Abstract

3D modelling and printing techniques are spreading in daily life as solutions or implementations of objects production. Among the advantages that these technologies have brought in industrial and niche sectors, the possibility to create, from a digital design, specific solid models and this is at the base of the popular emmlovement in prototyping. Moreover, there are fields such as biomedical and conservation of cultural heritage, where the printing of unique objects that should be placed in “subjects” that are unique at the same way is a peculiarity. Reconstructing a fragmented artifact is a complex and time-consuming process and the use of low-cost techniques of 3D printing for the restoration of missing parts in cultural heritage preservation can be a strong improvement. However, in particular in the latter sector, aspects as long-term durability at environmental conditions (indoor or outdoor environments), compatibility with the object texture and reversibility are significant, therefore mechanical characterization only is not enough. One of the most common 3D printing methods is Fused filament fabrication (FDM)\(^1\), an additive manufacturing technology that builds parts up layer-by-layer by heating and extruding thermoplastic filament where the printing process uses a continuous filament of a thermoplastic material. It allows to create a single specific piece, characteristic why biomedical and conservation fields are taking advantages of these new solutions; printed objects are unique and placed in “subjects” that are unique in the same way. In particular, in the latter sector, aspects as long-term durability at environmental conditions (indoor or outdoor environments), compatibility with the object and reversibility are significant, therefore mechanical characterization only is not enough. Filaments are based on thermoplastic polymers of different chemical nature sometimes enhanced with fillers in order to obtain particular colours or materials effects (e.g. being similar to wood or metal) more than improved mechanical properties. Even though they are composite materials and this change has an effect on their workability and lifetime, aspects are not often taken into consideration by artisans and producers, both.

Therefore, several filaments have been characterized for evaluating the influence of filler addition and changes eventually induced during the printing step, from chemical modifications to VOCs release. In particular, FTIR-ATR, TGA, DSC, Py- and SPME-GC/MS together with mechanical tests have been carried out on original, printed and aged materials. Data have then been compared with specifications supplied by the producers, i.e. printing suggestions and material performances, often without considering work-conditions, neither indicating if suitable for external environment.

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1 Boparai K.S., Singh R., Singh H. Rapid prototyping journal, 22/2 (2016) 281-299
3 Braghieri et al., Oral presentation. Daily seminar “Il restauro nell’era della fabbricazione digitale”, Parma, Italy, 12/2015
The clue of a limited characterization of the commercial materials has risen observing how some filaments are heated up to temperature higher than their offset temperature of degradation. In other cases, a chemical modification has been detected just leaving the unprinted material in a drawer in laboratory environment conditions.

This poster aims at introducing the most peculiar results of this research, underlining materials weaknesses.