

The Colouration of Additive-Manufactured Polymer

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Abstract : The convergence of additive manufacturing (AM) and traditional textile dyeing techniques has initiated innovative possibilities for improving the visual application and customization potential of 3D-printed polymer objects. Textile dyeing techniques have progressed to transform fabrics with vibrant colours and complex patterns over centuries. The layer-by-layer deposition characteristic of AM necessitates adaptations in dye application methods to ensure even colour penetration across complex surfaces. Compatibility between dye formulations and polymer matrices influences colour uptake and stability, demanding careful selection and testing of dyes for optimal results. This study investigates the development interaction between these areas, revealing the challenges and opportunities of applying textile dyeing methods to colour 3D-printed polymer materials. The method explores three innovative approaches to colour the 3D-printed polymer object: (a) Additive Manufacturing of a Prototype, (b) the traditional dyebath method, and (c) the contemporary digital sublimation technique. The results show that the layer lines inherent to AM interact with dyes differently and affect the visual outcome compared to traditional textile fibers. Skillful manipulation of textile dyeing methods and dye type used for this research reduced the appearance of these lines to achieve consistency and desirable colour outcomes. In conclusion, integrating textile dyeing techniques into colouring 3D-printed polymer materials connects historical craftsmanship with innovative manufacturing. Overcoming challenges of colour distribution, compatibility, and layer line management requires a holistic approach that blends the technical consistency of AM with the artistic sensitivity of textile dyeing. Hence, applying textile dyeing methods to 3D-printed polymers opens new dimensions of aesthetic and functional possibilities.

Keywords : polymer, 3D-printing, sublimation, textile, dyeing, additive manufacturing

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