AUTOMOTIVE

Light Metal Alloys

15_AUTO_LMA_DIJOALS

Title: Dissimilar joining of metallic components for serial applications.

Description: Dissimilar joining of:

- aluminum-steel
- Steel- composite
- Aluminum- composite for serial applications.

Dissimilar joining can be possible with only possible with screw and nut and some rivets technology in serial productions.

These have some limitations; therefore, we need alternative solutions:

- More aesthetic
- Faster
- Cheaper
- Lighter

Objectives:

- Increasing the lightweight material on vehicle
- Give design convenience to designer
- Faster, more reliable and lighter joining
- Less heat generating during joining (like arc welding)

Challenges:

- Dissimilar joining without extra fastener usage (no screw, no nut) or very small low cost elements. Constraint: the mechanical properties of the joining area must be bigger than the lowest properties of sheet metal in the mechanical structure.

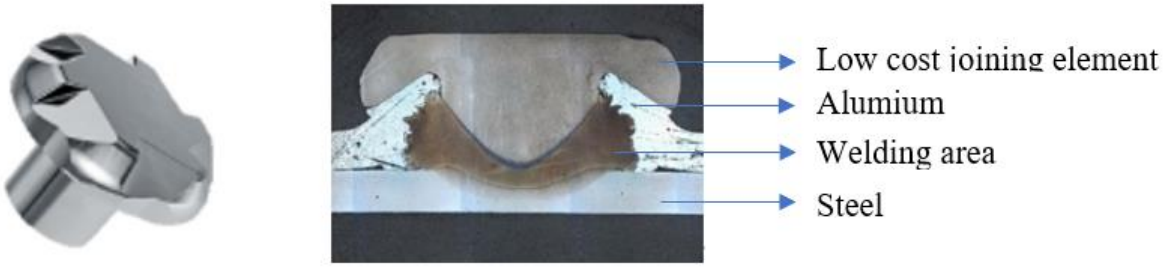

Figure 1: Example of low cost element

- Joining without pre-readiness (hole opening, nut welding etc.), for current solutions, we need to make extra operations for joining. Opening holes, welding nuts, tuckers etc. We are looking

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005435

to eliminate opening holes, welding nuts, tuckers etc, and create easy assembly ways. Example: self-drilling screws

Figure 2: Self drilling screws

- We want to use hole expansion index properties to create a nut with sheet material itself. We want to create a norm about it

Figure 3: Hole expansion index

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005435

16_AUTO_LMA_E-carGEAR

Title: Light metal alloys for e-car gearbox

Summary: Light weight alloy (or as more challenging alternative fibre reinforced polymers) with noise reduction characteristics to be utilized to realize e-car gearbox and differential housings. Possible application extension (depending on production cost) also on industrial gearboxes. Start TRL4/5, end TRL7

Description:

New e-vehicle will require a big attention to weight, to improve the overall efficiency of the vehicle, penalized by the big mass of the battery pack. Innovative solution will be necessary either to reduce the weight of the vehicle transmission (gearbox and differential) or to reduce NVH (in particular, noise) due to the fact that to improve e-motors performances their max speed is already above 20K rpm. Innovative solutions can identify new material that can replace aluminum/cast iron die casting and that could be more efficient in terms of NVH and weight, i.e., composite material with sandwich structure. Obviously, cost could be another important driver.

Please note that the challenge doesn't consider battery pack production, as the reference on battery pack is only to remind that the e-vehicle with heavy BP, could need to improve their weight but on other components (like transmission or other components).

New materials and production technologies will be necessary to take up this challenge

Objectives:

- Objective n.1: alternative material/solution to aluminum housing of a gearbox, with a weight reduction at least of 30% and a cost increase not higher than 10%. As output of the Project a sample of gearbox/ generic housing, to show weight reduction at same mechanical overall performances.
- Objective n.2: improve NVH emission by at least 30-50% with a laboratory simulation at different frequencies.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005435

40_AUTO_LMA_ALUweld

Title: Reducing aluminium oxidations on the surface for laser welding applications

Description: Aluminum is important to the automotive industry because of its lightweight, strength, flexibility, malleability, conductivity, reflectivity, and resistance to corrosion. Aluminum is light, with about one-third the density of steel.

Vehicles made from aluminum have better acceleration, better braking, and better handling. The rigidity of aluminum provides drivers with more immediate and precise control.

Scope of the challenge

One of main challenge of welding aluminum involves the formation of oxide film on the work surface. The melting point of aluminum oxide is approximately 3x the melting point of pure aluminum, which can result in particles of aluminum oxide contaminating the weld and leading to porosity issues. In most cases, oxide film must be removed either by mechanical or chemical means prior to welding. Aluminum oxide can affect laser welding: oxide films can change the reflectivity of the parts surface, which negatively impacts the amount of laser energy making it to the base metal. To avoid oxide films and hydrocarbon contamination, aluminum to be laser welded must be thoroughly cleaned. This is often achieved mechanically, using stainless steel wire brushes, grinding, filing, or scraping to remove any oxides. Alternatively, there are chemical cleaning methods utilizing immersions in caustic solutions and water that are effective at removing aluminum oxide.

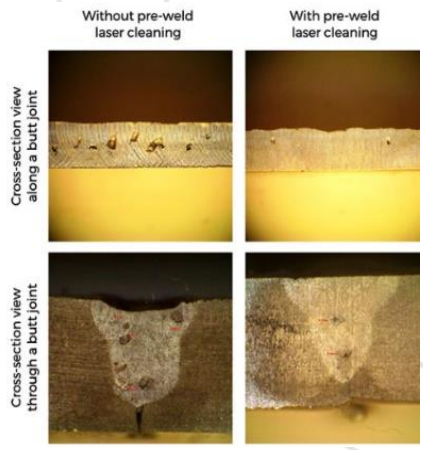

Figure: Welding result with cleaning the oxidation; Source: https://www.laserax.com/blog/cleaning-aluminum-welding

Objectives

Development of an alternative aluminium surface processing enabeling following benefits in comparisson to the conventional processes:

- Reduction of the cost for surface preparation by 20%,
- Deaccelerate the oxidation process on the surface by 30%,
- Reduction of porosities in the welding pool by 20%.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005435

41_AUTO_LMA_ASAS

TITLE: Removing Zinc impurities in 6xxx billet casting

Description

Casting the 6xxx Al series after the 7xxx Al series:

- 7020 to 6063
- 7020 to 6082
- 7005 to 6063
- 7005 to 6082.

Nowadays, it is expensive to cast 7xxx series aluminum alloys especially for large industries. Since 7xxx series have lower demand compared to 6xxx series, current demands cannot meet big furnaces capacity. As a result, large extrusion companies cannot give respond to these demands. Zinc content in the furnace after casting 7xxx alloys has to be removed which reduces the quality of the 6xxx cast. Solving this issue would allow reducing the price and therefore increase the competitiveness of 7xxx series. Automotive OEMs who are eager to replace steel with 7xxx alloys would benefit from the reduced prices. There could be a great progress in replacing steel with aluminum for improving lightweight performance. Large companies' investment in these works will also pave the way for research and R&D studies for 7xxx series aluminum alloys.

At the manufacturing stage, billets are input of the extrusion process and they are produced by direct chill casting (DC). 7xxx series alloys have Zn as main alloying element. 6xxx series alloys have Si and Mg as main alloying element. When the 7xxx series are casted, the 6xxx series cannot be casted in the furnace because of the remaining Zn impurities. The furnace must be cleaned to remove impurities. That’s why in the passing from 7xxx series casting to 6xxx series casting, 2 scrapyard castings are made. Casting of the 6xxx series is a problem. In order to ensure its continuity, at least 2 castings are wasted. These wasted castings cannot be used as scraps.

They have some limitations; therefore, we need alternative solutions:

- More sustainable
- More efficient
- Cheaper
- Faster

Challenges:

On the one hand, 7xxx series are the most valuable alloys of the Challenge giver. According to EN 573-3 standard for alloys, the composition is shown in Table 1.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005435

Alloy/Element	Si	Mg	Zn	Al
7020	0,35	1,0-1,4	4,0-5,0	Remain
7005	0,35	1,0-1,8	4,0-5,0	Remain

Table 1. 7020&7005 Alloy Content (only major elements are shown)

On the other hand, 6xxx series are the most common alloys, which composition is shown in Table 2 according to the same standard.

Alloy/Element	Si	Mg	Zn	Al
6063	0,2-0,6	0,45-0,9	0,10	Remain
6082	0,7-1,3	0,6-1,2	0,20	Remain

Table 2. 6063&6082 Alloy Content (only major elements are shown)

The problem is that after casting the 7xxx alloy, the Zn element does not leave the process while casting the 6xxx alloy. Zn needs to be removed from industrial casting furnace reverber type, which is achieved with 2 extra scraps waste castings. Constraint: element content of 6xxx series billets must be lower than the 0.1% zinc content after the 7xxx series billets.

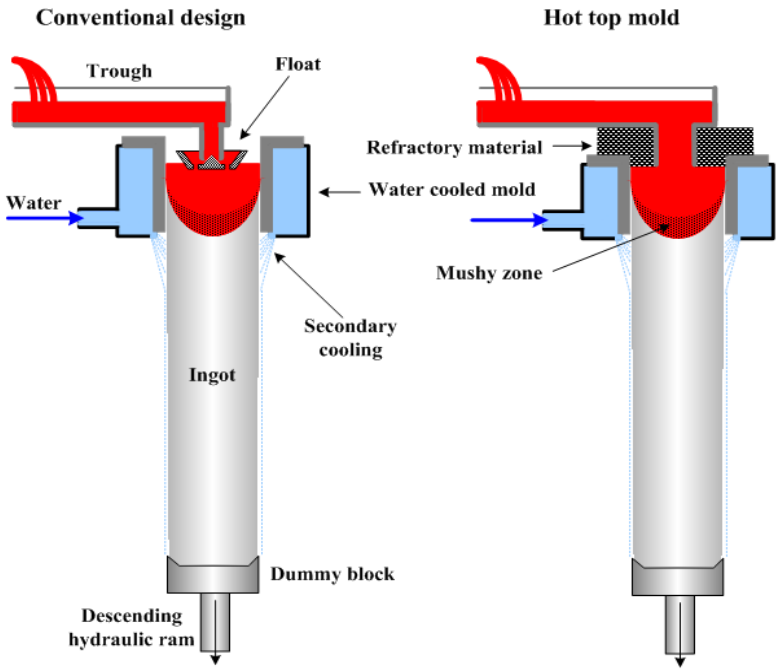

Figure 1. Vertical Direct Chill (DC) Casting

Objectives:

- Faster, more reliable and efficient casting,
- Less time passing during the casting,
- No Zinc content (at least lower than 0.1%),

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005435

- No other impurities,

Lower CO_2 emissions.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005435