1. Publishable summary

Light alloys play the main role in vehicles weight reduction and in the last years the amount of aluminium parts in new vehicles has been steadily increasing. Moreover, weight is even a more critical factor in newly developed electric and hybrid vehicles, as it highly affects their autonomy. Furthermore, the global green house savings from the use of aluminium in vehicles is expected to double by 2025. However, the use of aluminium alloys is limited by the quality and insufficient properties of the cast parts that suffer from gas porosity.

The presence of hydrogen in the molten metal is the mainly reason of gas porosity in high performance components, which is currently dealt with by melt degassing techniques that involve purging of gas mixtures (often containing chlorine and fluoride) through the melt. This technology is expensive, has limited efficiency and poses health hazard.

Previous research demonstrated that treating the liquid metal with ultrasonic oscillations highly reduces the concentration of hydrogen, improving the quality or the cast parts and increasing the efficiency of some existing degassing techniques when combined with them. The known demonstration of the efficiency of ultrasound-aided degassing has been done on laboratory and pilot scale, and not in the mass production of cast components.

OBJECTIVE: The DOSHORMAT Project intends to improve a method to apply the ultrasound degassing treatment in light-alloys foundry (most of foundries are SMEs), providing the foundry with the environmentally friendly and safe means to improve the quality of cast parts.

Therefore, during the DOSHORMAT Project the link between parameters of ultrasonic degassing, melt quality and casting parameters will be established, which will allow the development of versatile technology that can be finely tuned to the specific casting process. This new degassing technology based on ultrasound will be validated and compared in performance with the currently used ones.

Work performed during the second period of the project and the main results achieved so far:

- Adaptation of the prototypes to commercial machines considering components manufacturing costs and manufacturing feasibility; security regulation; aesthetics, ergonomics and efficiency of the equipment; market trends and functional requirements.
- Preliminary testing of Machines (in HPDC and Gravity Casting & LPDC) in an industrial laboratory .
- Feasibility studies to propose new machine configurations for different structures of production
- Two different full industrial degassing ultrasonic machines have been designed and have evolved during the project execution according to the results obtained in the trials at the foundries.
- Different sonotrode geometries have been designed and tested highly increasing the initial degassing efficiency of the ultrasonic equipment.
- An alternative degassing treatment performed in a melt flow has been addressed obtaining very interesting results.
- The control of the ultrasonic equipment has been integrated in the main control panel on the 2 final versions of DOSHORMAT degassing machines (robotic arm and Machine for Total Melt Flow Treatment (TMFT))
- The different trials conducted under industrial enviroment show similar porosity levels and mechanical properties for the three casting processes tested in the project (HPDC, LPDC, GC) to commercial gas bubbling technologies with much lower dross formation

DOSHORMAT is an example of R&D project that propose an important improvement for the EU foundry sector of non-ferrous alloys. The development of a new degassing system that will improve the melt quality, by reducing the gas content and removing the oxides, will enhance significantly the quality of the components produced by the EU foundries. In addition, the complete absence of harmful gas emissions will meet the present and all the future potential environment regulations.

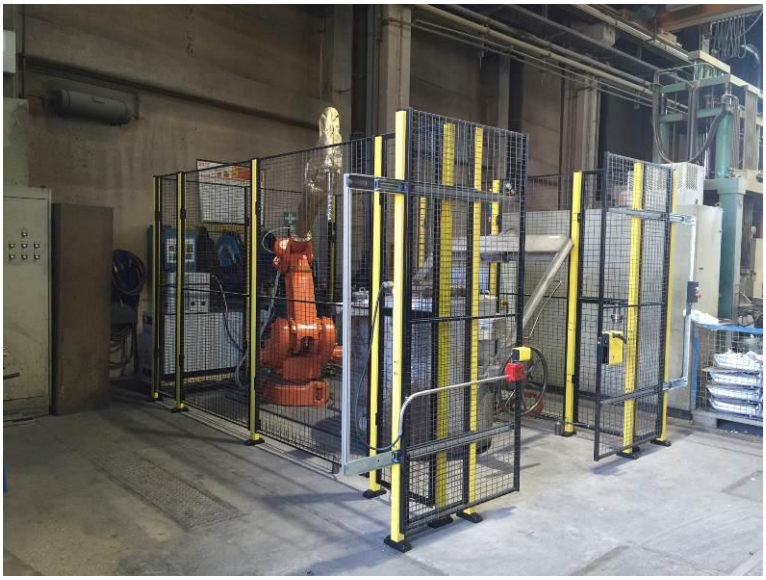

Figure 1.1 Machine 1 based on a robot for "HPDC, LPDC & GC machines"

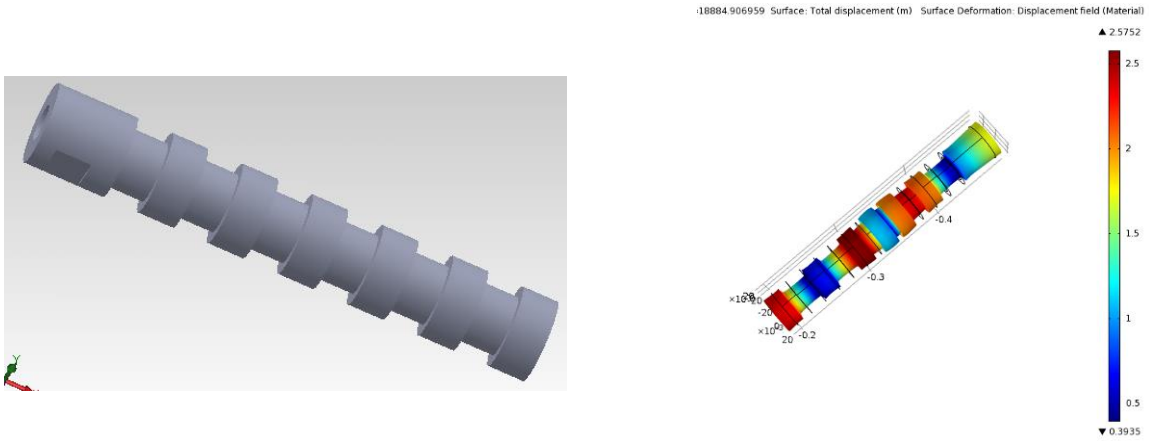

Figure 1.2 CAD 3D of the wave-length stepped sonotrode (left) and image of the corresponding simulation (right).