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CHEM 2119-1  
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## Experiment 5: Structure-Property Relationships in Light-promoted Synthesis of Acrylate Network

*Post Lab*

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Resin	Photoinitiator (.5 mole %)	Monomer 1	Monomer 1 mol %	Monomer 2	Monomer 2 mol %	Crosslinker	Crosslinker %
VJ1	BAPO	IBA	100	none	0	<i>Triacrylate</i>	10
VJ2	BAPO	IBA	50	n-Bu methacrylate	50	<i>Triacrylate</i>	10
VJ3	BAPO	IBA	60	n-Bu methacrylate	40	<i>Triacrylate</i>	10

**Table 1.** composition of tested polymers (included this as had to change some of the amounts)

Disk	Height (mm)
VJ1_1	5.70
VJ1_2	5.79
VJ1_3	5.98
VJ2_1	3.48
VJ2_2	4.06
VJ2_3	4.39
VJ3_1	4.51
VJ3_2	5.25
VJ3_3	5.05

**Table 2.** Hight of disks after polymerization

<b>Disk</b>	VJ1 (Water)		n/a		n/a	
<b>Initial Final</b> <b>mass (g)</b>	0.5102	0.4024	n/a	n/a	n/a	n/a
<b>Disk</b>	VJ2-1 (water)		VJ2-2(water)		VJ2-3 (water)	
<b>Initial Final</b> <b>mass (g)</b>	0.3783	.3372	0.0963	0.3092	0.1251	0.3383
<b>Disk</b>	VJ2-1 (hexanes)		VJ2-2 (hexanes)		VJ2-3 (hexanes)	
<b>Initial Final</b> <b>mass (g)</b>	0.3889	0.2450	0.3819	0.2870	0.2596	0.2579
<b>Disk</b>	VJ3-1 (water)		VJ3-2(water)		VJ3-3 (water)	
<b>Initial Final</b> <b>mass (g)</b>	0.4030	0.3780	0.2956	0.3323	0.3051	0.3821
<b>disk</b>	VJ3-1 (hexanes)		VJ3-2 (hexanes)		VJ3-3 (hexanes)	
<b>Initial Final</b> <b>mass (g)</b>	0.2402	0.3102	0.4911	0.3058	0.4091	0.2694

**Table 3.** Swelling data

<b>Disk</b>	<b>VJ1</b>		<b>VJ2</b>		<b>VJ3</b>	
<b>Initial Final</b> <b>mass (g)</b>	0.8270	0.9354	0.7454	0.9252	0.8198	0.9160

**Table 4.** Gel Fraction data (the increase in mass indicates that samples failed to dry)

Water				Hexanes						
		Shrinkage (%)		Swelling (%)			Swelling (%)			Gel Fraction (%)
Sample	Shrinkage (%)	Average	Standard Deviation	Swelling (%)	Average	Standard Deviation	Swelling (%)	Average	Standard Deviation	
VJ1_r1	5	2.94666667	2.378767188	-21.4	n/a	n/a	-17.99	n/a	n/a	113
VJ1_r2	3.5			n/a			n/a			n/a
VJ1_r3	0.34			n/a			n/a			n/a
VJ2_r1	42	33.7266667	7.674537988	-10.86	126.713333	121.8403321	-37	-20.8	18.52673744	124
VJ2_r2	32.34			221			-24.8			n/a
VJ2_r3	26.84			170			-0.6			n/a
VJ3_r1	28	18.78	8.157524134	-6.2	10.4666667	15.78902572	29.1	-14	37.35384853	112
VJ3_r2	12.5			12.4			-37			n/a
VJ3_r3	15.84			25.2			-34.1			n/a

**Table 5.** Full quantitate and statistical resalts of experimentation.

**Experimental write-up**

Looking at the results of the experiment, it is clear that the qualities of the crosslinker played a major impact on the physical properties of the polymers. While all of the monomers used featured nonpolar molecular attributes, the somewhat polar Triacrylate seemed to dictate the molecular affinity of the polymers as seen in the swelling data. The swelling data illustrates this fact as both VJ2 and VJ3 had preferably absorbed water which is a polar compound and failed to absorb hexanes which is a non-polar compound. (Tables 3 and 5) Given that like absorbs like, the swelling data indicates the polymers featured a polar character.

That being said, the monomer make up did play a role as well. Looking at the differences in the swelling data between VJ2 and VJ3, it was clear that the increased presence of n-Bu methacrylate did drive additional polar preference which makes sense given that the species has been shown to be slightly more polar compared to IBA. This increase in polar preference is shown in the swelling data as VJ2 did have higher water absorption compared to VJ3. (table 3 and 5) Additional effects of the monomer were highlighted in the shrinkage data as increased amounts of n-Bu methacrylate also lead to increased amounts of shrinkage. (Tables 1 and 5) Now whether this shrinkage was driven by the sole presence of n-Bu methacrylate or of the

molecular interplay between the n-Bu methacrylate and IBA during photopolymerization is unknown and should be further investigated.

Lastly there are a few things that the given data doesn't describe that should at least be mentioned as further avenues of investigation. First, the increased inclusion of n-Bu methacrylate caused the polymer to change in firmness. When comparing VJ1 which was all IBA monomer to VJ2 which featured a 50/50 split between IBA and n-Bu methacrylate, the ladder polymer was significantly more gel like while the former was extremely rigid. Secondly, the use of BAPO as the photopolymerizer may have played a role in the physical properties. The polymers made had a bright yellow hue to them and when exposed to the hexanes, each of the different variants seemed to further stiffen. Exploring the role of photopolymerizers in the outcome of physical properties may prove fruitful.

When making the claims of this write up, the main data points used were the high and swelling data. This is because the data had clear results and replicates. The gel fraction data was not included as it was evident that the dry samples post reflux weren't actually dry. It should also be mentioned that due to issues getting VJ1 out of the mold, there were some reductions to the ability to replicate some data points.