

# Synthesis and characterization of waterborne polyurethane based on castor oil

Ji-Hong Bae, Kyung Seok Kang, Chan Hyuk Jee, Hyo Jin Jung, Wonbin Lim, Byung Joo Kim, PilHo Huh\*  
Department of Polymer Science and Engineering, Pusan National University, Busan 609-735, South Korea  
\* pilho.huh@pusan.ac.kr

## Abstract

Waterborne polyurethanes(WPU) based on castor oil were successfully prepared using polycaprolactone diol(PCL), castor oil(CO) and 4,4'-methylene dicyclohexyl diisocyanate(H<sub>12</sub>MDI) as soft segment part, dimethylolbutanoic acid (DMBA) as emulsifier, and trimethylamine(TEA) as neutralizer based on different molecular weight of prepolymer. The various properties such as mechanical strength and surface reforming were evaluated using UTM, contact angle, FE-SEM based on the different molecular weight of polyol. Waterborne polyurethanes based on castor oil could be considered as a promising candidate to be applied the various adhesion fields.

## Objective

- To synthesize the biocompatible waterborne polyurethanes (B-WPUs) through two-step processing
- To evaluate the castor oil effect on the mechanical properties of B-WPUs
- To investigate adhesion properties and the enzymatic biodegradability on the surface of collagen

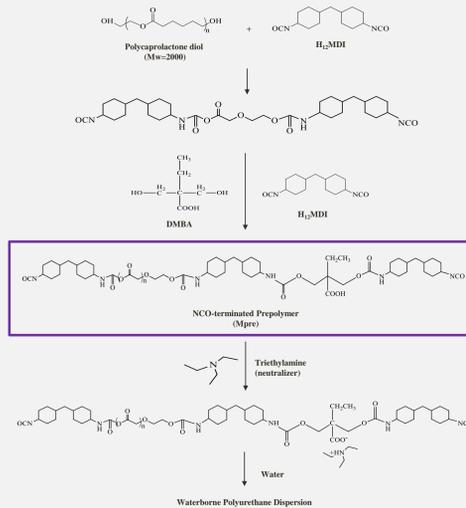
## Experimental

### Formulation

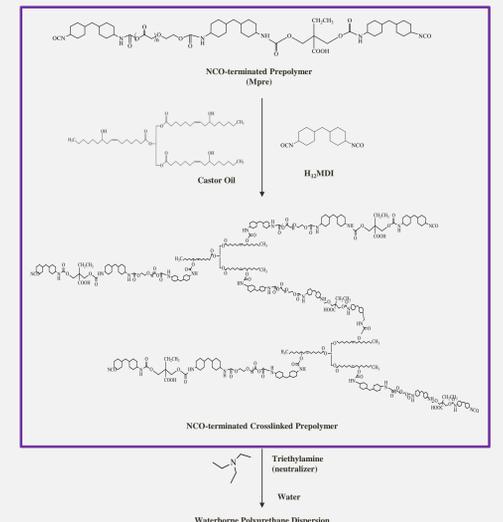
|    | Mpre  | Series  | Soft segment |                     | Ionic group |                     | Castor Oil |                     | TEA    |
|----|-------|---------|--------------|---------------------|-------------|---------------------|------------|---------------------|--------|
|    |       |         | PCL(530)     | H <sub>12</sub> MDI | DMBA        | H <sub>12</sub> MDI | Castor Oil | H <sub>12</sub> MDI |        |
| #1 | 3000  | WPU-3   | 0.0293       | 0.0393              | 0.0101      | 0.0101              | -          | -                   | 0.0101 |
| #2 |       | WPU-3C  | 0.0293       | 0.0393              | 0.0101      | 0.0101              | 0.0050     | 0.0050              | 0.0101 |
| #3 | 6000  | WPU-6   | 0.0310       | 0.0360              | 0.0101      | 0.0101              | -          | -                   | 0.0101 |
| #4 |       | WPU-6C  | 0.0310       | 0.0360              | 0.0101      | 0.0101              | 0.0025     | 0.0025              | 0.0101 |
| #5 | 10000 | WPU-10  | 0.0316       | 0.0346              | 0.0101      | 0.0101              | -          | -                   | 0.0101 |
| #6 |       | WPU-10C | 0.0316       | 0.0346              | 0.0101      | 0.0101              | 0.0015     | 0.0015              | 0.0101 |
| #7 | 30000 | WPU-30  | 0.0323       | 0.0333              | 0.0101      | 0.0101              | -          | -                   | 0.0101 |
| #8 |       | WPU-30C | 0.0323       | 0.0333              | 0.0101      | 0.0101              | 0.0005     | 0.0005              | 0.0101 |

Solid:30g, Ionic group:5wt%

### Scheme 1

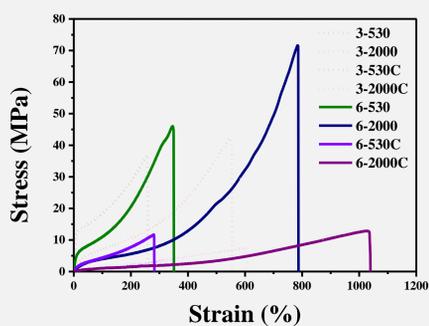


### Scheme 2



## Results

### Mechanical property of WPUs

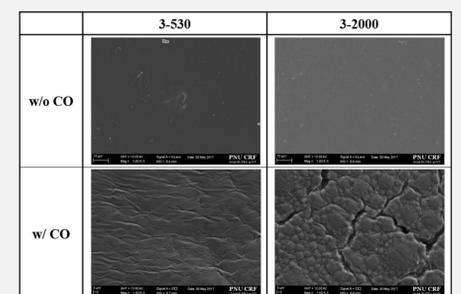


|    | PU Code  | Young's Modulus (MPa) | Stress at break (MPa) | Elongation at break (%) |
|----|----------|-----------------------|-----------------------|-------------------------|
| H1 | 3-530    | 194.91                | 36.77                 | 255.69                  |
| H2 | 3-2000   | 23.24                 | 41.81                 | 551.11                  |
| H3 | 3-530-C  | 0.80                  | 3.54                  | 319.86                  |
| H4 | 3-2000-C | 1.38                  | 2.02                  | 124.86                  |
| H5 | 6-530    | 75.67                 | 46.02                 | 346.94                  |
| H6 | 6-2000   | 8.16                  | 15.51                 | 529.44                  |
| H7 | 6-530-C  | 5.79                  | 11.53                 | 278.61                  |
| H8 | 6-2000-C | 0.72                  | 12.58                 | 1034.86                 |

### Contact Angle Test of WPUs

|        | Series | Mean(°) |
|--------|--------|---------|
| w/o CO | H1     | 85.02   |
|        | H2     | 82.20   |
|        | H3     | 30.82   |
|        | H4     | 25.98   |
| w/ CO  | H5     | 72.73   |
|        | H6     | 71.75   |
|        | H7     | 42.48   |
|        | H8     | 33      |

### FE-SEM image of WPUs



## Conclusion

- A molecular weight series of Castor oil-based B-WPU were successfully controlled
- Mechanical properties can be adjusted to suit particular wound closure

## Acknowledgement

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