Interreg France-Wallonie-Vlaanderen

GoToS3
Elasto-Plast

AVEC LE SOUTIEN DU FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL
MET STEUN VAN HET EUROPEES FONDS VOOR REGIONALE ONTWIKKELING

Newsletter Elasto-Plast

07/2020 2020/4

In this newsletter

- Advantages and limits of TPEs 3D printing
- Manufacturing strategies
- Properties of printed parts made of TPEs
- Examples of printed parts made of TPEs

Contact Us

https://interreg-elastoplast.eu/

sebastien.alix@univ-reims.fr

sebastien.charlon@imt-lille-douai.fr

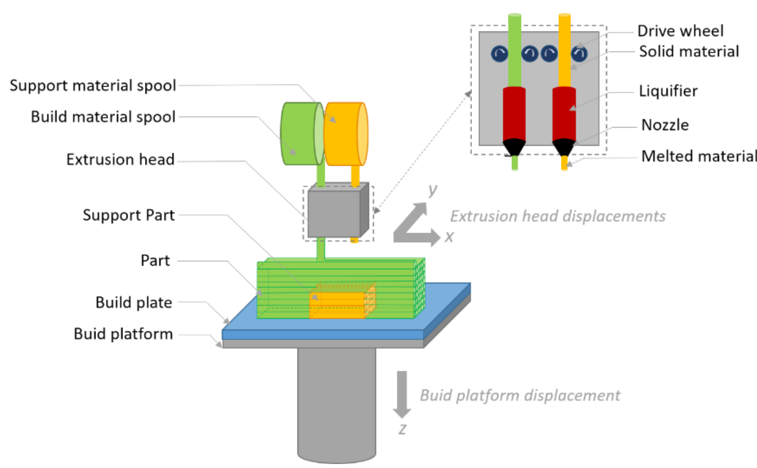
jeremie.soulestin@imt-lille-douai.fr

3D printing of flexible parts made of TPEs

Elastomer thermoplastics (TPEs) are known to be as elastic as elastomers and as easy to be transformed as thermoplastics. Nowadays, complex geometry parts made of TPEs can be manufactured due the recent developments of additive manufacturing technologies.

Advantages and limits of TPE 3D Printing

Several additive manufacturing (AM) technologies allow creating flexible parts such as stereolithography (SLA) or selective laser sintering (SLS). Fused filament fabrication is however the most employed because of its easiness of use and its low cost. In this process, a plastic filament is loaded into a heated nozzle thanks to drive wheels. The solid filament is therefore softened/melted and deposited onto a build plate raster by raster to form a layer and layer by layer to create the hole part.



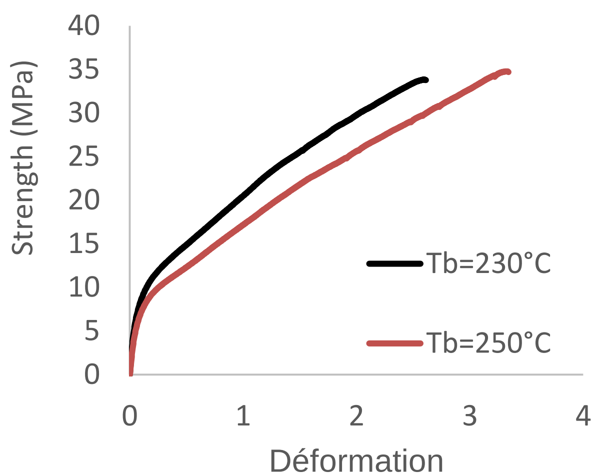
This process allows to easily create parts that could be personalized, functionalized, lightened and/or geometrically complex without using any expensive mould or tools.

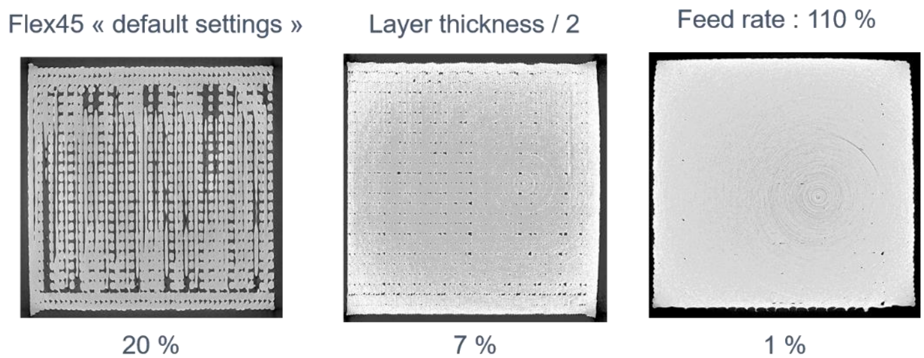
Commercial TPE filaments (most on the time, thermoplastic polyurethane (TPU) are used) are compatible with the FFF process but this kind of raw material is limited due to its lack of diversity in the market and to some alimentation drawbacks into the nozzle with the most flexible TPE (ie: low Shore A). Indeed, the material flow passing through the nozzle is irregular with the most flexible TPEs: the filament tends to be deformed between the drive wheels and the nozzle. Several manufacturing strategies could therefore be employed to limit or to remove these drawbacks.

Manufacturing strategies

Three manufacturing strategies can be envisaged (i) printing low softness TPEs (ie high Shore A) with AM 3D printers fed with commercial filaments, (ii) production of "home-made" filament that would be used for the printing, (iii) using AM machines fed with plastic pellets instead of filaments. In the frame of the Elasto-plast project, the solutions (i) which can be used by everyone and (ii) which can be used by companies were tested.

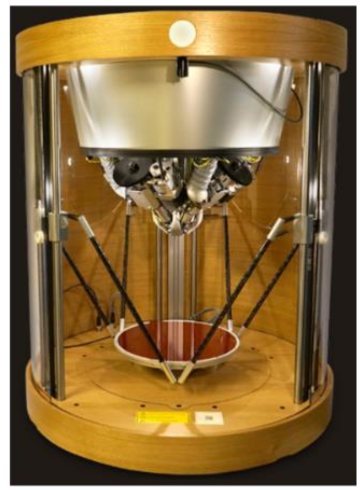
(i) The FFF process is the cheapest and the easiest AM technology to use. Several commercial TPE filaments were tested in the frame of the Elastoplast project: Flex45 and TPU from Dutch Filaments, Flexifil from FormFutura and Istroflex from Nanovia. The internal structure and so the properties of the printed parts made of these filaments strongly depend on the process parameters such as displacement speed, nozzle temperature (Tb), plate temperature, layer thickness and material flow passing through the nozzle.





(iii) Two AM machines were also used to manufacture 3D parts from TPE pellets : Freeformer (Arburg, Allemagne) et PAM (Pollen AM, France).

Freeformer


PAM

The possibility to print flexible parts using these machines was tested using several TPEs (TPU (Elastollan), SEBS (Kraton), Biopolyesters (Hytrel), …). The most thermally stable TPEs seem to be the best candidates to obtain flexible parts. Indeed, non-thermally stable TPEs tend to degrade during the process leading to decrease the quality of the printed part or to fail the printing in extrem cases.

Partners/Partenaires:

Geassocieerde partners/Partenaires associés:

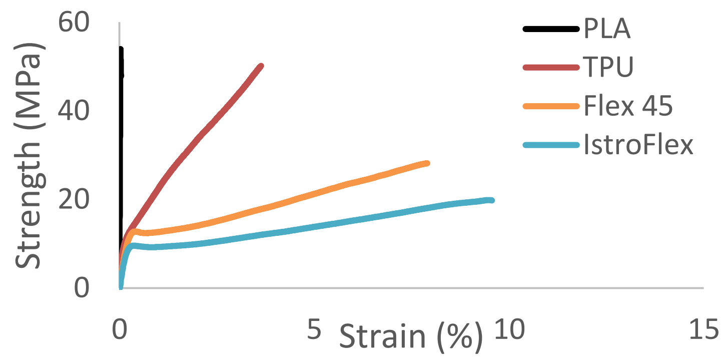
Non-thermally stable material

Thermally stable materials

TPU | TPU | Polyester | SEBS

Properties of printed parts made of TPE

Properties of 3D printed parts depend on several factors such as the chemical structure of the TPEs and on the process parameters. The chemical structure of the TPEs mostly affects the intrinsic physico-chemical properties of the materials while process parameters mostly impact the macrostructure of the printed part like the residual porosity and the dimensional accuracy compared to the CAD model.



The dimensions of the printed parts depend on process parameters but also on the precision of the AM machine.

TPE	Dimensional variations
PLA	0,03 à 5 %
Flex 45	0,06 à 5,2 %
IstroFlex	0,16 à 3,2 %
FlexiFil	0,06 à 5,8 %
TPU	0,02 à 1,8 %

Partners/Partenaires:

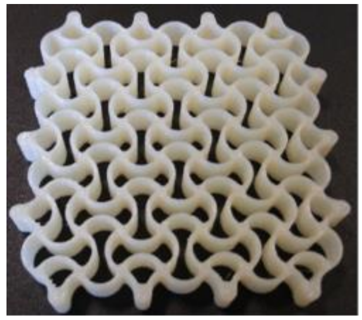
CENTEXBEL · Université de Lille · Université de Reims Champagne-Ardenne · ARMINES · Materia Nova · KU LEUVEN · IMT Lille Douai

Geassocieerde partners/Partenaires associés:

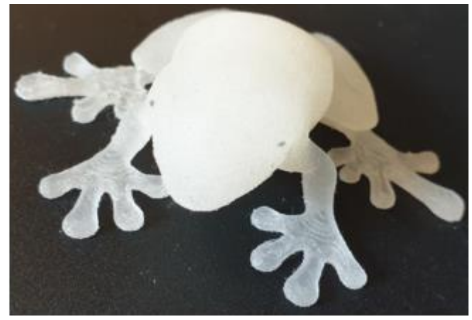
Plastiwin · EuraMaterials · materalia

Examples of printed parts made of TPE

The new technologies allow to easily create personalized parts having complex geometries that cannot be obtained by using common processes.



TPU



SEBS

AM machines were also employed during the COVID 19 sanitary crisis to rapidly provide safety devices to health care institutions. Some of the devices were made of TPE.

Partners/Partenaires:

CENTEXBEL · Université de Lille · Université de Reims Champagne-Ardenne · ARMINES · MATERIA NOVA · KU LEUVEN · IMT Lille Douai École Mines-Télécom IMT-Université de Lille

Geassocieerde partners/Partenaires associés:

plastiwin PLASTICS INNOVATORS · EuraMaterials · materalia

Theoretical and practical session training in TPE 3D printing

During previous events organised by Elasto-Plast, we noticed that knowledge on thermoplastics was concentrated in few companies. Elasto-plast team will provide a "TPE training session" including short conferences giving theoretical knowledge on 3D printing and discussions in front of AM machines in operation in order to disclose TPE knowledge and to encourage the use of TPEs. The **free**-training will be organized in **IMT Lille Douai** on **December 8th 2020**. If you are interested in joining the training session, please subscribe by sending an email to sebastien.charlon@imt-lille-douai.fr or to sebastien.alix@univ-reims.fr.

Elasto-Plast Team

Partners/Partenaires:

Geassocieerde partners/Partenaires associés: