

Research Article

Innovation in Metal

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Abstract: This article was made to explore innovation or development of aluminium in automotive industry which was applied in a modern world. This is because in a modern world where economy was rise to the top, most of family at least have one car that used to carry someone to other destination easily. But to have a safe car, we need to analyze and look for the best material to built a safe car with high specification of safety. Aspects of material selection and innovative car construction concepts that use aluminium as the best light-weight material were presented, and recent developments in the established and advanced use of aluminium in passenger cars that help to meet economic and environmental requirements were discussed. Aluminium alloys were shown that had been enhanced to meet rising demands for stronger strength and better formability, resulting in weight savings and increased crashworthiness. Furthermore, examples for aluminium solutions in advanced "Multi-material" Super-Low-Car (SLC) designs, which achieve considerable mass savings, were given as developments in multi-material light weight design. Therefore, this paper will review the creativity and innovation in metal.

Keywords: metal; car; safety.



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1. INTRODUCTION

The European automobile sector is regarded as the world's most technologically sophisticated and inventive. As a result of increasing economic and political pressure to minimise fuel consumption and CO₂ emissions, efforts for lightweight automobile construction have expanded dramatically, and particular solutions based on the use of modified or newly created aluminium alloys have been presented. The average quantity of aluminium used in passenger automobiles has doubled in the previous decade, and new design concepts suggest that this trend will continue in the next years. Aluminium is in a brutal battle with other materials, such as newly created innovative steels, which claim back the lightweight promise of aluminium through better strength alloys appropriate for decreasing wall thickness. Magnesium, titanium, and glass or carbon fibre-reinforced polymers are also competitors. The latter has progressed in the aerospace sectors, and substantial R&D efforts are now being made fit for mass production in automobiles, particularly novel electric cars. Innovative automotive ideas have used the multi-material design philosophy, which uses the best material available for each function.

Aluminum is the material of choice for many automotive applications, including chassis, autobody, and numerous structural components, due to its low density, superior formability, and corrosion resistance. Non-heat treatable AlMg alloys used in chassis optimised for superb resistance to

intercrystalline corrosion and concurrent high strength, or heat treatable AlMgSi alloys for extrusions and autobody sheet modified for improved age-hardening response during the automotive paint bake cycle, are examples of aluminium alloys tailored by suitable variations in chemical composition and processing.

The European vehicle industry have effectively implemented outstanding light-weight solutions for automotive applications based on a thorough understanding of specific material characteristics and impacts. Intensive R&D and ongoing collaboration between material suppliers and application engineers resulted in optimal solutions for often conflicting aspects of the specific needs, such as material selection and optimal strength-to-formability ratios.

Material-specific processing approaches and bespoke solutions have been established in close collaboration with OEM partners and suppliers. A tuning of characteristics is feasible using comprehensive understanding of the physical processes involved and the microstructure/properties connection in order to develop optimal and stable products for the high demands in car applications. The successful implementations exemplify the substantial breakthroughs in aluminium automotive applications that have been made in recent years by developing revolutionary lightweight and cost-effective solutions. With the outcomes of the SLC project as a guide, it is envisaged that the usage of aluminium with especially improved qualities would develop in many automotive applications in the near future, meeting rising economic and environmental demands. The volume fraction utilised in automobiles of all classes and sizes will expand greatly as a result of the good experience obtained in the project and previous successful implementations.

The SLC idea clearly demonstrates that aluminium can be utilised for automobile body structures and that a mass advantage of at least 30% can be achieved without sacrificing performance. For the most part, the current exterior panel grades may be used. When very high strengths are required, 7xxx series alloys can sometimes be employed to preserve this large mass advantage. Aluminium solutions are the most cost-effective for high-volume applications. Castings will be used when a high level of component integration is possible. Extrusions can be used as straight profiles, but generating an extruded shape, such as bumper beams used in the SLC prototype vehicle, is cost-effective for huge numbers. Aluminium is the perfect light-weight material since it can save up to 50% of the mass of commercial materials in most applications without sacrificing safety.

Several new product advancements were developed in the SLC project to address particular BIW needs that current aluminium alloys could not achieve. For example, a high-Mg-content 5xxx alloy explicitly designed for heated forming. New 6xxx alloys for structural applications were introduced, which were used for the crash members in the SLC model's front structure, or a new 6xxx alloy was introduced as a "Roof alloy" when applied to a steel structure with a fast paint bake response to withstand thermally induced plastic deformation.

2. FINDINGS

The body frame is aluminium because of the recycling aspect. Aluminium is easier to recycle compare to other metal. This will make the aluminium easy to get material compare to other metal. The only down side of using aluminium is that aluminium is a soft type metal and not strong enough for heavy duty job like becoming a body frame of transport. Because of that a new material that is alloy been introduced. Alloy is a mixture between aluminium, magnesium and silicon. Alloy has more durability and can take more load because this mixture can be considered strong enough despite of not being too heavy and make the car reach its maximum load capacities. The higher strength of the alloy could increase the dent resistance of the outer panel. As age hardening response getting higher, the paint-bake temperature decreasing.

The new combination of aluminium, magnesium and manganese (Al-Mg-Mn) alloy show an optimum combination of strength and durability by solid solution and deformation-hardening mechanism due to their specific high-strain-hardening. In Europe, non-heat-treatable Al-Mg-Mn alloy are applied for larger quantities of automotive as hot and cold rolled sheets and hydro-formed because its good formability. A well-established alloy with high magnesium content is used for complex and strength stamping. Mg Long-term exposure at $>80^{\circ}\text{C}$ can cause the precipitation of $\text{-Mg}_5\text{Al}_8$ particles at grain boundaries, resulting in susceptibility to intergranular corrosion cracking (ICC). Special high-Mg-content alloys with a good compromise for appropriate strength and ICC resistance have been designed for these situations. When a wide field of aluminium solution and application is opened by making use of the well-established technology of aluminium extrusions. By allowing innovative light weight-design with integrated function, we can see a quite complex shapes of profiles can be achieved.

Most of the component car are casting using aluminium such as engine block, cylinder heads and special chassis parts to prevent forming of rust on the car component that could damage the component when it operates normally. Cast iron has generally been used before but progress in aluminium alloy development (Al-Si-CuMg-Fe type) and new casting techniques overcome it with improved materials properties and functional integration that enables aluminium to meet these requirements that are much better than cast iron. The construction of space-frames, axle parts and structural component also accept the aluminium casting.

The new BIWs concept of “multi-material designs”, have a suitable application of any available material with the principal idea to use the ‘best’ material for each function. Two important conditions are to taken into account that is affordable cost and optimum performance. Mass is a major factor, besides aerodynamics drag, rolling resistance, engine efficiency, electric consumption, that contribute to CO₂ emission need to count in affordable cost. Investment will be targeted in the element that produces the greatest CO₂ reduction per invested Euro, allowing a maximum acceptable cost increase to be established for each factor. It depends on the material selection and the slope must be decreased by an intelligent multi-material approach that can meet regulation on acceptable, if it not meets regulation it will bring many problems such as far from budget or material not suitable for use.

The aluminium concern new alloys and alternative production method aluminium parts has been contribute in the multi-material SLC design. To make complex aluminium into tubular shapes using internal gas pressure to form hollow bodies or tubes within a warm environment is a new technique that called heat forming. TWBs (tailor welded blanks) are a well-established product for steel automotive applications that may easily be adapted to aluminium.

3. CONCLUSION

Aluminium is the material of choice for many automotive applications, including chassis, autobody, and many structural components, due to its low density, superior formability, and corrosion resistance. Non-heat treatable AlMg alloys used in chassis optimised for superb resistance to intercrystalline corrosion and concurrent high strength, or heat treatable AlMgSi alloys for extrusions and autobody sheet modified for improved age-hardening response during the automotive paint bake cycle, are examples of aluminium alloys tailored by suitable variations in chemical composition and processing. The SLC idea clearly demonstrates that aluminium can be utilised for automobile body structures and that a mass advantage of at least 30% can be achieved without sacrificing performance. For the most part, the current exterior panel grades may be used.

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Acknowledgments: The authors would like to thank Universiti Tun Hussein Onn Malaysia for the facilities provided that make the research possible.

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