

## ***Thermo-Mechanical Recycling of 3D Printed Formwork: Characterization of Thermoplastic Composite Rheological Properties***

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### **Abstract**

Interest in sustainability has steadily increased over the past few decades. With an increased awareness of human impacts on the natural and built environments, sustainability efforts across all sectors have increased; the transportation infrastructure and construction sectors being no exception. In conjunction, adaptation of the large-format additive manufacturing process has presented an opportunity to recycle and reuse material. The purpose of this work is to experimentally characterize two additively manufactured thermoplastic composite materials, with applications as formwork for concrete, over several recycling cycles. Additionally, this work is interested in the use of novel bio-based materials in the place of traditional synthetic materials. Presented in this poster are the experimental findings for the changes in rheological properties over the course of one recycling cycle. These properties include the complex viscosity, complex modulus, and the apparent viscosity of both the bio-based and synthetic materials. These properties are significant because they directly relate to the processability of the material during manufacturing. Therefore, retention of these properties is crucial in ensuring the viability of the recycling process. The experimental results showed that both material systems experience degradation of the apparent viscosity; with the bio-based material seeing a reduction of approximately 120% and the synthetic material seeing a reduction of approximately 65%. Similarly, the complex viscosity and complex modulus of the bio-based material was reduced following recycling. However, there was no statistical significance between the complex modulus and complex viscosity of the synthetic material before and after recycling.

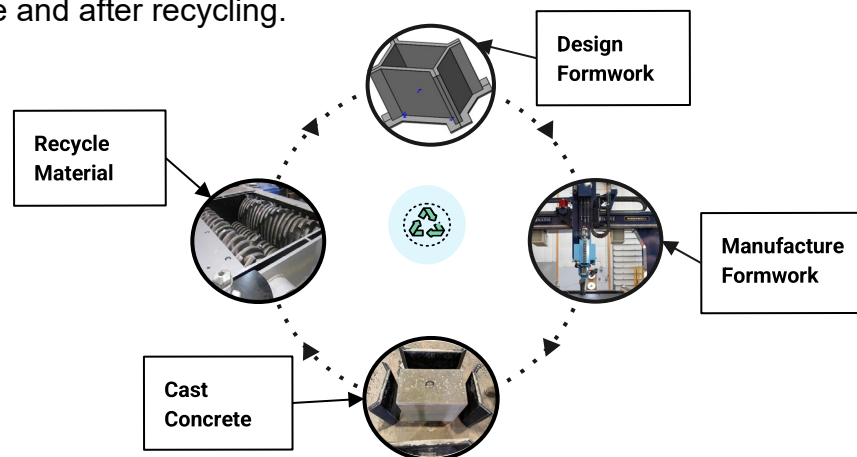


Figure 1: Circular life of AM formwork for concrete casting

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