

**Environmental Engineering**

**and Earth Sciences**

**EEES Department Seminar**

**‟** **The Rational Design of Lignin-derived Polymer Structures Engineered for Chemical Recycling”**

**Presented By**

**Dr. Srikanth Pilla**

*Robert Patrick Jenkins Endowed Professor Founding Director, Clemson Composites Center*

<https://clemson.zoom.us/j/5783910968>

**Abstract**

The environmental crisis caused by the modern accumulation of plastic waste has driven many to search for a circular lifecycle for commodity plastics. The synthesis of new plastics for a sustainable economy has often looked towards biobased sources without incorporating an inherent design for recyclability. In this work, we report the results of a study aimed at recycling lignin-derived non-diisocyanate polyurethanes and track the structural alteration that occurs to recycled precursors. Lignin composes about 30% of natural biomass and is the largest source of aromatic carbon on earth. The use of lignin comes with opportunities and challenges. Lignin is a reactive, heterogeneous polymer that is prone to side reactions that reduce its functionality and value as an aromatic precursor to polymer synthesis. Starting from a patent-pending protocol developed in our lab for non-isocyanate polyurethane foams, a hydrolytic chemical recycling technique is used to revert waste polymers back to their precursors: lignin and a bio-derived curing agent. In addition, through the use of vulnerable "molecular zippers" throughout the polymer structure, native structural features of lignin can be regenerated during chemical recycling. By exploring additives during chemical recycling, the prospect of enhancing recycled feedstocks is explored. Finally, recycled precursors are used to synthesize a second generation of polyurethane foams and the physical and mechanical properties are compared the first generation. This study opens a unique window toward understanding how lignin can be used in the rational design of polymer structures specifically engineered to undergo chemical recycling at their end of life.

A person wearing a suit and tie

Description automatically generated**About the Speaker:**   
Dr. Srikanth Pilla is the Robert Patrick Jenkins endowed professor, and the founding director of Clemson Composites Center at Clemson University. He earned his doctorate in mechanical engineering from University of Wisconsin-Milwaukee with a postdoctoral training from Stanford University. Prior to joining Clemson, Pilla worked as an Assistant Scientist at University of Wisconsin-Madison. Pilla also spent time in industry having worked at SC Johnson and SuGanit Biorenewables as R&D scientist. Pilla’s research interests are in the fundamentals and applications of sustainable and lightweight functional materials and manufacturing. Encompassing “Circular Economy” and “Sustainable Engineering” domains, Pilla’s created **Circular Engineering** concept builds on the foundations of “Materials Genome Initiative”, and “Hybrid and Intelligent Manufacturing Technologies”. Specifically, Pilla’s work enables informatics- driven materials and manufacturing discoveries of concepts that DRIVES (Driving Research and Innovation for Value-added Environmental Sustainability) the world on a true sustainable path. Pilla has co-authored over 125 peer-reviewed archival publications. He edited the world’s leading handbook in bioplastics and biocomposites and four SAE-Progress in Technology Series books. His research is supported by NSF, DOE, USDA, DOD, NIH, and NASA, besides several foundations and industries including automotive OEMs, and their suppliers. His research has created over $31M of funding. Pilla’s efforts in research and engineering education have garnered him numerous awards, including the 2019 SPE Composites Educator of the Year Award, 2019 McQueen Quattlebaum Award, 2018 SC Governor’s Young Scientist Award, 2018 University of Wisconsin GOLD Award, 2017 BEPS Outstanding Young Scientist Award, 2017 Stefan Pischinger Young Industry Leadership Award, 2017 SAE Ralph R. Teetor Educational Award, 2017 Forest R. McFarland Award from SAE, and 2016 Robert J. Hocken Outstanding Young Manufacturing Engineer award from SME.

***Friday, November 20, 2020***

***2:30 PM***

***Online via Zoom***

***“Attendance is mandatory for graduate students enrolled in EES 8610, EES 9610, and GEOL 8510.”***