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Synthesis and Characterization of Biodegradable Castor oil-based Waterborne Polyurethane (WPU)

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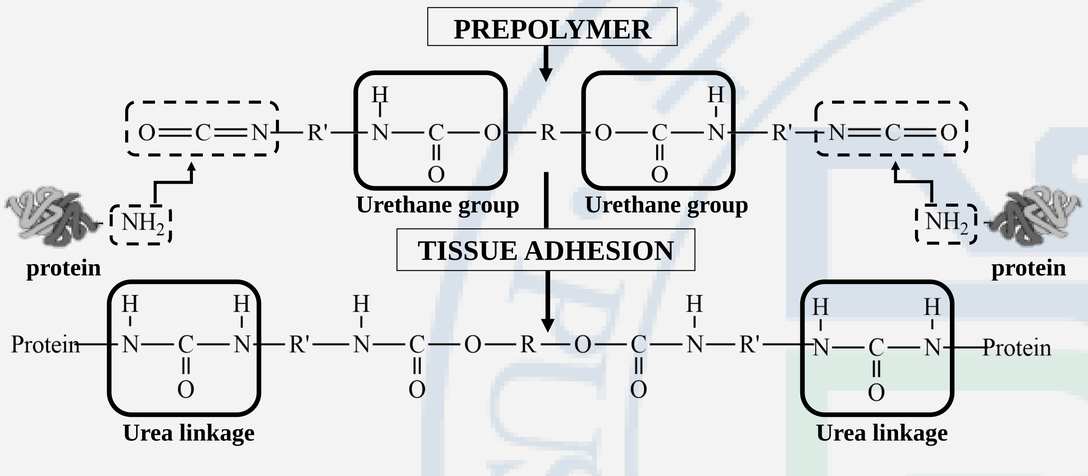
Abstract

Waterborne polyurethane (WPU) was synthesized using castor oil-based polyol, petroleum-based polyol, and isophorone diisocyanate. The crosslinking of WPU was obtained by the castor oil based polyol that has three functionalities. The crosslinked WPUs were characterized by FT-IR, DSC, TGA, and UTM. Their biodegradations were analyzed thorough the effect of enzyme in the samples morphology. The crosslinked WPU could be considered as a promising candidate to be applied the various bio-fields because of the possibility of their synthesis as prepolymers and therefore their reaction with amino groups present in the biological molecules.

Objective

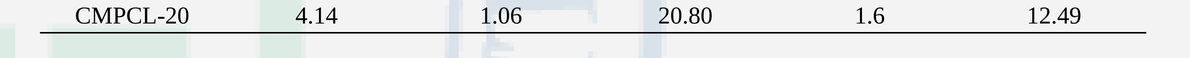
1. To synthesize the waterborne polyurethane from two types of polyol; poly caprolactone diol and castor-oil with two different structures
2. To evaluate mechanical and thermal properties by crosslinking effect from castor oil that has three -OHs
3. To investigate the enzymatic biodegradability of three functional castor oil

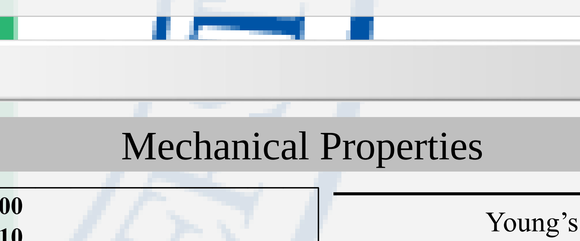
Tissue Adhesion

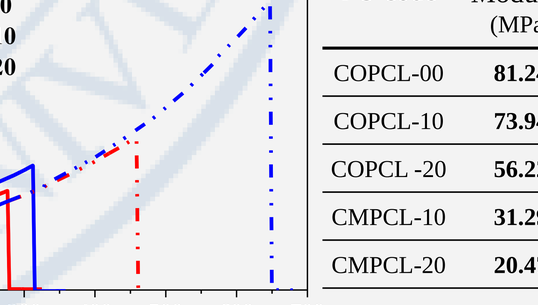


Experiment

Materials & Scheme







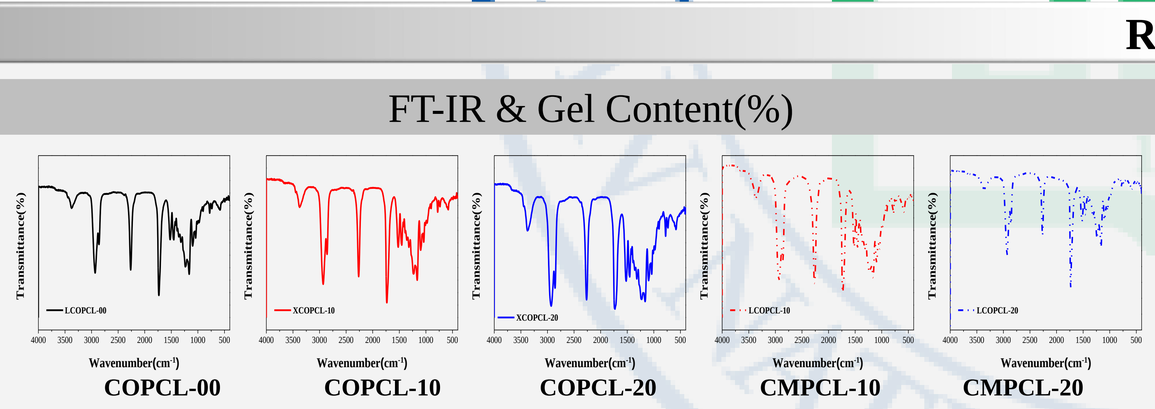
Formulation

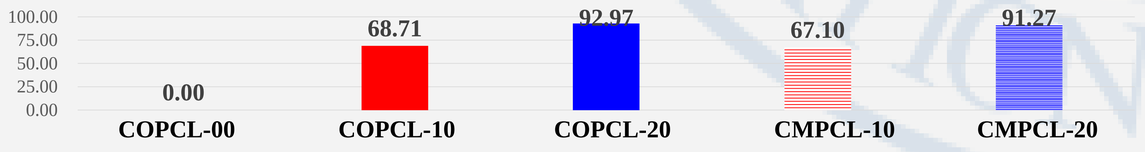
(unit: g)

PU code	Castor Oil	Mono Alcohol	PCL2000	DMBA	H12MDI
COPCL-00	-	-	26.00	1.6	12.49
COPCL-10	2.6	-	23.40	1.6	12.49
COPCL -20	5.2	-	20.80	1.6	12.49
CMPCL-10	2.07	0.53	23.40	1.6	12.49
CMPCL-20	4.14	1.06	20.80	1.6	12.49

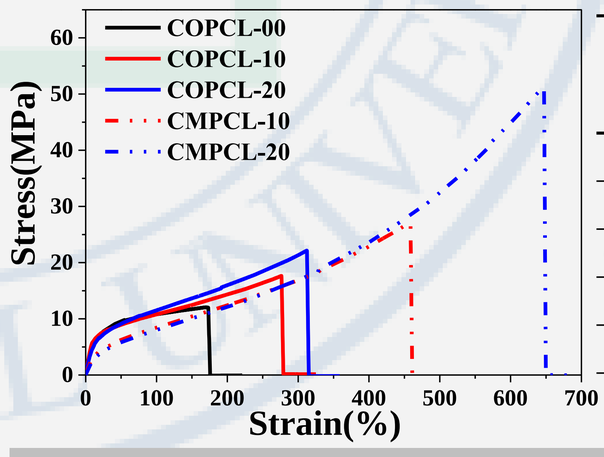
Results

FT-IR & Gel Content(%)



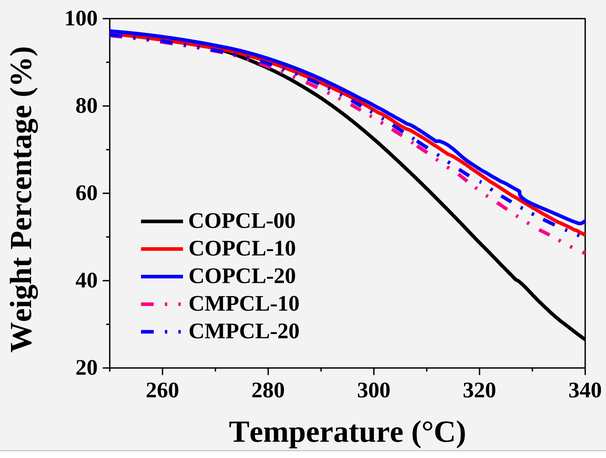


Mechanical Properties



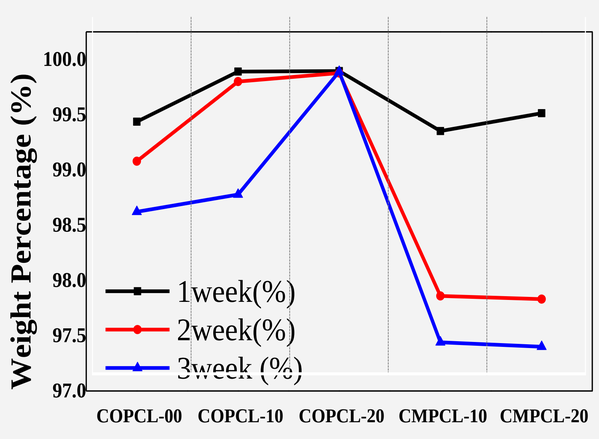
PU code	Young's Modulus (MPa)	Tensile Strength (MPa)	Elongation at break (%)
COPCL-00	**81.24**	**9.89**	**166.84**
COPCL-10	**73.94**	**17.66**	**276.58**
COPCL -20	**56.22**	**22.17**	**312.40**
CMPCL-10	**31.29**	**27.25**	**458.58**
CMPCL-20	**20.47**	**51.43**	**647.20**

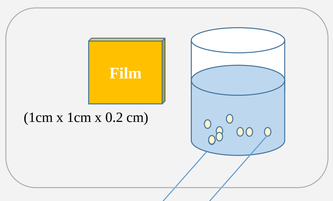
Thermal Analysis



PU code	T_{50} (°C)
COPCL-00	318.90
COPCL-10	340.64
COPCL -20	346.09
CMPCL-10	333.96
CMPCL-20	339.44

Enzymatic Degradation Test





PH 7.2 buffer solution

Enzyme powder mg/ml

Type of enzyme, changed.

Conclusion

- The successful formation of NCO-terminated castor oil based WPU
- The increase of gel content with increasing castor oil content
- The improved mechanical property and thermal stability due to the increased crosslinking effect
- The reduced bio degradability of castor oi based WPU due to the higher crosslinking effect

Acknowledgement

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Advanced Steric Polymer Laboratory