한국고분자학회 The Polymer Society of Korea

2024 한국고분자학회 춘계 정기총회 및 학술대회
April 03 - 05, 2024 | International Convention Center JEJU (ICC JEJU), Korea

부산대학교 PUSAN NATIONAL UNIVERSITY

Synthesis and properties of biodegradable waterborne polyurethane with castor oil

*Jae-Ryong Lee, Won-Bin Lim, Jin-Gyu Min, Ju-Hong Lee, Sang-Wook Byun, Seong-Ho Kim, Ji-Hong Bae, PilHo Huh**

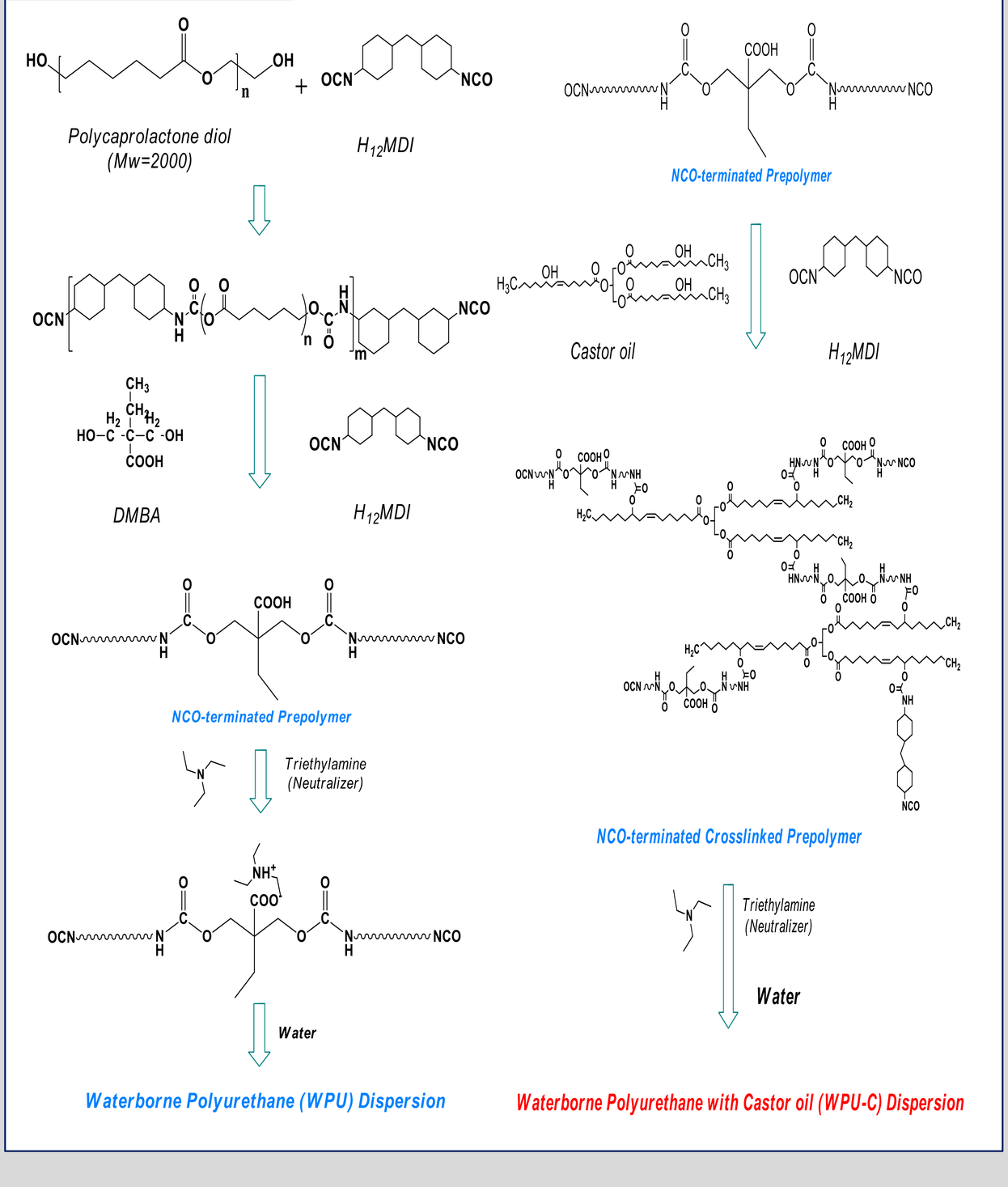
Department of Polymer Science and Engineering, Pusan National University, Busan 46241, South Korea

** pilho.huh@pusan.ac.kr*

Abstract

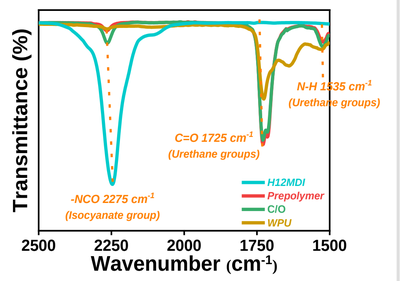
A waterborne polyurethane(WPU) polymer was synthesized through a urethane reaction using polycaprolactone diol (PCL) and 4,4'-methylene dicyclohexyl diisocyanate (H12MDI). Dimethylol butanoic acid (DMBA) was used as an anionic internal emulsifier and trimethylamine was used as a neutralizing agent. Castor oil was a representative vegetable oil used as a raw material for eco-friendly products in the petroleum industry. The content of castor oil increases the total molecular weight of WPU, which was designed to improve bio-adhesiveness as a result of an increased in the crosslinked structure. Biodegradability evaluation followed a biodegradability evaluation procedure using the effect of a bio-enzyme through a field emission scanning electron microscope (FE-SEM). It was confirmed that the physical properties of the synthesized WPU through this synthesis were excellent and had biodegradability by the effect of bio-enzyme.

Experimental

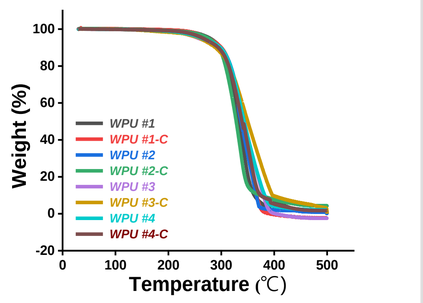


Results

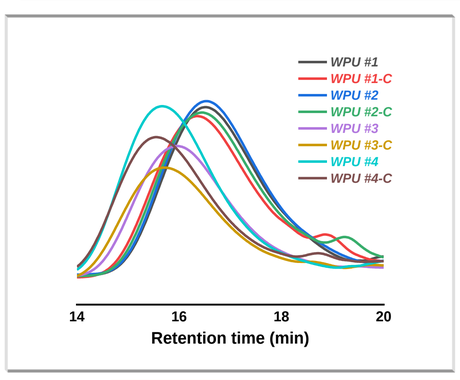
FT-IR



TGA

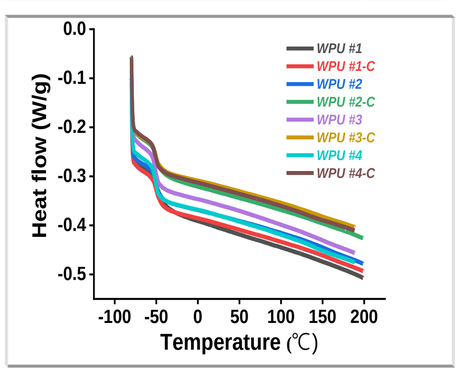


GPC

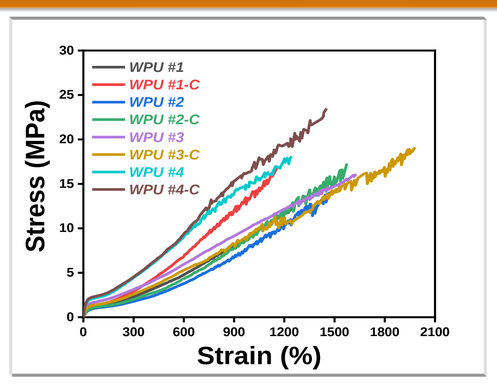


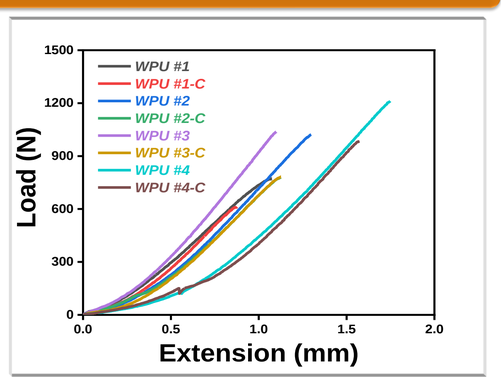
Series	M_n	M_w	PDI	Particle size (nm)
WPU #1	8754	16621	1.89	138.87
WPU #1-C	10765	18821	1.74	180.58
WPU #2	9863	17591	1.78	185.89
WPU #2-C	11850	20064	1.69	195.20
WPU #3	16291	28361	1.74	188.83
WPU #3-C	18622	31161	1.67	208.60
WPU #4	21302	36596	1.72	219.09
WPU #4-C	23254	39987	1.72	229.80

DSC



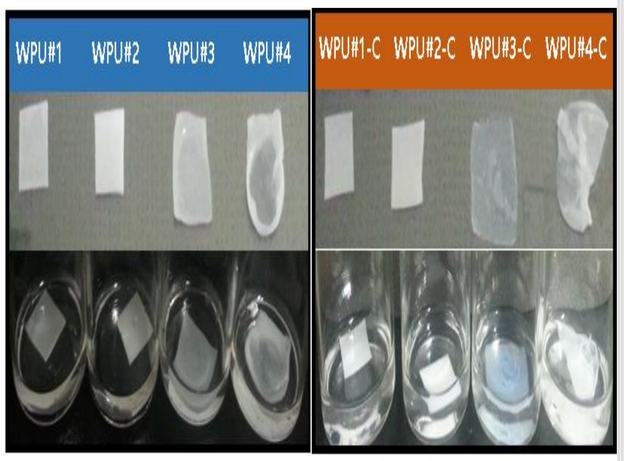
UTM



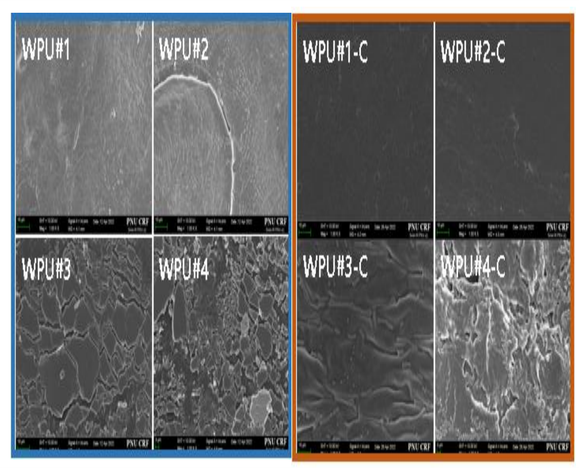


Series	Tensile Stress (MPa)	Strain (%)	Load (N)
WPU #1	12.28	1247.3	773.11
WPU #1-C	16.85	1157.1	611.73
WPU #2	14.10	1474.3	1022.5
WPU #2-C	17.29	1573.5	778.92
WPU #3	16.09	1629.8	1037.2
WPU #3-C	19.12	1980.5	783.28
WPU #4	18.08	1243.4	1212
WPU #4-C	23.47	1453.1	983.75

Enzymatic degradation



FE-SEM



Conclusion

▶ **Synthetic recipes according to the presence or absence of castor-oil in the PCL-based waterborne urethane series showed their potential as a bio-adhesive.**

▶ **As a result of biodegradation evaluation using bio-enzymes, castor oil affects biodegradability, showing the possibility of using biodegradable urethane in the future.**

Acknowledgement

This work was supported by the Technology Innovation Program (20014436, Development of biodegradable polycarbonate material and mass production process technology) funded By the Ministry of Trade, Industry & Energy(MOTIE, Korea)