IMPROVEMENT OF THE ADHESION OF 3D PRINTED CONDUCTIVE POLYMER ON WOVEN FABRICS BY USING 3D NEEDLE-PUNCHING FABRIC

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ABSTRACT

The 3D printing by fused deposition modeling technology (FDM) on textile base materials has been developing rapidly since last years, although it is often more expensive than traditional techniques, but 3D printing can significantly enhance production times of small parts produced in small numbers and for special applications.

The adhesion between the textile base material and the 3D printed polymer is a major factor to control in the process. The main reason for un-adhesion of the polymer material applied by FDM 3D printing on a woven textile is the textile surface characteristics. The weave textile surface is smooth and dense which leads to poor penetration of melted polymer into the textile structure. To mitigate the negative effect of the weave surface a 3D needle-punching fabric has been used. In the present research, we produced 3D needle-punching fabrics by needle punching a layer of non-woven fibers on the surface of weaving fabric with the aim to improve the adhesion between the printed polymer produce by FDM and weaving textile.

To produce the 3D needle-punching fabric a web of cotton fiber was needle punched twice on both sides of a 100% cotton woven fabric.

The 3D printing was done using two different type poly lactic acid (PLA) filaments, a non-conductive and a conductive. The 3D printing was done on both sides (technical front and back of the 3D needle-punching fabric. The obtained 3D printed fabrics were evaluated by testing tensile and peel strengths.

The results of the tests showed that the 3D printing on the front side with 3D needle-punching fabric did not give optimal tensile and peel strengths results especially in the case of conductive filament. Otherwise, the 3D printing on the technical back side of 3D needle-punching fabric increases the peel strength by 50% and the tensile strength by 20% compared with the printing on the woven fabric without 3D needle-punching.

The printing of the conductive PLA filament can be done correctly with a printer nozzle of 0,8mm diameter in order to avoid the clogging of the nozzle by the carbon particle.

The conclusion is that the 3D needle-punching fabric gives the best base to use for the 3D printing by fused deposition modeling technology on woven textile materials.