

IOWA STATE UNIVERSITY

Materials Science & Engineering Department

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Final Oral Examination
PhD Student with Michael Kessler

Wednesday, April 16 · 11:00 AM · 1030 Morrill Hall

“Polyurethane Films, Foams, and Nanocomposites Prepared From Vegetable Oil Based Polyols”

Polyurethanes are an important class of polymers with an exceptionally versatile range of properties and applications, such as elastomers, foams, coatings, adhesives, and fibers. Historically, the vast majority of the polyols and isocyanates used as the starting materials for the polyurethanes production are derived from petroleum. Recently, environmental concerns and the increasing price of crude oil have triggered great interest in the development of materials based on renewable resources, such as cellulose, starch, natural oils, and sugars. Vegetable oils are among the most promising options; they offer excellent properties, including ready availability, inherent sustainability, and relatively low cost.

In the study, two novel methods were developed to prepare 100% bio-based high functionalities polyols from various vegetable oils, resulting in polyurethanes exhibiting a wide range of thermophysical and mechanical properties from soft and flexible elastomer to hard and rigid plastics. The kinetics of the ring opening reaction in the synthesis was also studied. The resulting polyurethane films and foams were characterized and compared with that from petroleum-based polyols. Furthermore, nanocomposites reinforced with modified lignin and carbon nanotube were prepared and characterized. The bio-based polyurethane products may find applications in protective coatings, building construction, and medical device as partial or total replacements for petroleum-based counterparts in future.