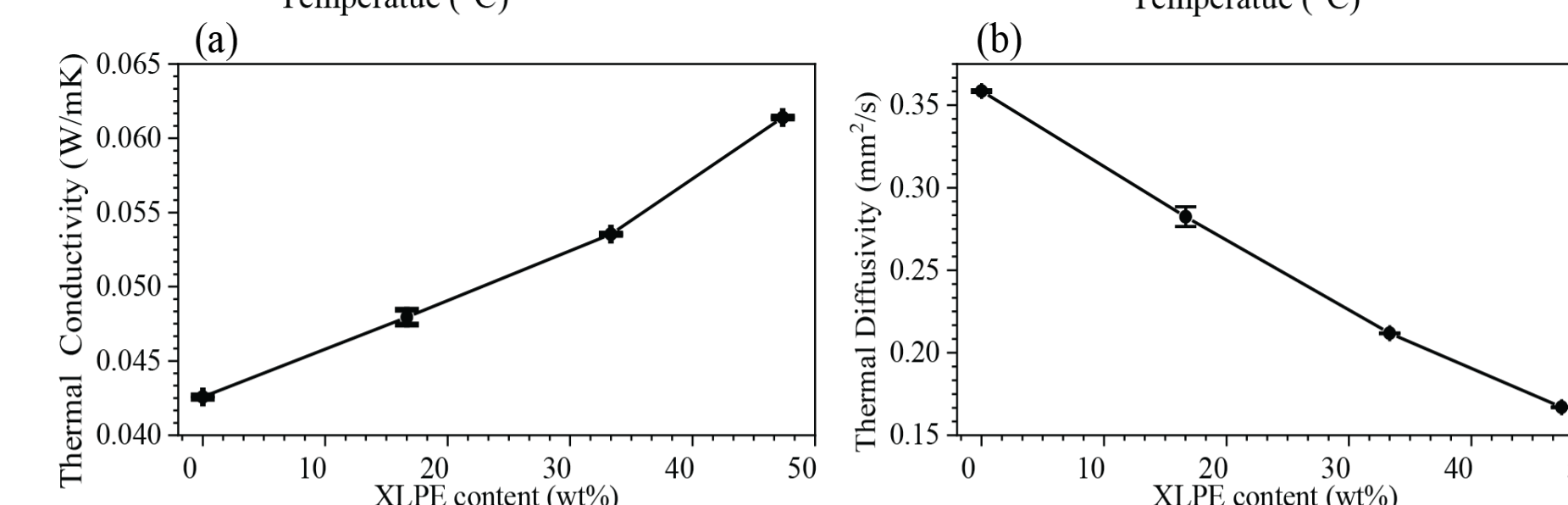
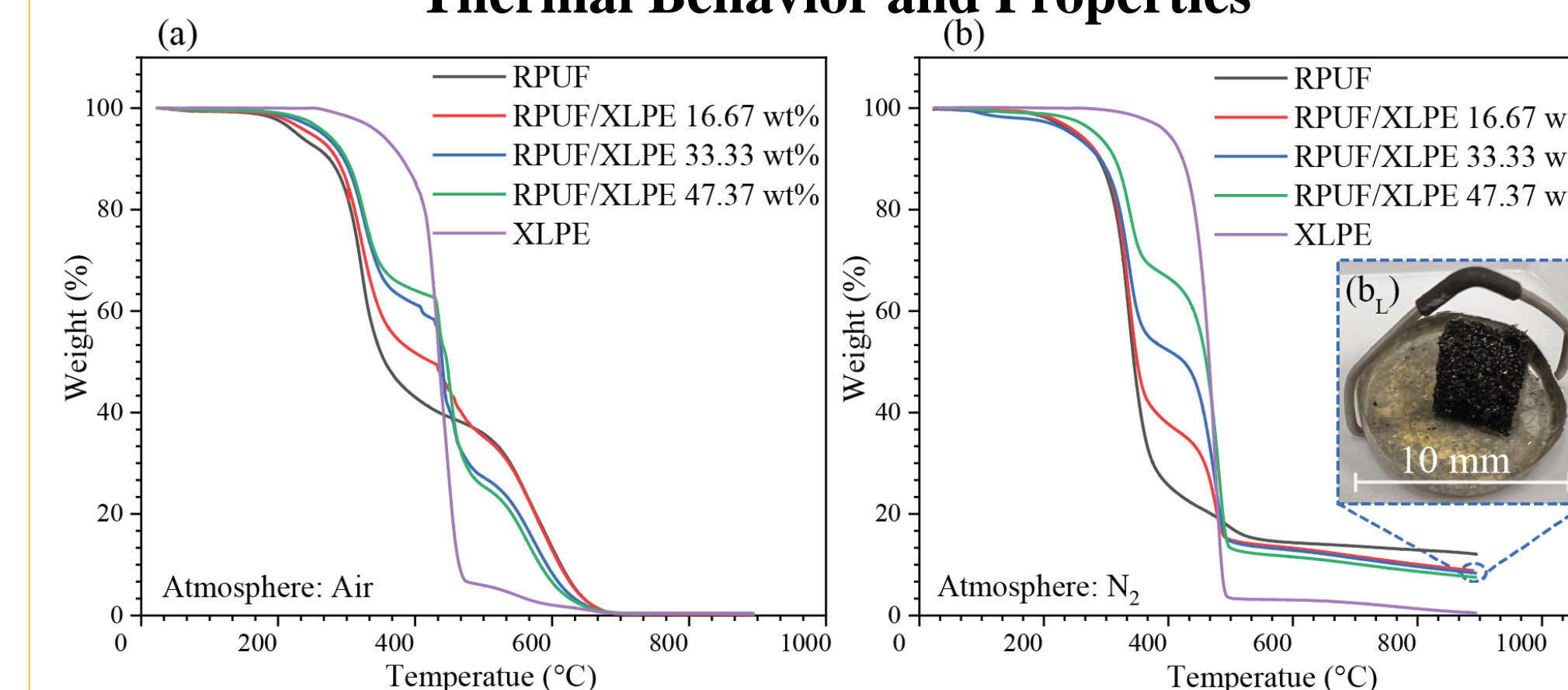
RPUF/XLPE
33.33 wt%



Conclusion:

Repurposing the XLPE is possible. The method is to improve the thermal properties of the RPUF by dispersing XLPE micron particles. The optimal ratio is RPUF/XLPE 33.33 wt%. The future work is to conduct a carbon life assessment and cost analysis and to scale up the project.

Thermal Behavior and Properties



Mechanical Properties:

