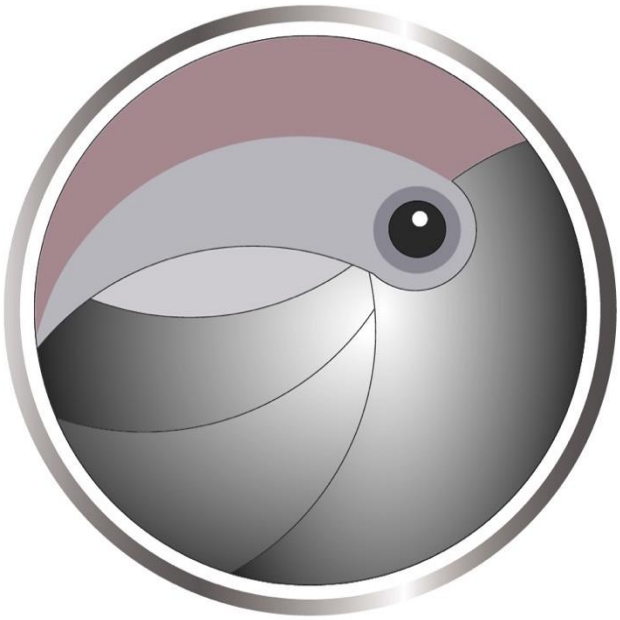

FLAMINGO

Fabrication of Lightweight Aluminium Metal matrix composites and validation In Green vehicles

Deliverable D 6.2
Extrusion of Al-MMCs parts

Lead Beneficiary	Constellium UK (CONST)
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Publishable Executive Summary

This report addresses the experimental activities related mainly to Task 6.2 (Extrusion of Al-MMnCs parts) in the approximately past 12 months, and some additional results from the continuation of Task 6.1 of the FLAMINGo project (Preparation of Al-MMnC 1:1 Scale DC-Casting billet). The main aim of Task 6.2 is to produce Al-MMnC extruded profiles that will be used to manufacture the main demonstrator of the project (rear-frame of ALKE vehicle), while the continuation from the Task 6.1 mostly focused on optimizing and upscaling the Al-MMnC casting recipe from lab-scale to 1:1 Scale casting, which has been ongoing since M19 (Start of Task 6.1) given the complexities in the casting process and associated challenges that have not been fully resolved yet, and which have been comprehensively addressed in D6.1.

From Task 6.1, the key gap for upscaling the Al-MMnC TiC-NP billet casting has been identified, namely, the sedimentation of the TiC-NP in the masterbatch due to density differences between TiC and the Al-melt, which is further intensified by the much higher melt volume and mandatory safety procedure involved in DC-Casting at scale 1:1. This results in a longer casting time, ultimately increasing the probability of the TiC particles to sediment in the bottom of the crucible before casting. This has also been observed during fire assay tests, where a sludge/sediment has been found at the bottom of crucible in the end of the casting, and confirmed through sedimentation experiments at lab scale. This observation corroborates the importance of maintaining the TiC-particles suspended in the melt and minimizing the melt holding time before casting. The investigations have indicated that he positions of the stirrer with respect to the bottom of the crucible would also enable a better dispersion of the nano-particles. The conditions for the addition method of TiC-NP masterbatch into the melt and ultrasonic treatment time also seem to be factors affecting the incorporation and dispersion of nanoparticles into the melt and their homogeneous distribution in the billet. These findings will be used as inputs for the next billet casting campaigns aiming at obtaining the final version of the recipe for billet casting.

Related to Task 6.2, extrusion trials using the preliminary Al-MMnC cast billets (with Ti levels up to 0.17wt.% Ti), which were extruded into different geometries (i.e. bumper beam and 50 mm wide flat-extruded strips) showed that no damage or wear from the presence of hard TiC NP have been observed in the extrusion press and tooling. Al-MMnC materials for weldability evaluation also have been sent to ISQ. From preliminary Al-MMnC material, we compared the tensile strength between samples machined from 1:1 Scale DC-casting billet and samples taken from extruded profile, and found no strength difference between HCA6.300 reference against its NP-TiC counterpart. On extruded material, we also perform evaluation using different aging properties (T6 and T7), and also found similar trend – no tensile strength difference between reference materials as compared to NP-TiC counterpart with different aging temper. This confirms the materials processing route such as artificial aging and extrusion process of the HCA6.300 NP-TiC does not affect the strengthening of nanoparticle in the system. Better dispersion and a higher amount of strengthening nanoparticles in the alloy seems to start providing positive effect to the material although increase in mechanical properties is still marginal and expected to be improved. Regarding the prototyping activities, Constellium have manufactured the dies required to produce the Al-MMnC parts for the main demonstrator,

and the corresponding die trials are ongoing with an aim to setting up the extrusion recipes to ensure properties, shape stability and tolerances are achieved.

The next step will be to define the Al-MMnC DC-casting recipe at scale 1:1, therefore allowing to produce the Al-MMnC DC-casting billets meeting the requirements, which will then be extruded into the required parts to manufacture the main demonstrator of the project.