Welding of PLA – Commercial Bioplastic

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Abstract

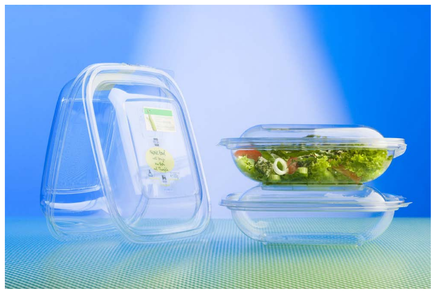
This project focused on the characterization of bioplastics joined with impulse heat sealing and ultrasonic welding. Polylactic acid (PLA), is typically derived from starch rich crops such as corn, was studied. This material was welded in two forms, rigid samples and film. Ultrasonic welding was used to weld rigid PLA samples and PLA films were joined with impulse welding. A characterization of the mechanical properties of this bio-based plastic was completed with a tensile test to determine which welding parameters were the most influential on the material strength. In addition the interfacial healing activation energy was calculated to predict interfacial healing for the different types of welding.

Objectives

- Promote industry-wide acceptance of bioplastics
- Increase the use of sustainable materials
- Calculate the activation energy of interfacial healing of molten biopolymer interfaces
- Determine weldability parameters affecting strength of PLA materials

Materials

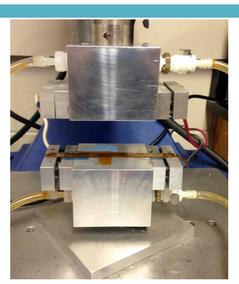
- **PLA (2003D)**
- **PLA (4032D)**



Methods

1) Impulse Welding (heat sealing)

- Weld Times: 2, 3, 5, 7, 25, 50, 99, 180, 300s
- Weld Currents: 10, 11, 12, 13, 14, 16, and 16.7 A

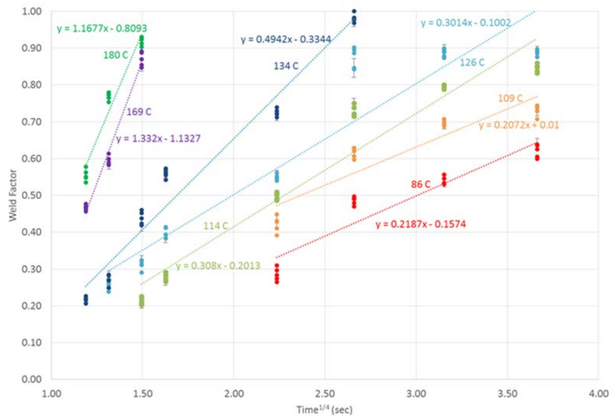


2) Ultrasonication Welding

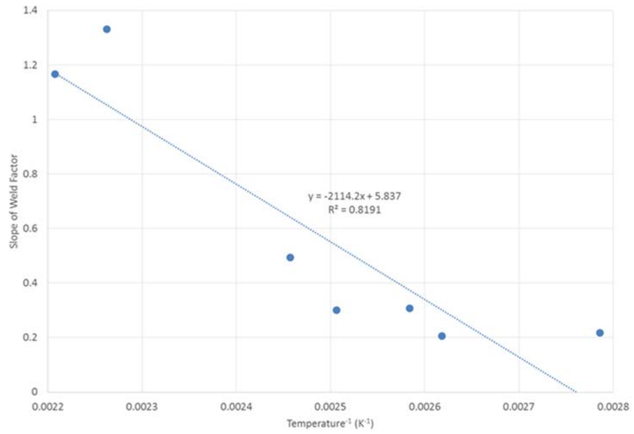
- Velocities: 0.1 mm/s, 0.2 mm/s, 0.4 mm/s, 0.6 mm/s, 0.8 mm/s, 1.0 mm/s
- Weld Distance: 0.1 mm, 0.2 mm, 0.3 mm

Results

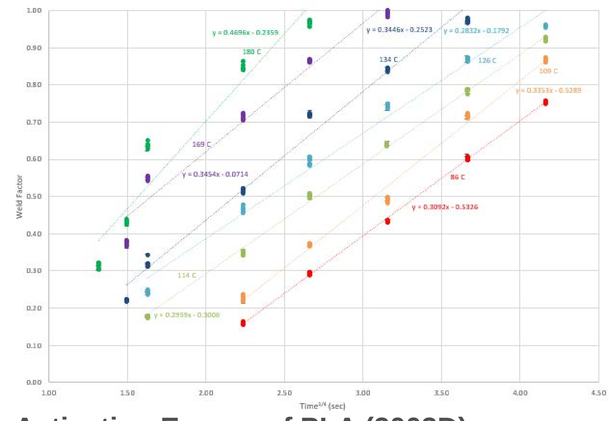
Impulse Welding: PLA (4032D)



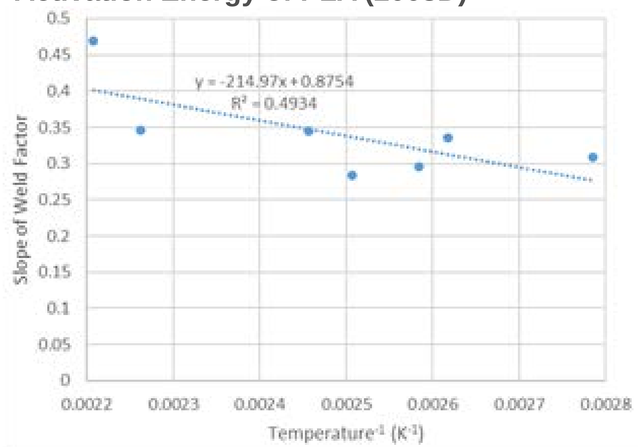
Activation Energy of PLA (4032D)



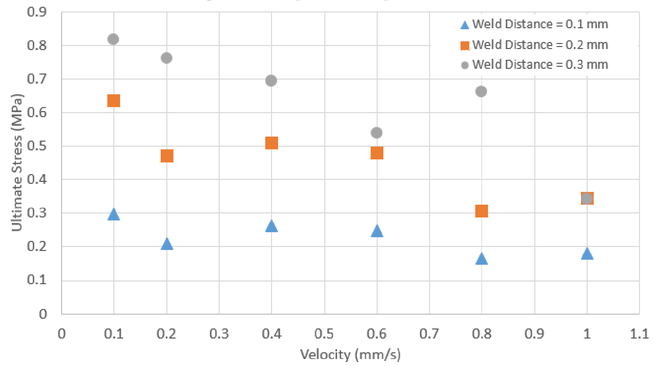
Ultrasonic Welding: PLA (2003D)



Activation Energy of PLA (2003D)



Tensile Testing PLA (2003D)



Conclusion

Welding parameters affecting weldability and material strength of PLA in ultrasonic welding are weld time, weld distance and velocity of weld; in impulse welding of films, heating time and temperature were the dominant welding parameters relative to weld strength.

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