

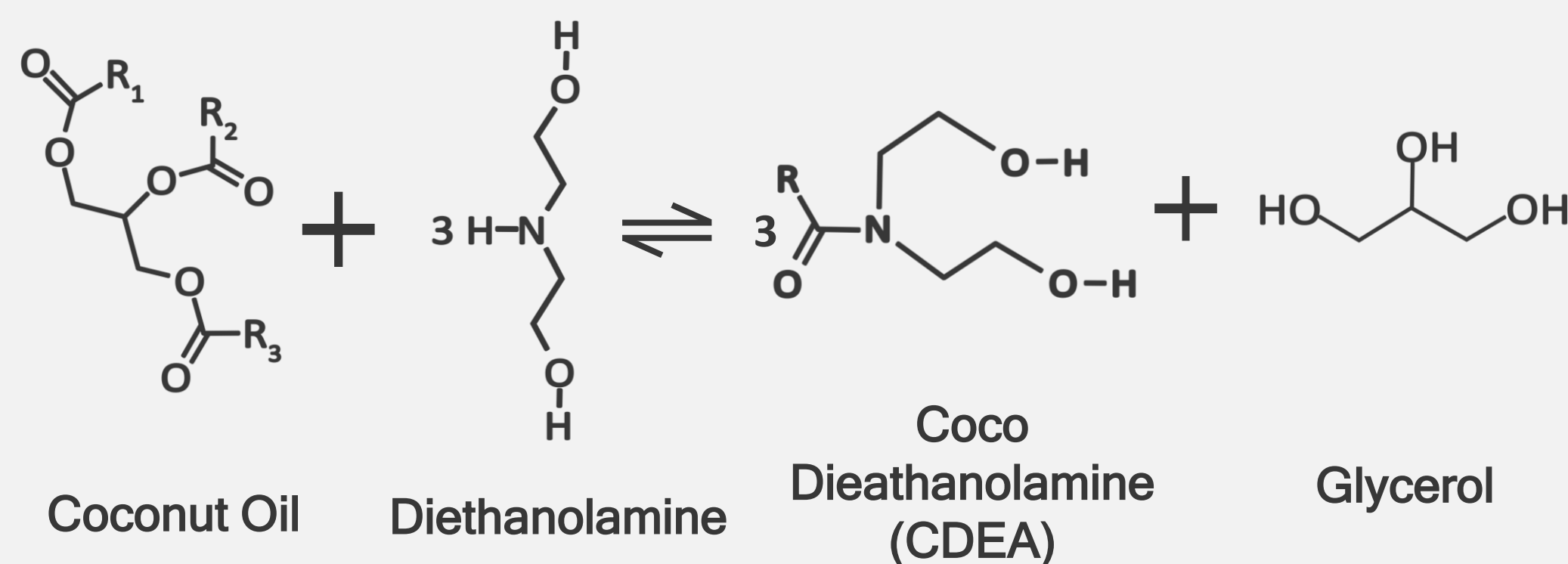
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## INTRODUCTION



Chemical Reaction of Coconut oil and Diethanolamine (DEA)

### Related Studies: Amidation and Prepolymerization

- Bio-based polyurethane (PU) foam from coco diethanolamide (CDEA) exhibits a good thermal conductivity showing a potential in the application of heat insulation.
- The mechanical properties of the foam degrades with increased CDEA addition in the PU system<sup>[1]</sup>.
- Prepolymerization are frequently used to provide materials with superior mechanical qualities, a good melt flow index, and improved thermal stability<sup>[2]</sup>.

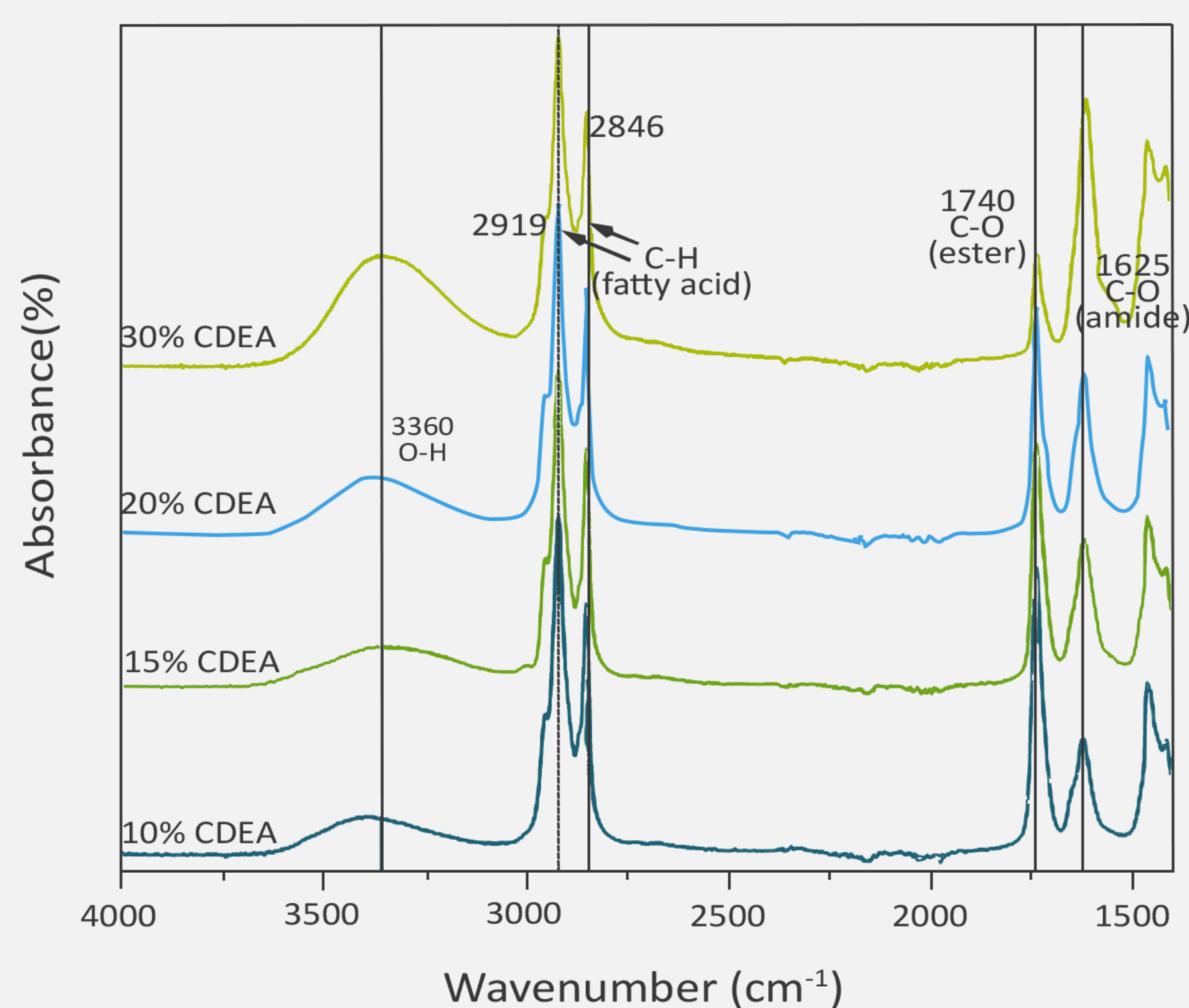
### Purpose of the Study

Obtain a highly-functionalized coconut-oil based polyol via direct amidation with high molecular weight via prepolymerization ideal in the production of bio-based polyurethane-urea (PUA) rigid foams.

## METHODOLOGY



## RESULTS AND DISCUSSIONS



FTIR spectra for varying DEA loading: 10, 15, 20, and 30%

### •Formation of OH and amide groups

- DEA loading was the main contributor in the increase of peak intensity of OH or formation of **hydroxyl groups (3360 cm<sup>-1</sup>)** and **amide groups (1625 cm<sup>-1</sup>)**

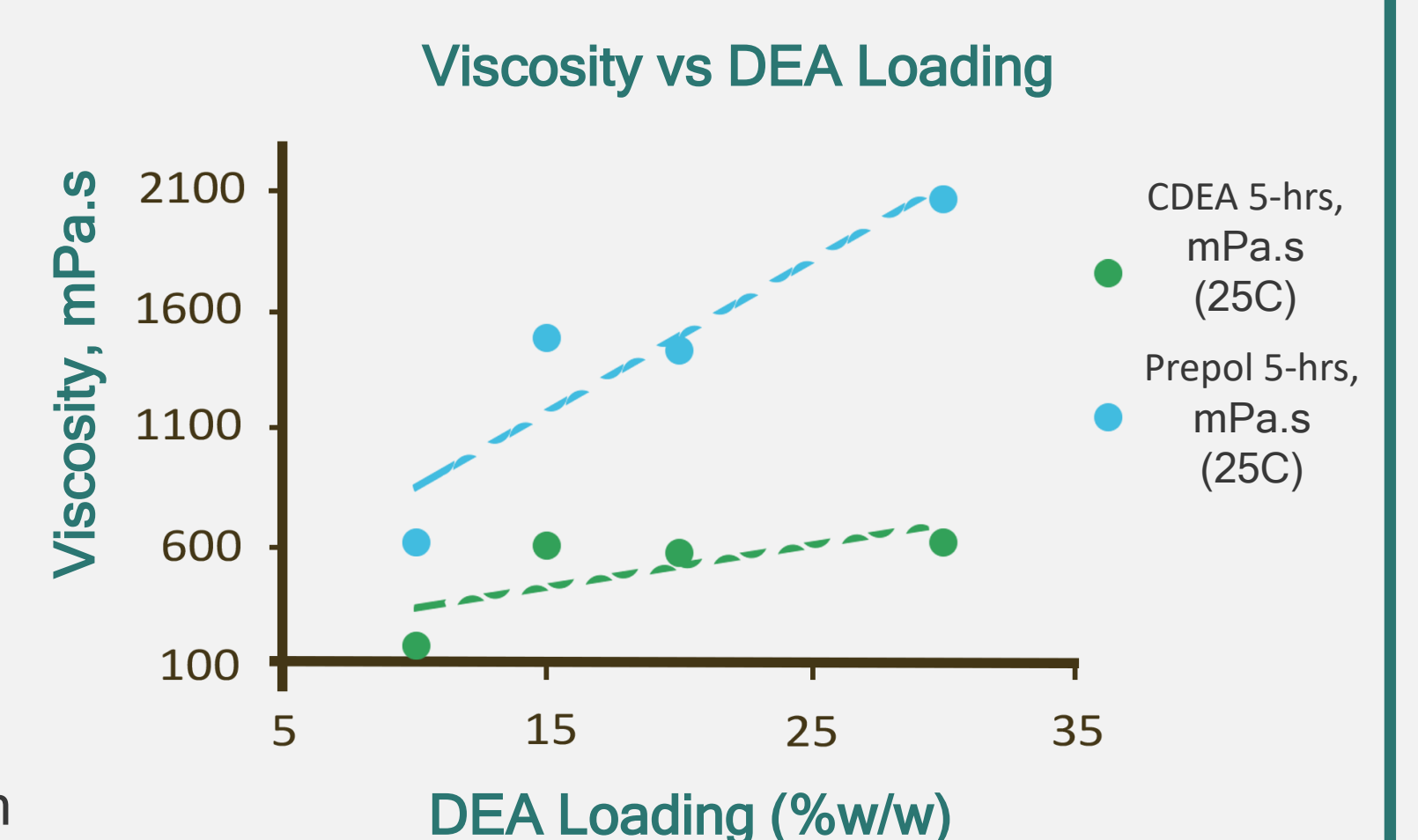
### •Decrease of ester groups

- The **ester groups (1740 cm<sup>-1</sup>)** in the triglyceride of oil also decreases as DEA increases since they react with each other to produce CDEA

- Viscosity increases with increasing DEA loading since more CDEA (higher molecular weight) is formed.

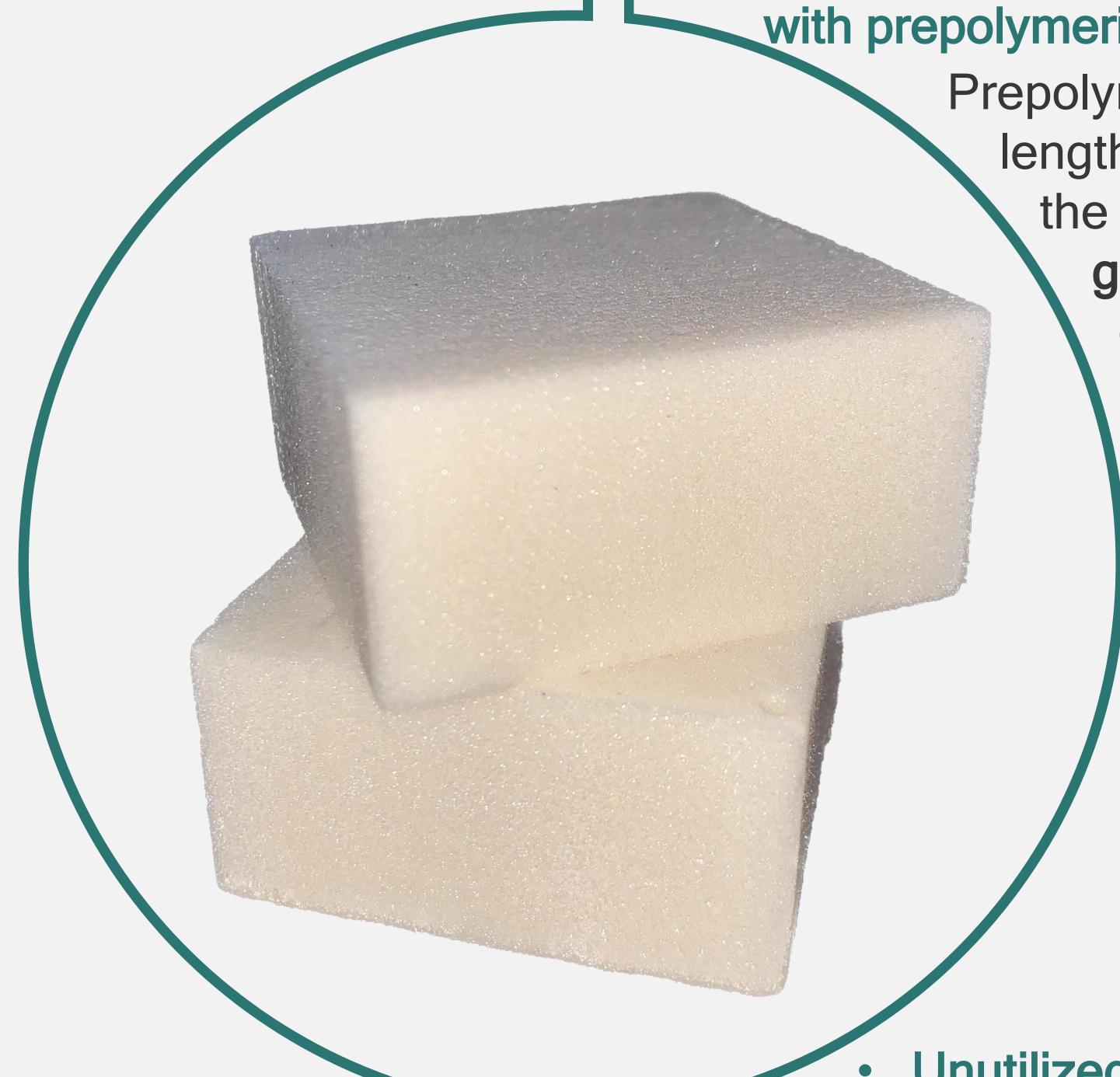
- The viscosity increased thrice with prepolymerization.

Prepolymerization lengthens the chain of the polyol since glycerol acts a crosslinker which increases the viscosity of CNOPOP



- Prepolymerization has influence in the improvement of foam's rigidity. The maximum stress of the foam is **doubled** with the incorporation of prepolymerization.

- The prepolymerized PUA rigid foam has a compressive strength of **538 kPa** - classified according to ASTM standards as **Type 3 for rigid structural sandwich panel core**.



- **Unutilized diethanolamine reacts with isocyanate to form urea during prepolymerization.** Amines generally have a higher reactivity and react faster than alcohols.

Comparison table on the max stress and force of prepolymerized and non-prepolymerized CDEA (140C, 5 hrs, 30 %w/w DEA)

	Max Stress, kPa	Max Force, N
CDEA w/o Prepol	238	608.814
CDEA w/ Prepol	538	1381.56

## CONCLUSION

In this work, direct amidation and sequential prepolymerization was successfully incorporated into PUA rigid foam synthesis with the intent of improving the mechanical properties. FTIR spectra of the CDEA confirmed that with increasing DEA loading, the peak intensity of hydroxyl groups increases as well. DEA loading and prepolymerization was the main contributor in the increase of viscosity. Enhancement of compressive strength of PUA foam is attributed to the increased viscosity, cross-linking, and lengthening of polyol chain during prepolymerization.

## ACKNOWLEDGMENT

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