

Project Proposal

ACMA 6013 – INDEPENDENT PROJECT

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Project Background

The purpose of this project is to establish the viability of supplied filaments in the manufacture of a limited number of parts requiring anti-static properties. This was intended to be completed using a number of different filaments advertised with Anti-static or conductive properties. A traditional method for manufacturing is to machine the parts from a billet material, often a carbon filled plastic. The cost of the billet material in addition to the cost of the material removed as scrap produces, in theory, a part that is more expensive by volume than a 3d printed replica of the same part.

It is intended to establish the change in properties once the filament has been extruded from that of the stock filament form. This would allow the selection of viable filament from the numerous options available. Given these findings, further testing would be conducted to find the optimal print settings to minimise the resistivity. This test would be completed using a standard sample that would allow settings such as wall thickness and infill density to be altered to provide a noticeable difference when one is present.

Aims and Objectives

A number of aims and objectives are intended to be achieved. This would help establish the viability of using Anti-static to conductive filament to create 3d printed parts with a suitable level of conductive properties to be considered anti-static.

The first objective would be to determine if using a 3d printing filament would produce parts that are acceptable for use in anti-static environments. Applications of anti-static tooling are found in the electronics or chemical industries where static electricity may develop in handling equipment and processing tools.

The second objective is to find a material variation or brand that provides the best performance of static-dissipative properties. It is intended to be completed comparatively using samples and a standardised test. The properties of the material is expected to change after it has been extruded from the printing nozzle. It is often unstated how the base material will behave with the dissipative additives after printing and if the distribution of additives will change. Therefore, a test is required to establish a material that responds well to printing.

The next objective is to optimise the properties of the material through the slicer software parameters. By adjusting these parameters, the properties of the part will change and are used to primarily adjust the strength and mass of the component. Using a recognised method, the slicer settings would be optimised to maximise the static-dissipative properties of the printed part.

Project Work Plan

In order to track the work to be completed, a project plan is required. Primarily there would be allowances for literature reviews, planning, testing and analysis. The project is estimated to begin once the proposal has been approved. The end of the project would be considered the date when the final draft of the report is completed. The project plan is expressed as a Gantt chart and can be seen in appendix One.

Background Research

The use of an antistatic polymers has benefits over the use of other electrically conductive materials like metals. Polymers are generally less dense than most metals which is beneficial in application where the mass is to be minimised. Polymers are commonly used alongside sensitive tissues or materials that would otherwise react to or in the presence of certain metals. Polymers can be used in place of metals but provide a degree of conductivity to power small ancillaries and to eliminate static buildup when it is handled or used to handle static sensitive items (Yi & Abidian, 2016).

Given developments in 3D printing, these specialised parts can be manufactured cheaper and with control over new features that can tailor the properties to the particular applications. An example of this is the manufacture of single polymer parts printed with conductive trace lines to effectively act as a large-scale circuit board for small circuits (Wasserfall, et al., 2020).

The parameter to be measured is the Surface resistance. This is a recognised measure that is often used to compare the static dissipative abilities of a material. The standard used to measure the surface resistance is EN 61340 which dictates the procedure and the equipment used during testing (Holdstock, 2022).

The control variable within these tests can be categorised into process and structural based parameters. Process based parameters include the printing temperature of the nozzle, bed and the print speed. Structural parameters include the layer thickness, the shape of infill, the density of the infill and the thickness of the shell (Prabhakar, et al., 2021). Additionally, parameters that adjust the physical features of the parts like the surface finish can have an impact on the surface resistance (Tang, et al., 2012). It is intended to investigate the impact these parameters have on the surface resistance. Processes like sanding or vapour smoothing are used to modify the surface finish. The exposure of the filler will vary according to these methods and it is intended to investigate the effects of these methods.

Required Materials, Equipment and Industrial Partners

As this investigation is focussed on materials, a number of materials are required for testing. A sample of filament from a number of brands is required. These would be selected according to their advertised static properties. It is intended these materials would be self-sourced, given the small amount of material that is required.

For further testing more material is required to create the necessary samples to produce the desired features. This material is intended to be acquired after the initial material test had been completed and the result from that test has been analysed.

Additional features that may be tested includes post processing methods like vapour smoothing or sanding. Vapour smoothing is a process whereby the component is exposed to a compatible solvent that, in the correct proportions, allows the surface to dissolve and resolidify into a smoother surface. The materials that are involved in this process would also be self-sourced.

A 3d printer is required to produce the samples reliably and with the features to be examined. It is intended to use an available Bambu Lab X1C to produce the samples. This has a hardened extruder and nozzle to prevent wear due to the use of such abrasive filaments.

To measure the results of this test, a surface resistance tester will be used. This testing equipment is owned by the author's place of work and consent has been given for the use of this equipment in the implementation of this investigation. The make and model of the tester is a Megger MIT 415/2 with a two point test probe conforming to EN 61340-2-3.

References

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- Yi, N. & Abidian, M. R., 2016. 10 - Conducting polymers and their biomedical applications. In: L. Poole-Warren, P. Martens & R. Green, eds. *Biosynthetic Polymers for Medical Applications*. Sawston: Woodhead, pp. 243-276.

Appendices

Appendix 1. Project Plan

ACMA 6013: Independent Project



