ULTRASONIC ASSISTED 3D PRINTING OF RECYCLED ACRYLONITRILE BUTADIENE STYRENE (ABS)

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TABLE OF CONTENTS

ULTRASONIC ASSISTED 3D PRINTING OF RECYCLED ACRYLONITRILE BUTADIENE STYRENE (ABS)

Fused Deposition Modeling (FDM) is one of the common 3D printing processes. However, a large amount of waste is produced due to printing and human errors. Waste has caused an impact on the environment due to its non-biodegradable polymer properties, which require recycling of the waste polymers. However, due to weak interlayer bonding, recycled polymers deteriorate in terms of mechanical properties. Hence, this book provides the effect of ultrasonic vibration on the improvement of mechanical properties of recycled Acrylonitrile Butadiene Styrene (ABS). ABS waste was granulated and extruded into a new filament that was used to print the test specimen. A piezoelectric transducer is mounted onto the FDM printer platform to transmit the vibration thoroughly while printing the test specimen. The ultrasonic frequency of the transducer is controlled at 0 kHz, 10 kHz and 20 kHz. Specimen orientation is controlled at the edge, flat and upright position (X, Y and Z). A tensile test and microstructure analysis were carried out to determine the mechanical properties of the recycled ABS specimen at different ultrasonic frequencies and orientations. Analysis of variance (ANOVA) determined the significant and optimum parameters.

The result of the tensile test shows that there had an increment in Ultimate Tensile Strength in the range (UTS) of 11.03% to 67.61%, an improvement of strain in the range of 1.30% to 45.83 % and an improvement of Modulus of Elasticity (MOE) in the range of 15.24% to 24.18%. The microstructure analysis showed that the number and size of porosities and voids decreased when the ultrasonic frequency increased to 20 kHz. The results of ANOVA showed that ultrasonic frequency and orientation had a significant effect on the improvement of UTS, strain and MOE and the optimum parameter was 20 kHz of ultrasonic frequency and Y orientation. Thus, by improving the mechanical properties of recycled ABS through ultrasonic-assisted FDM printing, the additional post-processing to improve the mechanical properties of recycled ABS can be eliminated.

TING KUNG HIENG received his Master of Science and Bachelor of Engineering (Hons) in Manufacturing Engineering majoring in Manufacturing Design from Universiti Teknikal Malaysia Melaka. He started his professional career as an automation engineer specialising in the digital twin, big data, solving automation gaps and real-time optimization at Top Glove Sdn Bhd. His area of interest includes additive manufacturing, plant simulation, process optimization and polymer recycling.

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HAMBALI AREP@ARIFF is a Professor from the Faculty of Manufacturing Engineering. He received his PhD from the Universiti Putra Malaysia in 2010, his Master's from Loughborough University, United Kingdom, in 2003 and his BEng (Hons) from Universiti Teknologi Mara, Malaysia in 1996. His research of interest includes New Product Development, Concurrent Engineering and Green Manufacturing. He has published more than 60 journals and more than 80 proceeding papers. He received more than 20 international innovation medals, such as Gold Medals (ITEX 2005; Geneva, 2005; MIIEx2016, MTE 2017), special awards (MTE 2017 and CITREX 2021), and also received the Silver medal from Harta Intelek Negara (2018) and many more. In terms of research grants, he received more than 1 million National and Industry research grants as the main principal researcher. He is a Professional Engineer from the Board of Engineers Malaysia (BEM) and currently holds the position of Director of the Advance Manufacturing Centre at University Teknikal Malaysia Melaka.

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