DEVELOPING 3D PRINTABLE CONTINUOUS NATURAL FIBER REINFORCED POLYPROPYLENE COMPOSITES: PARAMETER OPTIMIZATION USING EXPERIMENTAL AND MACHINE LEARNING METHODS

R. Cai, P. Cheng, Y. Peng, K. Wang*

School of Traffic & Transportation Engineering, Central South University, Changsha, 410075, China

** Corresponding author (kui.wang@csu.edu.cn)*

Keywords: 3D printing; Polypropylene; Natural fiber; Mechanical properties; Machine learning

3D-printed composites have promising potential for application in engineering fields. However, 3D-printed parts have lower mechanical properties than traditional methods processed ones, which limited their application in industry. In recent years, the continuous synthetic fibers reinforced composites have been increasingly developed to improve the mechanical properties of the printed parts. But these fibers brought negative impacts on the environment. Therefore, natural fibers were suggested to replace the synthetic fiber as the reinforcement. As an emerging 3D printing material, polypropylene (PP) has better recyclability compared with the traditional 3D printing thermoplastic materials and it is suitable for multiple remanufacturing sequences. In order to improve the mechanical properties of 3D printed specimens while meeting the requirements of environmental friendliness and sustainable development, a natural fiber reinforced 3D-printed PP-based composite was developed in this study. The composite was manufactured by in-situ impregnated fused deposition modeling process where dry twisted continuous ramie fibers and PP were utilized as reinforcement and matrix, respectively. Inter- and intra-layer bonding properties of continue ramie fiber reinforced polypropylene composites (CRFRPP) with different processing parameters were investigated. Printing parameters of CRFRPP were optimized using experimental and machine learning methods. The mechanical properties of the CRFRPP composites printed with optimized parameters were highly improved compared with printed resin materials.