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ADDITIVE MANUFACTURING AND CHARACTERISATION USING DIGITAL IMAGE CORRELATION OF TENSILE PIPE RING SPECIMENS

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Examination of structures and parts of pressure equipment fabricated by additive production techniques is an insufficiently studied area. With the development of new techniques and materials, additive production is becoming increasingly important when it comes to functional replacement parts for different assemblies and devices, in addition to an already established role in rapid prototyping. In order to develop a method for testing the pressure equipment such as pipelines, prototypes of ring-shaped test specimens with a stress concentrator (new pipe ring tensile specimens) are fabricated by different techniques and from various non-metallic and metallic materials. This work focuses on polylactic acid (PLA) specimens fabricated on a Fused Deposition Modeling (FDM) printer. The rings are produced in the axial direction so that the contours of the material obtained by extrusion through the nozzle are loaded with tension during the testing. 3D printed pipe rings are tested on Shimadzu's electro-mechanical universal testing machine. The testing is accompanied by digital image correlation (DIC) on the specimen surface; GOM Aramis system, consisting of two cameras, acquisition equipment, and software, is utilized. This way, the 3D displacement/strain field on the specimen surface is tracked. The obtained results indicate that repeatability of the testing process is possible, and the development of the methodology will be continued in the same direction. In addition to the testing results, this work will include a discussion on the applicability and possible limitations of the proposed testing procedure in analyzing different stress concentrators on pipelines (including corrosion and stress corrosion defects).

Keywords: Pipe ring specimens, Additive manufacturing, Tensile testing, Digital image correlation

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