# Possible processing technologies

## Possible processing technologies for the production of the parts with cool-touch effect

**Content:**



**Scope of the report:** 10 pages

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# 1 Introduction

The so-called "cool-touch effect" can be achieved either using thermally conductive plastic additives or by the use of special processing technologies that apply a more or less thin metal layer to the surface of the plastic. The advantage of the latter method is the possibility of using commercial inexpensive standard plastics and still obtaining manufactured surfaces of parts that give the impression of being made of metal. However, the combination of plastics and metals also poses difficulties due to different material properties, such as differences in thermal expansion. There are also limits to the choice of process technology due to the different processing temperatures required. For example, due to their limited heat deflection temperature, only a limited number of coating processes are suitable for plastic parts. From the WP1 State of the Art report “Manufacturing processes for plastic components with metallic surfaces” two technologies were selected from all the project partners. The first method is the direct production of the injection moulded parts, without any additional processing, with the composites with high thermal conductivity with the addition of metallic Master Batch. The second method is in-mould labelling with aluminium foil. The main disadvantage of IML technology is the 3D forming of aluminium foil, which is for project partners Gorenje and Intra lighting of great importance.

# 2 Selected technologies

From the WP1 State of the Art report “Manufacturing processes for plastic components with metallic surfaces” two technologies were selected from all the project partners. The first method is the direct production of the injection moulded parts, without any additional processing, with the composites with high thermal conductivity with the addition of metallic Master Batch. The second method is in-mould labelling with aluminium foil. The main disadvantage of IML technology is the 3D forming of aluminium foil, which is for project partners Gorenje and Intra lighting of great importance.

For the production of parts with the composites with high thermal conductivity, the prototype tool inserts with 3 different surface roughnesses (Figure 1) could be used. All the produced composites compounds were done at FTPO: compounding, injection moulding and laboratory characterization. As the second step, the prototype tool inserts with 3 different surface roughnesses with PolyMetal & Interreg SI-AT logos and SI-AT maps were used (Figure 2).

For the production of in-mould labelling technology, three different tool inserts were used. First, the flat prototype tool with different surface roughnesses (Figure 1), then tool insert with SI map and FTPO sign in the final step the tool insert with PolyMetal & Interreg SI-AT logos and SI-AT maps (Figure 2) were used. In the first step, the thermoplastics resin in the combination with Al foil applied Hotmelt adhesion layer were tested. After that, the 3D shapes forming directly at IML technology was conducted and as the final step demonstrator from the tool inserts with PolyMetal & Interreg SI-AT logos and SI-AT maps were produced.

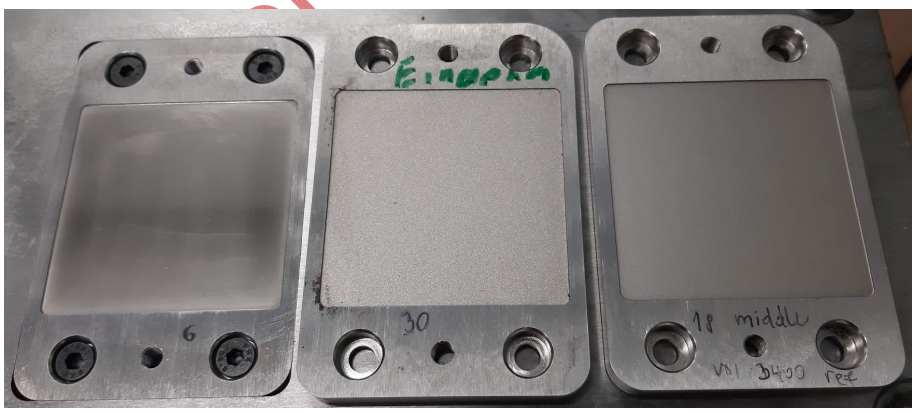


*Figure 1: Prototype tool inserts with different surface roughnesses*

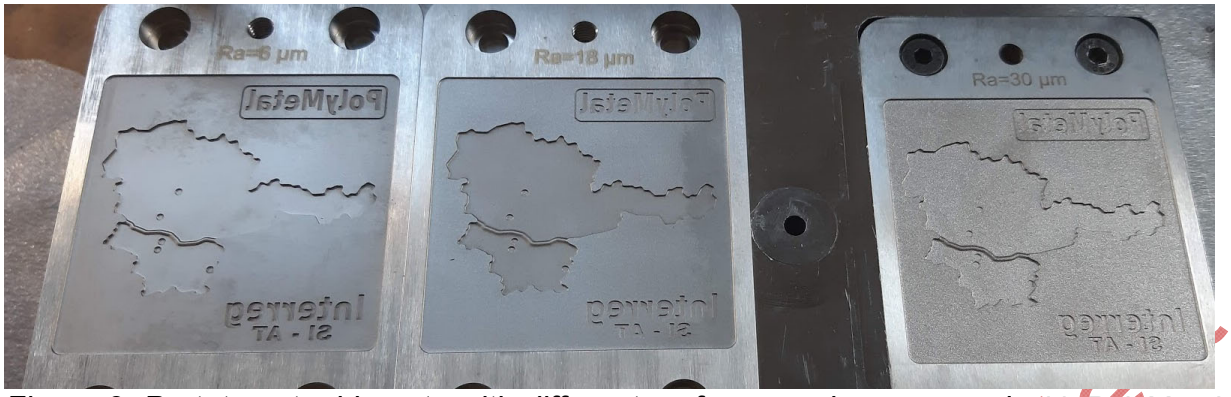


*Figure 2: Prototype tool inserts with different surface roughnesses and with PolyMetal & Interreg SI-AT logos and SI-AT maps*

# 3 Produced prototypes

The production of the prototype was divided into several steps:

- Testing of the filler size and shape influence the surface roughness of the injection moulded parts (Figure 3)
- Influence of the filler content and type on the thermal conductivity of the injection moulding parts (Figure 3)
- Influence of the metallic Master Batch on the optic and haptic of the injection moulded parts (Figure 4)
- Production of demonstrators of the PolyMetal project (Figure 6, 7)
- Influence of the Al foil thicknesses on the optic and haptic of the produced parts (Figure 5)
- Production of demonstrators of the PolyMetal project (Figure 8)

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*Figure 3: Produced samples of the direct injection moulding technology with the composites with high thermal conductivity*


*Figure 4: Produced samples of the direct injection moulding technology with the composites with high thermal conductivity and addition of metallic Master Baches (from top to bottom and left to right: PA 6, PP, ABS, PS, PC) in the prototype tool*


*Figure 5: Produced samples of the IML technology with different thicknesses of Al foils*

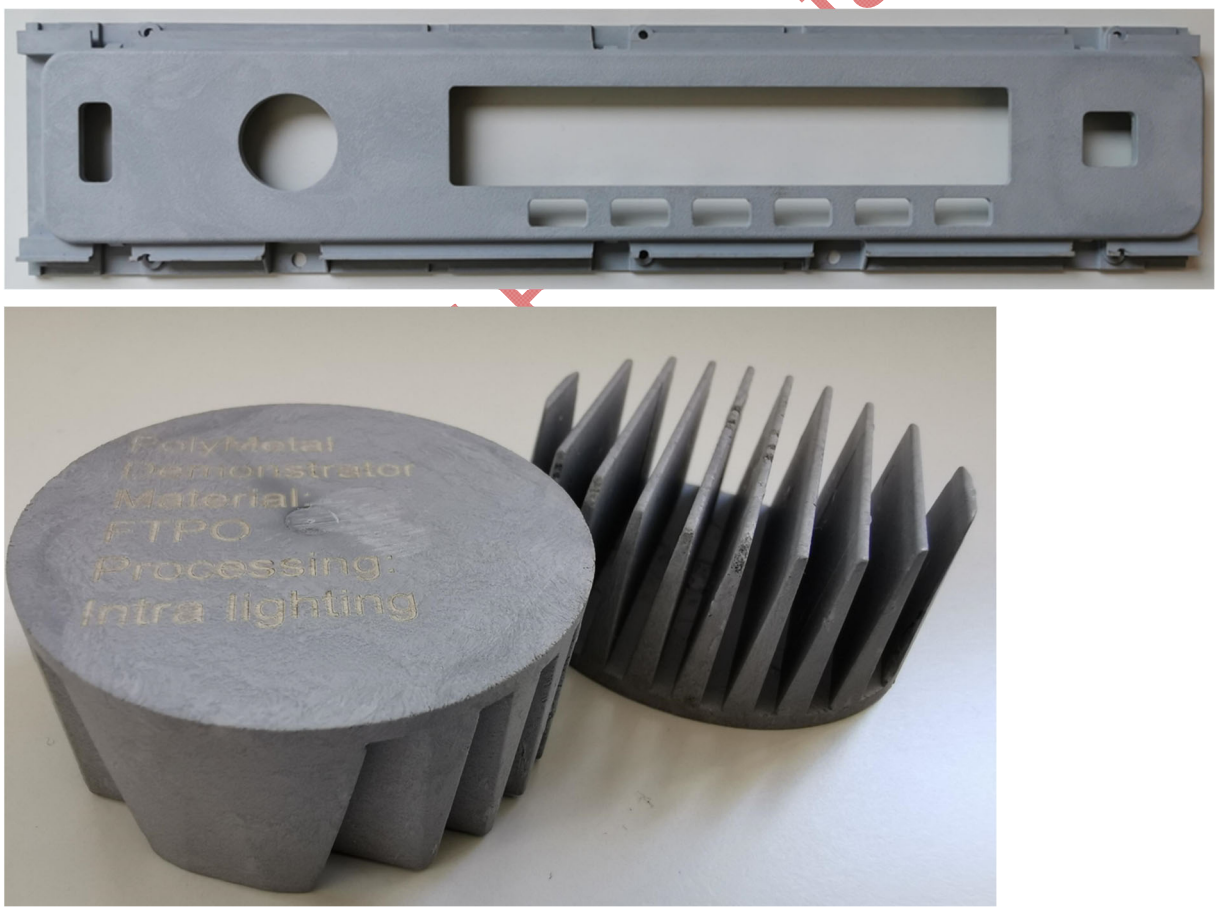


*Figure 6: Produced PolyMetal project demonstrators for Gorenje (top) and Intralighting (bottom)*

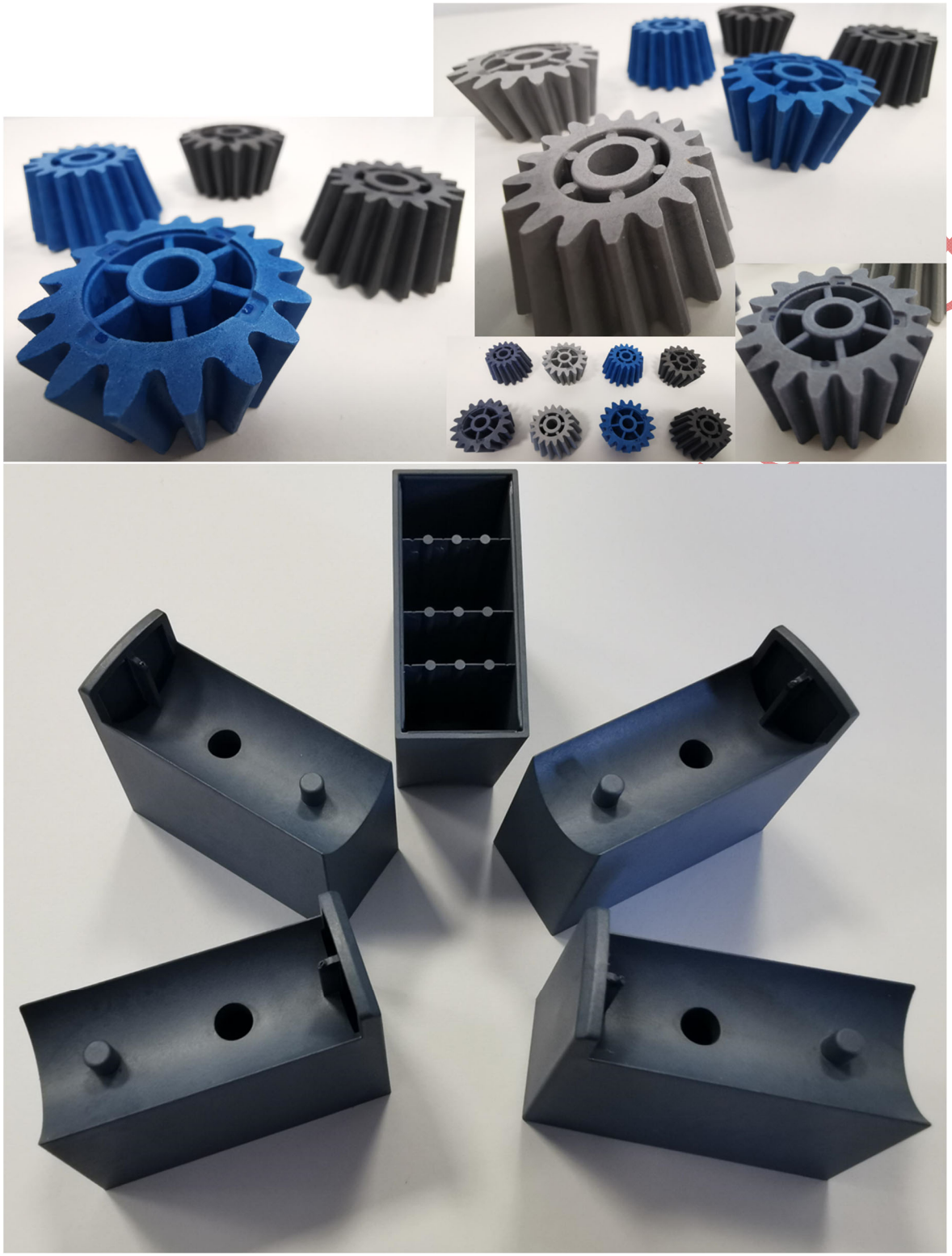

*Figure 7: Produced PolyMetal project demonstrators for Tehnoplast Povše (top) and Tehnomat (bottom)*


*Figure 8: Produced samples of the IML technology in the prototype tool*

# 4 Conclusions

After the State of the Art check, the decision of all project partners was IML technology and the injection moulding technology, without any additional processing, with the composites with high thermal conductivity and with the addition of metallic Master Batch.

At IML technology the different thicknesses of Al foil with applied TPU hot melt as an adhesion layer and with 3D forming in the tool at injection moulding were tested. The best solution was Al foil thickness 0,1 mm, where the optimal optic and haptic properties were conducted.

At injection moulding technology without any additional processing, with the composites with high thermal conductivity and with the addition of metallic Master Batch the addition of 60 % boron nitride was chosen for the demonstrators. The combination of the fillers, especially glass fibres and bigger particle size of talc or CaCO3 lowered the price and had minimal influence on the thermal conductivity of the composites. In this direction, the composites with PP, ABS, PS, PA 6 and PC thermoplastic matrixes were done.

The produced prototypes showed the efficient way to change metallic parts with plastic composites with high thermal conductivity. With the produced composites with high thermal conductivity, we have successfully disseminated the results of the project to two companies and at the Plastics Gears conference, besides the presentations and articles within the project. The project showed good results due to the excellent cooperation of all project partners and knowledge exchange within the project between project partners and also by external institutions. Further research can be conducted with the combination of different fillers besides boron nitride and with different compatibilizers to control the properties of those composites.