Current Trends of Giga-Casting Technology in Car Manufacturing

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Abstract

Giga-casting technology has revolutionized the automotive industry because of its compelling advantages relative to the traditional methods. The current trends of this technology have helped to scale up production for several automotive industries by not only exploring consumer demands but also by keeping the environment green. This article investigates three questions: the advantages, current trends and scope of improvisation in the field of giga-casting technology.

Introduction

Giga-casting technology refers to manufacturing large cast parts as a unified piece in an automotive manufacturing industry. Companies like Tesla have been at the forefront for designing Electric Vehicles (EVs) and several other companies like Volvo and Toyota are planning to adopt large casting in the near future for the EV platform. The huge consumer demands for EVs have accelerated the process for aluminum giga casting; aluminum usage in light vehicles have been growing since decades in Internal Combustion Engine (ICE) until now where aluminum is a predominant material for producing car bodies and battery trays since ICE is not used in building EVs.

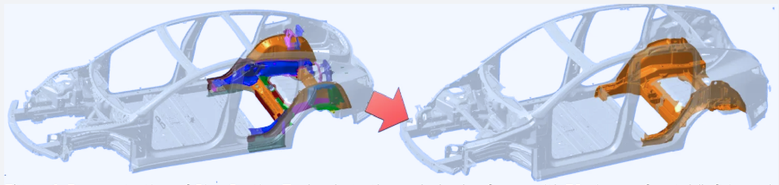

Figure 1. Demonstration of Giga Casting Technology: the underbody of a car with 70 pieces of metal (left image) was integrated into 2 pieces of metal (right image).
[source: https://www.linkedin.com/pulse/teslas-giga-casting-innovation-heavy-manufacturing-cortlandllc]

Operation of giga press of aluminum die casting uses high pressure injecting molten aluminum alloy into casting molds thereby producing unified pieces of large casts. One of the major benefits of this technology is designing lightweight vehicles which could balance the weight of batteries used in EVs.

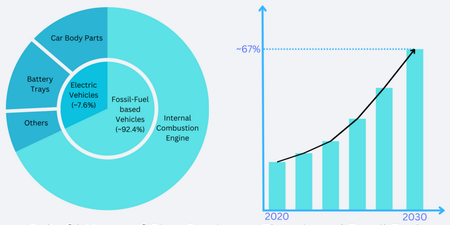

Figure 2. (Left) Usage of Giga-Casting on Electric and Fossil Fuel based vehicles. (Right) Estimated growth of giga-casting technology since 2020 over the next decade due to the growth of EVs.

A few questions have been investigated in this article which could potentially give a brief idea to delve deeper into the challenges and find a potential research question.

Statement of Research Question

1. What are the advantages of Giga-Casting technology?
2. Why did companies not adapt the giga-casting technology for car manufacturing before Tesla EVs?
3. What are the challenges and future scope of Giga-Casting technology in automotive industries for car manufacturing?

Methodology

Several new technologies have been developed to reduce fuel consumption; with the growing consumer demands of EVs and to keep the environment green. One of the most important matters to consider while building an EV is to keep it lightweight so as to balance the weight of the battery. Aluminum alloys have been studied and used in marine and defense applications since decades for its advantages in terms of lightweight, recycling, machinability and corrosion resistance [1]. Several methods are followed for aluminum die casting that includes mold casting, precision casting, high pressure die casting, squeeze casting, green sand casting, lost-foam casting, etc. [1-2].

1. What are the advantages of Giga Casting technology?

With the benefits offered by aluminum die casting, we have several advantages of giga-casting technology in several industries like EVs such as:

- *Lightweight:* With the need of lightweight vehicles, giga-casting has enabled to develop lighter as well as innovative modified parts without compromising the strength and durability.
- *Lower Cost:* Developing unified parts have drastically reduced multiple part manufacturing by cutting costs by ~40%.
- *Lower production and assembly time:* Designing and assembling unified parts have been lowered by ~50%.
- *Enhanced strength and durability:* Unified parts eliminates potential weak points arising from welds and joints.

2. Why did companies not adapt the giga-casting technology for car manufacturing before Tesla EVs?

Even after offering several advantages, companies had to think of startup costs like building huge machinery for giga-casting the automotive parts, transportation costs to transfer the automotive parts to the desired location, producing the proper cast without failure so as to reduce overdoing them and rebuilding parts in the case of huge or minor automobile collision damage. With advanced research, automotive industries like Volvo and Toyota are in the rise of adapting the giga-casting technology soon.

3. What are the challenges and future scope of Giga-Casting technology in automotive industries for car manufacturing?

The main challenges of giga-casting technology are:

- *Repairability*: Repairing an automotive part after a collision; increasing the repair costs drastically.
- *Tolerance maintenance:* Since some parts tends to cool faster than other parts, there arises a deviation and variation in tolerance which thereby leads to distortions which could potentially lead to bad simulations.
- *Size and dimension characteristics:* Designing unified part needs accurate size and dimensions of every angle to produce non-defective castings.
- *Quality of castings:* Designing high quality non-defective castings is extremely challenging.

Future Scope:

- Designing molds efficiently for casting unified automotive parts.
- Developing high quality castings by using appropriate additives in aluminum and alloys.
- Working on repairability after collisions by using techniques to mold castings in directly into the affected automotive part without working on the complete thing which would not only be cost-effective but less labor-intensive.

Conclusion

This article investigated a few questions on giga-casting technology demonstrating the current trends as well as challenges and future scope. Potential research questions based on challenges can improve this technology keeping in mind the huge consumer demands on lightweight EVs which is expected to grow exponentially over the decade.

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References

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