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The Influence of Microscopic Features on the Self-Cleaning Ability of Developed 3D Printed Fabric-Like Structures Using Different Printing Parameters

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Abstract : Self-cleaning surfaces are getting significant attention in industrial fields. Especially for textile fabrics, it is observed that self-cleaning textile fabric surfaces are created by manipulating the surface features with the help of coatings and nanoparticles, which are considered costly and far more complicated. However, controlling the fabrication parameters of textile fabrics at the microscopic level by exploring the potential for self-cleaning has not been addressed. This study aimed to establish the context of self-cleaning textile fabrics by controlling the fabrication parameters of the textile fabric at the microscopic level. Therefore, 3D-printed textile fabrics were fabricated using the low-cost fused filament fabrication (FFF) technique. The printing parameters, such as orientation angle (O), layer height (LH), and extruder width (EW), were used to control the microscopic features of the printed fabrics. The combination of three printing parameters was created to provide the best self-cleaning textile fabric surface: (LH) (0.15, 0.13, 0.10 mm) and (EW) (0.5, 0.4, 0.3 mm) along with two different (O) of (45º and 90º). Three different thermoplastic flexible filament materials were used: (TPU 98A), (TPE felaflex), and (TPC flex45). The printing parameters were optimised to get the optimum self-cleaning ability of the printed specimens. Furthermore, the impact of these characteristics on mechanical strength at the fabric-woven structure level was investigated. The study revealed that the printing parameters significantly affect the self-cleaning properties after adjusting the selected combination of layer height, extruder width, and printing orientation. A linear regression model was effectively developed to demonstrate the association between 3D printing parameters (layer height, extruder width, and orientation). According to the experimental results, (TPE felaflex) has a better self-cleaning ability than the other two materials.

Keywords : 3D printing, self-cleaning fabric, microscopic features, printing parameters, fabrication
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