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Synthesis and Characteristics of Bio-based Biodegradable Waterborne Polyurethane for Bio-adhesive

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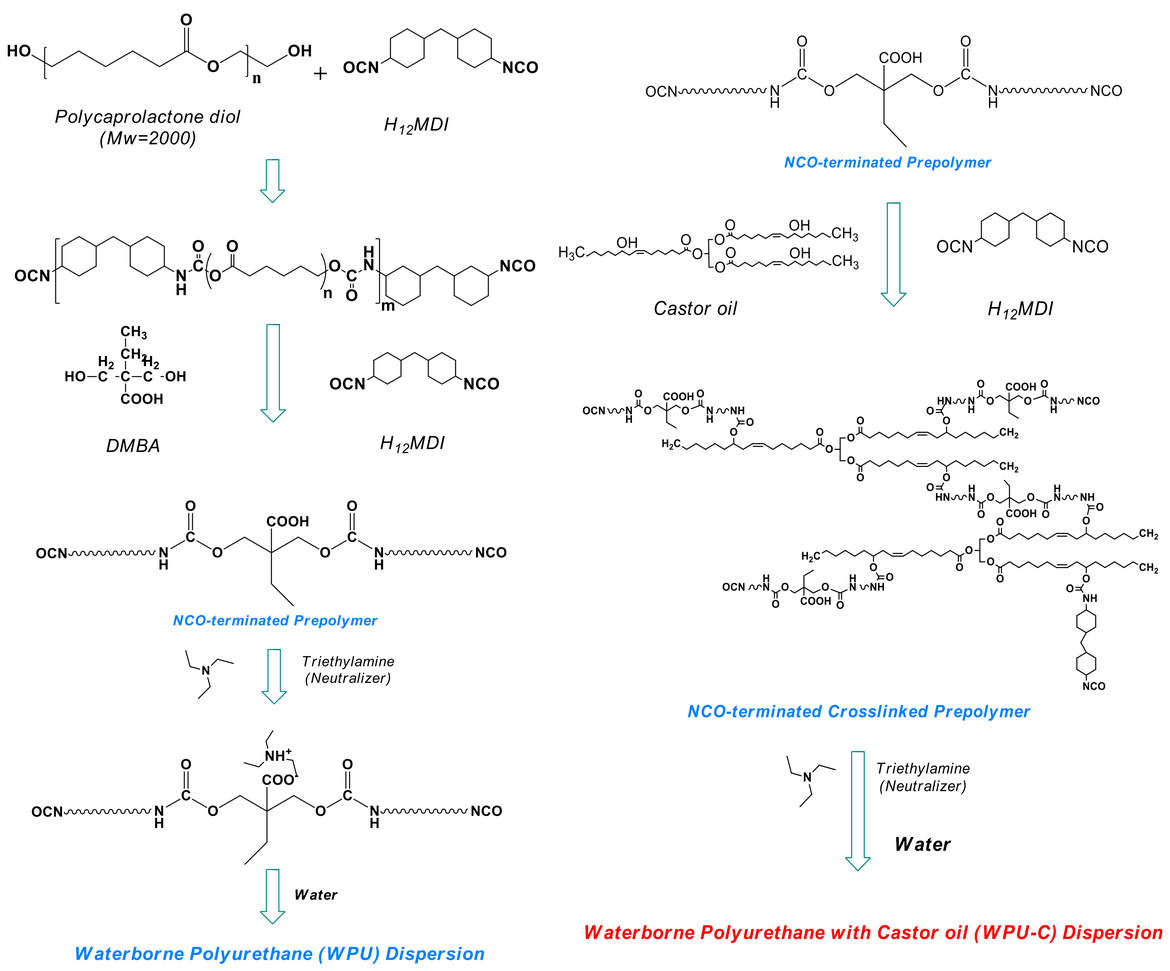
Abstract

Various waterborne polyurethane (WPU) series using polycaprolactone diol (PCL) and 4,4'- methylene dicyclohexyl diisocyanate (H12MDI) as main domains of urethane, dimethylol butanoic acid (DMBA) as anionic internal emulsifier and trimethylamine (TEA) as neutralizing agent was successfully synthesized. The physical properties of WPU were changed according to the presence or absence of castor oil and molecular weight. Waterborne polyurethane designed to increase bio-adhesion as the total molecular weight of the waterborne polyurethane increases had cross-linked structure by castor oil. As a result, mechanical properties were improved, and biodegradability evaluation using bio-enzymes was also successfully conducted. The biodegradability evaluation using the effect of the bio-enzymes was thoroughly analyzed through SEM. WPU made through the above experiment has excellent physical properties and biodegradable by bio-enzymes, so it is environmentally friendly and can be considered as a promising candidate in various bio fields.

Objective

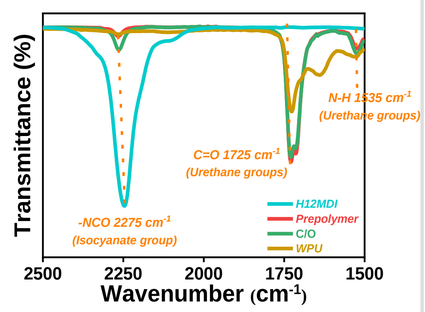
1. **To synthesize a WPU adhesive with excellent biocompatibility.**
2. **To evaluate characteristics and biodegradable of bio-adhesive.**
3. **The biodegradability evaluation using the effect of the bio-enzymes was analyzed through SEM.**

Experimental

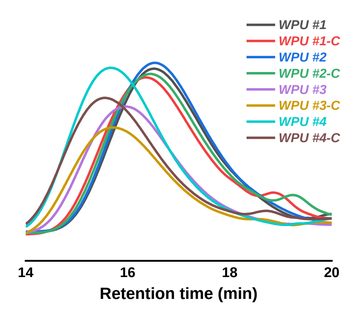


Results

FT-IR

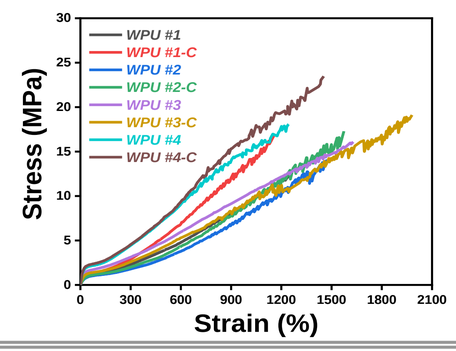


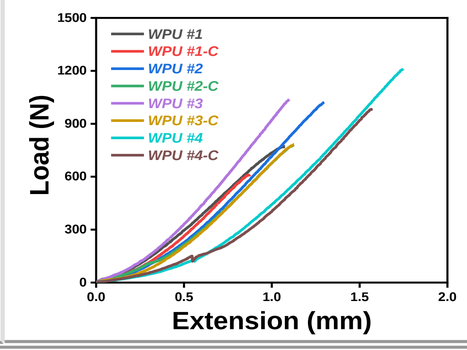
GPC



Series	M_n	M_w	PDI	Particle size (nm)
WPU #1	8754	16621	1.89	138.87
WPU #1-C	10765	18821	1.74	180.58
WPU #2	9863	17591	1.78	185.89
WPU #2-C	11850	20064	1.69	195.20
WPU #3	16291	28361	1.74	188.83
WPU #3-C	18622	31161	1.67	208.60
WPU #4	21302	36596	1.72	219.09
WPU #4-C	23254	39987	1.72	229.80

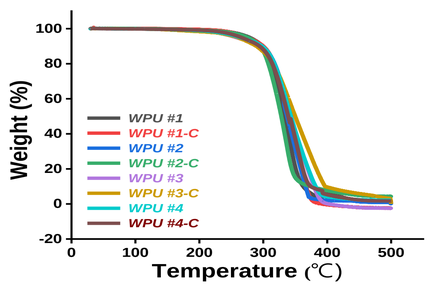
UTM



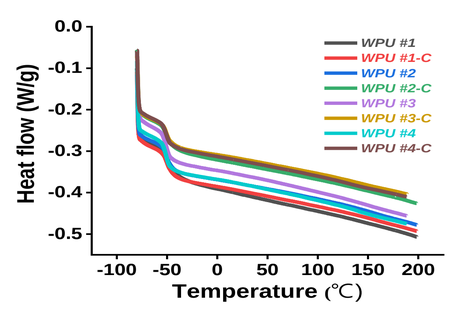


Series	Tensile Stress (MPa)	Strain (%)	Load (N)
WPU #1	12.28	1247.3	773.11
WPU #1-C	16.85	1157.1	611.73
WPU #2	14.10	1474.3	1022.5
WPU #2-C	17.29	1573.5	778.92
WPU #3	16.09	1629.8	1037.2
WPU #3-C	19.12	1980.5	783.28
WPU #4	18.08	1243.4	1212
WPU #4-C	23.47	1453.1	983.75

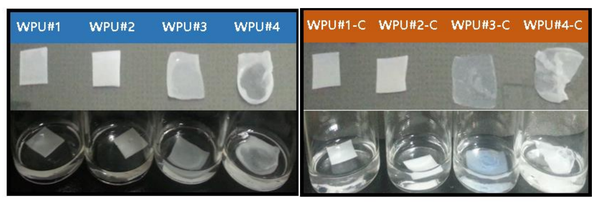
TGA



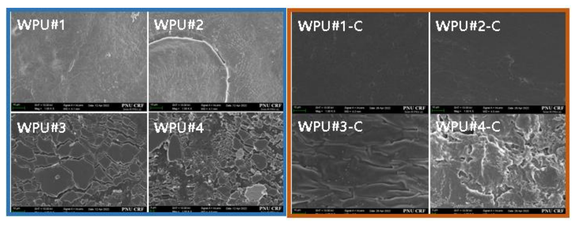
DSC



Enzymatic degradation



FE-SEM



Conclusion

- **Waterborne polyurethane (WPU) series with and without castor oil synthesized in this study showed potential as a bio-adhesive.**
- **The bio-enzyme degradation evaluation showed that the material has potential as a bio-adhesive.**

Acknowledgement

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