

Three-Dimensional Printed Jute Fiber Reinforced Composite Using Digital Light Processing Stereolithography Process

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Abstract

Three-dimensional printing, known as additive manufacturing, is an additive process that adds material layer upon layer to manufacture the finished product. It can be accomplished through a variety of processes in which material is deposited, joined, or solidified under computer control, typically layer by layer. The process is significantly different from other conventional manufacturing processes for making three-dimensional objects directly from a CAD model. 3D printing allows for the creation of complex shapes while using less material than traditional manufacturing methods. The aim of this research is to develop a new method based on digital light processing stereo lithography for printing jute fiber-reinforced composite in three dimensions. Jute is a low-cost, high-volume natural fiber that is environmentally friendly. The technique enables direct 3D fabrication without the use of molds. For the fabrication of the reinforced composite, we used the 3D model of ASTM D638. Raw and 1% alkaline (NaOH) solution-treated jute fiber were used with 405nm Ultraviolet (UV) thermoset liquid to make the reinforced composite. Alkaline treatment primarily disrupts hydrogen bonds in the network structure, resulting in a rougher surface. "Green" composites, based on natural fibers derived from plants and biodegradable resins, are in high demand to meet regulatory requirements for recyclability. However, the conventional fabrication methods for composites require expensive facilities and equipment, such as autoclaves and complex rigid molds, which hinder the wide application of composites. The development of ideas is accelerated by 3D printing. The ability to print a concept the same day it was designed reduces the development time from months to days. In our research, we develop 3D printed reinforced composite materials and find out the mechanical properties of the reinforced composite.

Keywords

Additive Manufacturing, Polymer Composites, 3d Printing, Natural Fibers and fused deposition modelling.

Acknowledgements

For the fabrication work, 3D Printing Hub will help to provide technical assistance.

Biographies

Arafath Mohiv is an undergraduate Mechanical Engineering (ME) student at Ahsanullah University of Science and Technology's Department of Mechanical and Production Engineering (MPE) (AUST). His research interests include Additive Manufacturing, Industry 4.0, Product Design & Development, Generative Design, and the Reverse Engineering Process. He is proficient in Solidworks, Matsercam, catia, Ansys, Autocad, Fusion360, Simplify3D, Pura Slicer, Photon Workshop, Cura, Keyshot and the C and Python programming languages. He aspires to conduct extensive research in Additive Manufacturing, Industry 4.0, non-traditional manufacturing processes and so on.

Md Amjad Hossain Khan is an undergraduate student of Mechanical Engineering (ME) under the Department of Mechanical and Production Engineering (MPE) at the Ahsanullah University of Science and Technology (AUST). His research interest includes the area of Design and Manufacturing, Automotive materials, Vehicle maintenance, Advanced material processing, Combustion and Energy Systems, Industry 4.0, Electric Vehicles, Sustainable Product Design. He has achieved prizes and certificates in an International Automobile competition (SHELL ECO MARATHON-2018) in Paris, France. He has also participated in various technological competitions in Bangladesh like AUST ROVER CHALLENGE, Science fairs etc. He has completed his internship program at Bangladesh Power Development Board (BPDP), Ghorashal Training Centre, Narsingdi (Ghorashal Power Plant Station) as a Trainee Engineer. He has basic idea over Solidworks, MATLAB, ANSYS, AutoCAD, CNC programming and operation. And also have knowledge on programming languages JAVA, C, C++, Python. He wishes to conduct substantial studies in Design and Manufacturing, Automotive materials, Vehicle maintenance, Advanced material processing, Combustion and Energy Systems, Industry 4.0, Electric Vehicles, Sustainable Product Design etc.

Jonaed Hossain is an undergraduate student of Mechanical Engineering (ME) under the department of Mechanical and Production Engineering (MPE) at Ahsanullah University of Science and Technology. He has great interest in 3D printing, composite material and industry 4.0. He has good experience in product design and development. He has short time industrial training at Bangladesh Industrial Technical Assistance Center (BITAC) and also taken part different kinds of tech based competition throughout his educational career.

Dr. M. Azizur Rahman is an Assistant Professor in Industrial and Production Engineering (IPE) under the department of Mechanical and Production Engineering (MPE) at Ahsanullah University of Science and Technology (AUST), Dhaka, Bangladesh. He is a member of IEB (Bangladesh), OCIEBS (Singapore) and IMechE (UK). Dr. Azizur is a registered Chartered Engineer (CEng, UK). He earned B.Sc. in Mechanical Engineering from Bangladesh University of Engineering and Technology (BUET), Masters in Mechanical Engineering from National University of Singapore (NUS), Master of Science (Logistics) from Nanyang Technological University (NTU), Singapore and Ph.D. in Mechanical Engineering from National University of Singapore (NUS), Singapore. Dr. Azizur is currently serving as a Guest Editor for Special Issue "Intelligent Additive/Subtractive Manufacturing" in Journal Micromachines. He also serves in Editorial, Advisory, and Review Board of IJAMP (International Journal of Advanced Manufacturing Processes), JPSME (Journal of Production System and Manufacturing engineering), AOE (Annals of Engineering). Dr. Azizur has extensive working experience in various manufacturing industries in Singapore. His research interests include Additive manufacturing (3D printing), Metal cutting and Ultra-precision machining, Electrical discharge and Laser beam machining, Micro/nanofabrication, Logistics and Supply chain management, Intelligent manufacturing process for Industry 4.0.

Md. Ershad Khan is an Associate Professor in Textile Engineering under the department of Textile Engineering (TE) at Ahsanullah University of Science and Technology (AUST), Dhaka, Bangladesh. He has 16 years of professional experience in several industries as well as academia. He has completed his B.Sc. in Textile Technology and M.Sc. in Textile Engineering degree from Bangladesh University of Textiles (BUTEX). He is currently pursuing his Ph.D in Chemistry from Bangladesh University of Engineering and Technology (BUET). He was former member of Society of Dyers and Colourists (SDC, UK) and American Association of Textile Chemists and Colorists (AATCC). He is an active member of the Institution of Engineers, Bangladesh (IEB). He has authored a book titled 'Technology

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