Synthesis and Characterization of PEG-Polyurethane for Biomedical Applications

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Hypothesis

PEG-Polyurethane can be optimized for biomedical applications through the characterization of the polymer's structure and function along with analysis of key properties such as molecular weight (MW).

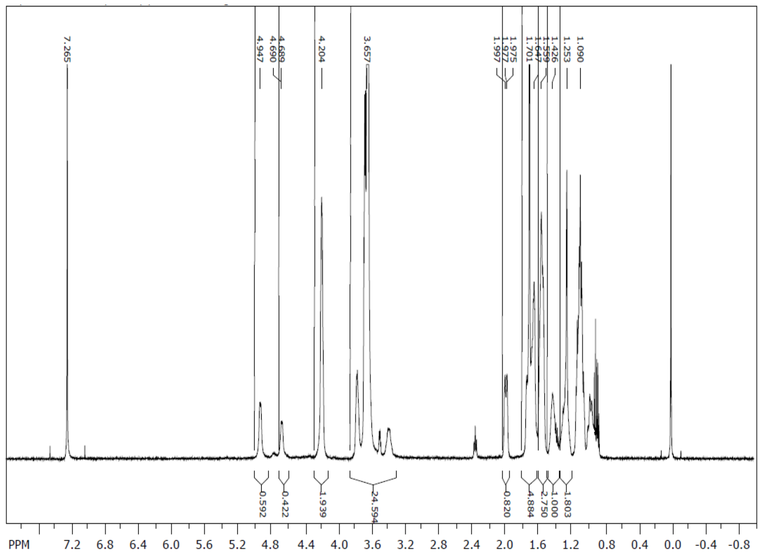
Introduction

- PEG-Polyurethane has shown to exhibit mechanical strength and excellent biocompatibility [1]
- PEG-Polyurethane is being used for biomedical applications such as in catheters, heart valves, and in tissue regeneration [2]
- Improving PEG-Polyurethane properties through varying synthesis conditions can be translated to specific biomedical needs

Methods

- Poly (ethylene glycol) (PEG)-Polyurethane
- Synthesis Conditions
  - -1hr & 24hr
  - - 60°C, 80°C, 100°C
  - -Two Catalysts:
    - Dibutyltin dilaurate (DBTDL)
    - 1,4-diazabicyclo[2.2.2]octane (DABCO)
- Characterization Techniques
  - - H Nuclear Magnetic Resonance (H-NMR)
  - - Fourier Transform Infrared Spectroscopy
  - -Gel Permeation Chromatography (GPC)

Results



Proton	Chemical Shift
Methylene CH_2	1.253
Methylene CH_2(ring CH)	1.426
NH(ring$CHCH_2CH_2$)	1.559
NH(ring$CHCH_2CH_2$)	1.647
NH(ring CH) and OCH_2CH_2	3.657
$C(O)OCH_2$	4.204

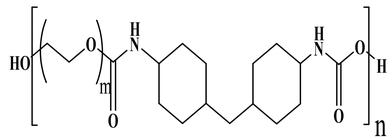


Figure 1: H-NMR Representation of Poly(ethylene) Glycol + Cycloaliphatic Diisocyanate

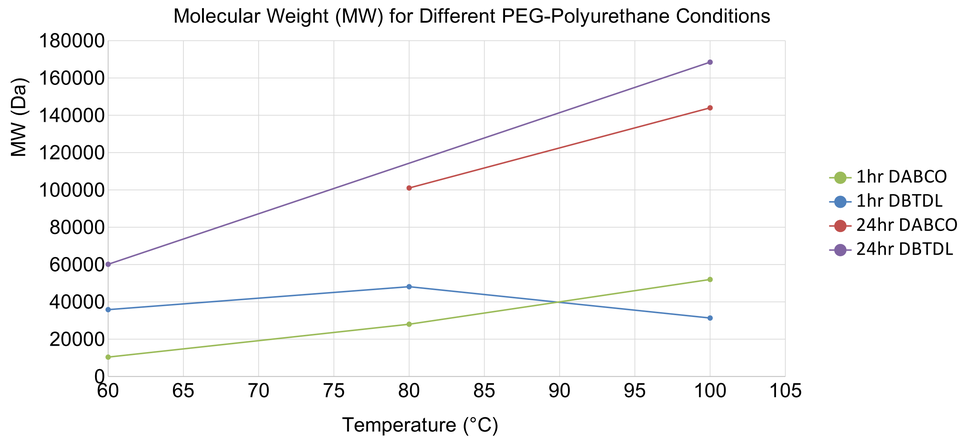


Figure 2: Molecular Weight Based on Synthesis Conditions

Discussion

- H-NMR Characterization illustrates the overall chemical structure of the PEG-Polyurethane polymer
- 24-hour syntheses indicates greater MW when compared to 1-hour syntheses
- Temperature and MW indicate a positive correlation
- Difference in Catalyst (DABCO & DBTDL) makes no difference in overall MW
- Largest MW = 24hr, 100°C, DBTDL

Future Work

- Analyze the swelling capacity as well as the accelerated degradation times of the synthesized PEG-Polyurethane polymers
- Synthesize more polymers with more targeted conditions for optimization

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References

[1] Zhou Z, et al. Cystine dimethyl ester cross-linked PEG-poly(urethane-urea)/nano-hydroxyapatite composited biomimetic scaffold for bone defect repair. J Biomater Sci Polym Ed. 2020 Feb;31(3):407-422.
[2] Guelcher, Scott. "Biodegradable Polyurethanes: Synthesis and Applications in Regenerative Medicine." TISSUE ENGINEERING: Part B, Volume 14, Number 1, 2008.

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