WiSys TECHNOLOGY FOUNDATION

WiSys Ref: T180031

Low Cost Bio-based PLA and Lignin Thermoplastic Composite Filaments for 3D Applications

Market and Background

The 3D plastic material market is projected to reach a value of more than $1.9 billion by 2023, representing a CAGR of 26.1% over 2017. Within this, the filament form segment is expected to experience the highest growth rate. Key drivers leading to this rising demand include increased use in industries such as aerospace, electronics, automotive and healthcare, and heightened interest in bio-based plastics.

Among the most common thermoplastics currently used in 3D printing are ABS (acrylonitrile butadiene styrene) and PLA (polylactic acid). ABS is a petroleum derived plastic that is prone to warping during 3D printing and is not biodegradable. PLA is made from more environmentally friendly renewable resources, but it has been found to be brittle. Previous attempts to overcome these deficiencies by creating biocomposite polymers using PLA and Kraft lignin have achieved limited success.

Research and Development Status:

Invention description. University of Wisconsin-Platteville professors in engineering and chemistry have developed a proprietary production process for creating novel thermoplastic biocomposite polymers for 3D printing applications using renewable agriculture and forest waste materials. These polymers are a blend of plant-based PLA combined with lignin extracted from wood by the organosolv method. Pellets and long-strand filaments made from these biocomposites are suitable for additive printing using extrusion-based printers and offer several advantages over preexisting filaments, including reduced material cost, adjustable mechanical properties, potential flame retardation, ultraviolet shielding and biodegradable properties.

Stage of development. Polymers with up to 40 weight percent organosolv lignin have been produced and have demonstrated good rheological properties that enable material flow and sustained filament formation. Extruded filaments made with this technology have been 3D printed into samples. Initial mechanical tests and scanning electron microscope fractographic analysis of these samples indicate the biocomposite filament possesses comparable strengths and better toughness than PLA. Mechanical and thermal properties were further verified by additional tests conducted in the laboratory and in the field by a prototyping company. It is envisioned that the final product will be a bio-based PLA/organosolv lignin filament spool to be sold by 3D printing material suppliers.

Applications:

- 3D printing using the fused filament fabrication process
- 3D prototyping and manufacturing for a wide variety of uses – automotive, aerospace, medical devices, safety, education, research

Key Benefits:

- 100% renewable materials: lignin waste product from paper industry plus plant-based PLA
- Reduced material cost

- UV radiation shielding
- Potential flame-retardant properties
- Increased incorporation of lignin in composite – 700% enhancement over preexisting Kraft lignin methods

Intellectual Property:

A PCT application is pending for this technology. For more information, please contact Jennifer Souter at jennifer@wisys.org or by phone at 608-316-4131.

Development and Commercialization Needs:

WiSys is currently seeking strategic partners in the 3D printing material supply industry that are interested in further optimizing the formulation of these biocomposites for production-scale manufacturing, ultimately providing a path to market for commercialization.