

PROGRAMME DE COOPÉRATION TRANSFRONTALIÈRE
GRENSOVERSCHRIJDEND SAMENWERKINGSPROGRAMMA

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Elasto-Plast

Processing / Structure / Properties relationships of 3D printed polymers and polymer blends

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Cofinanciering



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

From **conventional** to **smart** thermoplastic elastomers

Improving the properties and processability of classic polymers:

- ✓ Increase of impact strength
- ✓ Deformability under pressure, etc.



- ✓ New processing technologies (*3D printing*)
- ✓ High quality textile and plastic applications

Suitable for interesting and innovative industrial applications

In the same context:



Polyactic acid

Biodegradable material 
Low strength (fragility) 



How to improve the impact resistance of PLA ?

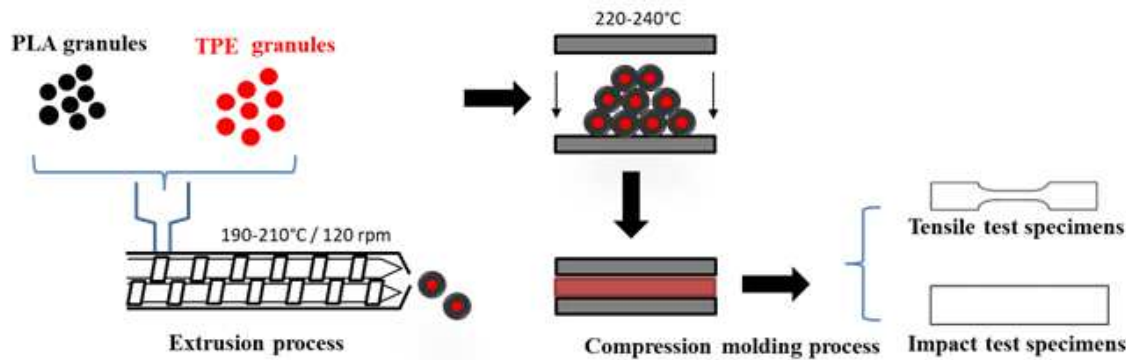
Modification of the mixture composition

↳ *Interesting results*



Addition of a thermoplastic elastomer

Modification of the mixture composition



Process



Tensile test



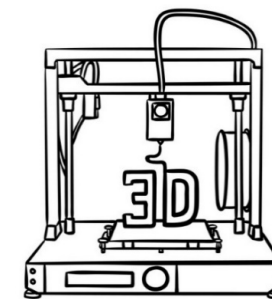
Impact test

PLA-Hytrel-X% blend

Good balance of **impact resistance** and **rigidity** with enough **elongation at break**



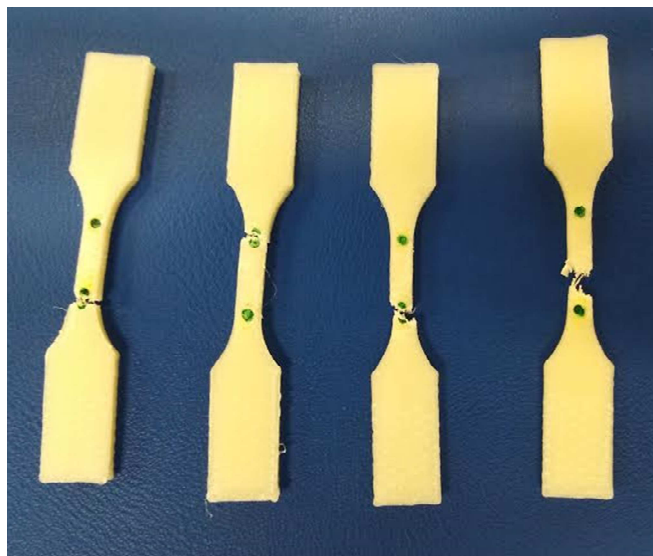
Selected to be tested in FFF printing process



Impact of printing parameters → Nozzle temperature
→ Bed temperature

Printing parameters impacts

Impact of nozzle and bed temperatures



When the nozzle and bed temperatures
↗:

- ✓ Good filling quality → Porosity ↘
- ✓ Young's modulus ↗
- ✓ Ultimate tensile strength ↗

Printing parameters impacts

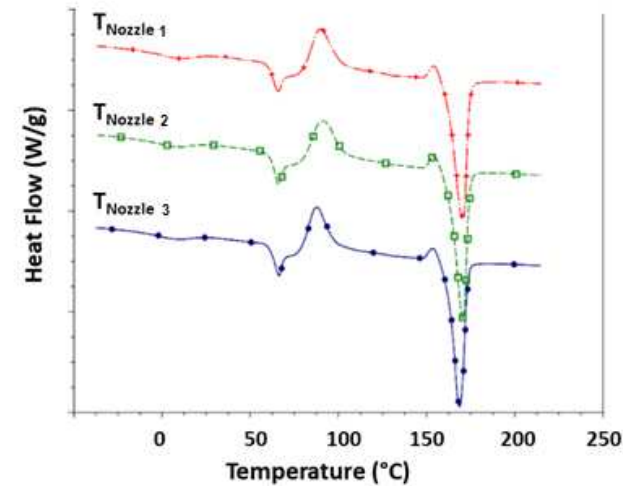
Impact test



When the **nozzle** and **bed** temperatures ↗:

- ✓ Impact energy ↗

Crystallinity

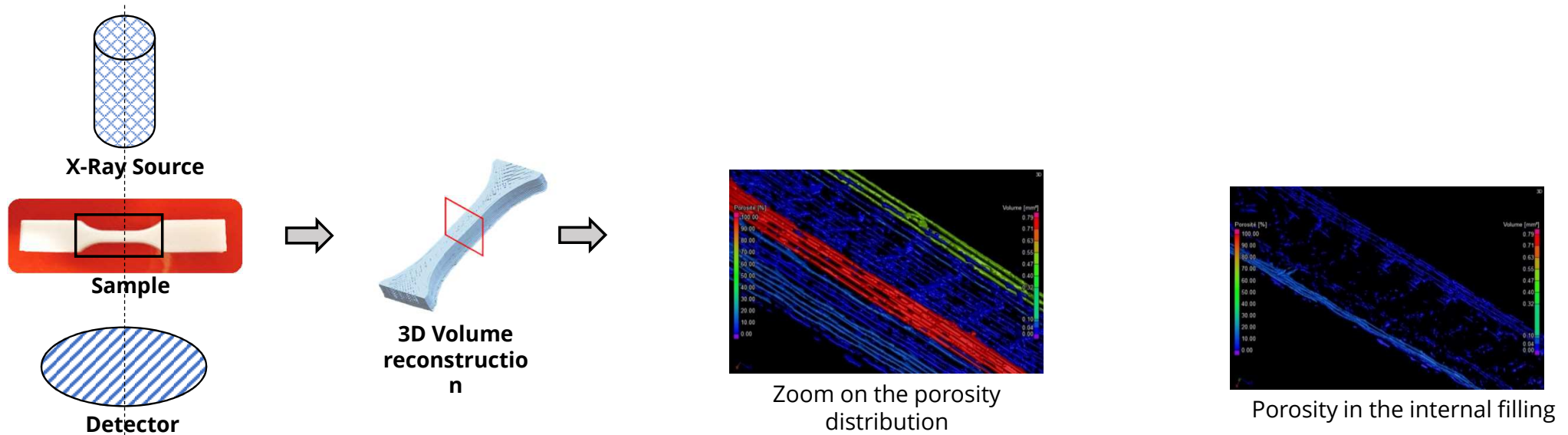


No impact of the **nozzle** temperature on the **crystallinity**

When the **bed** temperature ↗:

- ✓ Crystallinity degree ↗

Tomographic observations



Tomographic analysis

- ✓ Local anisotropy of porosity
Mostly present between the adjacent printed filaments

When the **nozzle** and **bed** temperatures
↗:

- ✓ Reduction of the number and size of pores
- ✓ Good contact surface

Conclusions

PLA / TPE blends:

Small amount of TPE:

- ✓ Enhancement of the impact resistance
- ✓ Increase of the elongation at break
- ✓ Slight decrease of Young's Modulus

3D printing:

Nozzle and **bed** temperatures ↗:

- ✓ Increase in the rigidity and impact resistance
 - ✓ Reduction of porosity
 - ✓ Good contact surface
-
- ✓ No effect of the nozzle temperature on the crystallinity
 - ✓ Positive influence of the bed temperature on the crystallinity behavior

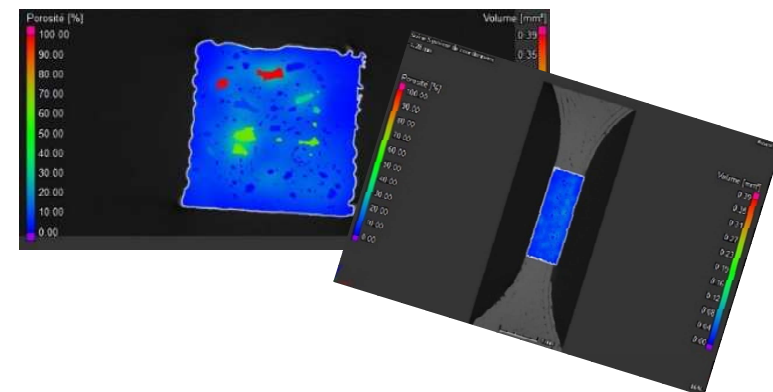
Young's Modulus (Printed parts) < Young's Modulus (Molded Part)



Due to the presence of porosity



Mostly present along the adjacent printed filaments



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d'innovation
Katalysator
van innovatie



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