Swelling Behavior of Single-Layered Polyurethane Films for Optimized Drug Delivery

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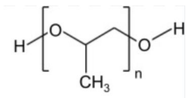
Research Question

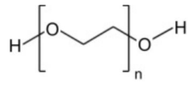
How does the swelling behavior of PPU 4 and PPU 10 influence water absorption and drug transport properties in a controlled drug delivery system?

Introduction

- Polyurethanes (PUs) are versatile polymers used in biomedical applications [1]
- PUs possess unique properties and offers excellent biocompatibility [1]
- Commonly used as biomaterials, especially in cardiovascular applications [1]
- PPU 4 and PPU 10 are synthesized using polypropylene glycol (PEG) and poly-ethylene glycol (PPG) to study the impact of water absorption on drug transport properties



PPG



PEG

Methods

Synthesizing Polymers

- PPU 4 and PPU 10 synthesized using PEG, PPG, catalyst, water, and isocyanate
- Heated in oven for 1 hour to complete polymerization

Film Casting

- Synthesized polymer dissolved in ethanol-water solution
- poured into mold and heated in oven overnight to cast into film

Swelling Test

- Three 1 cm^2 samples of PPU 4 and PPU 10 were soaked in water overnight
- Weighed samples and measured thickness before and after soaking to conduct tests to assess error ratio

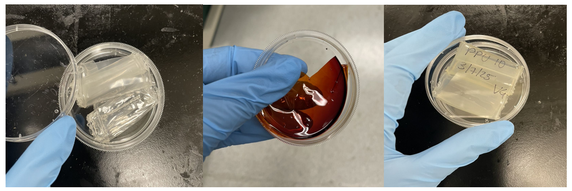


Figure 1. PPU4, drug-infused polymer, and PPU10. All films display smooth, uniform surfaces, with slight differences in density and texture visible between formulations.

Results

Polymer	Sample	Polymer Weight (g)	Polymer + Water Weight (g)	Difference (g)	Swelling Ratio (%)
PPU4	S1	0.072	0.143	0.071	49.65
	S2	0.066	0.134	0.068	50.75
	S3	0.065	0.128	0.063	49.22
PPU10	S1	0.049	0.1	0.051	51
	S2	0.048	0.0974	0.0494	50.72
	S3	0.04	0.0842	0.0442	52.49

Table 1. The table above shows the weight of the polymers (PPU4 and PPU10) before and after water absorption, along with the swelling ratios for each sample. The swelling ratios range from 49.22% to 52.49%, indicating the extent of water absorption, with PPU10 showing slightly higher swelling compared to PPU4

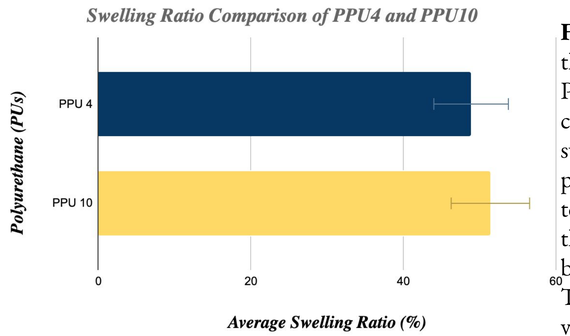


Figure 2. The bar graph displays the average swelling ratios of PPU4 and PPU10 polymers, with corresponding error margins. The swelling ratios represent the percentage increase in volume due to water absorption, highlighting the difference in water uptake between the two polymer types. The error bars indicate the variability in the measurements.

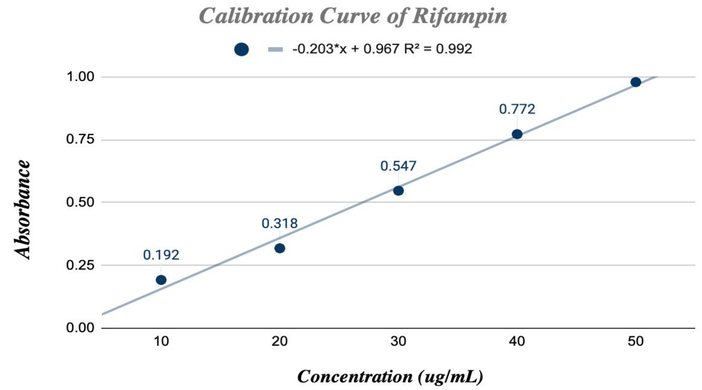


Figure 3. The graph represents the relationship between the concentration of rifampin (µg/mL) and its absorbance at a wavelength of 475 nm, using UV spectrophotometer. The data points were obtained from serial dilutions of a rifampin stock solution, and the linear regression of the data provides a calibration curve that can be used for the quantification of rifampin in unknown samples based on their absorbance values.

Conclusion/Future Work

- The swelling behavior of PPU 4 and PPU 10 significantly impacts water absorption, which directly influences drug release potential
- PPU 10 exhibited slightly higher swelling ratio, suggesting greater water uptake and potential for faster drug diffusion
- Future work will focus on correlating swelling data with actual drug release profiles to optimize therapeutic outcomes

References

[1] Wienen, D., Gries, T., Cooper, S. L., & Heath, D. E. (2023). An overview of polyurethane biomaterials and their use in drug delivery. Journal of Controlled Release, 363, 376–388. https://doi.org/10.1016/j.jconrel.2023.09.036

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