

1. Materials in the Automotive Industry

Various materials are used to make cars. The main materials used for making cars, parts and components, along with future trends, are steel, aluminum, magnesium, copper, plastics and carbon fiber. The main factors for selecting the material, especially for the automobile body, are numerous and include thermal, chemical or mechanical resistance, easy manufacturing and durability. Affordability is an important issue in vehicle manufacturing, which includes factoring in the costs associated with a car's complete life-cycle, including manufacturing, operating and disposal costs.

Iron and steel form the critical elements of the structure for the vast majority of vehicles, and are low cost materials. The prime reason for using steel in the body structure is its inherent capability to absorb impact energy in a crash situation. There have been many developments concerning iron and steel over the past couple of decades that have made steel more lightweight, stronger, stiffer and improved other performance characteristics. Applications include not only vehicle bodies, but also engine, chassis, wheels and many other parts (doors, hoods, hatchbacks etc.)

Aluminum usage in automotive industry has grown within past years, due to its low density and high specific energy absorption performance and good specific strength. The use of aluminum can potentially reduce the weight of the vehicle body. Recent developments have shown that up to 50% weight saving for the body in white can be achieved by the substitution of steel by aluminum. Aluminum is used for body structures, chassis applications, closures and exterior attachments such as crossbeams, doors or bonnets.

Magnesium is another light metal that is becoming increasingly common in automotive engineering. It is 33% lighter than aluminum and 75% lighter than steel/cast iron components. Magnesium alloys have distinct advantages over aluminum that include better manufacturability and faster solidification. In addition, magnesium components have higher machinability.

Titanium has been mainly used in high temperatures zones, and high strength requirement areas, such as exhaust systems, suspension springs, valve springs, valves and connecting rods.

Lead is a heavy metal that is soft and malleable and is a poor conductor of electricity. Lead is used in multiple fields from the automobile and marine industries to the medical field as a protection against radiations, X-rays and the sports field. From among the many applications of lead, the most extensive one is in the manufacture of storage batteries. Lead is a principal component of lead-acid batteries used in cars.

2. Composites and plastics

Fiber reinforced composites offer a wide range of advantages to the automotive industry. It is because the composite structures are the high strength/low weight ratio. Carbon fiber-reinforced or fiber glass reinforced composites offer numerous new design possibilities for structural components in cars. These advanced materials are not only light in weight, but also stiff, strong and durable. The future lightweight materials will be used in the automobile industry. Now, carbon fiber is very expensive, but the automobile industry has been developing affordable carbon fiber, so the future cars will be lighter. Fiber reinforced composites are now being used to make structural and nonstructural components such as seat structures, bumpers, hoods, and fuel tanks.

Composite materials may have big advantages over steel in automobile manufacturing. Composites are considered to make lighter, safer and more fuel efficient vehicles. A composite is composed of high-performance fiber (such as carbon or glass) in a matrix material (epoxy polymer) that, when combined, provides enhanced properties compared with the individual.

Carbon fiber composites are equally good or better concerning stiffness and strength. They also do not rust or corrode like steel or aluminum, and they could significantly increase vehicle fuel economy by reducing vehicle weight. The issue with today's composites is that they have been developed for aerospace applications where the cost is not so critical.

With composite materials, we get high strength-to-weight and stiffness-to-weight ratios, as well as excellent energy-absorbing capability per mass. Strength and stiffness factors are why composites are currently used in aerospace applications, which also require a material that is extremely light. And compared to single-layered steel in cars, multiple-layer composite laminates can be designed to absorb more energy in a crash. However, the use of these materials in the automotive industry has been very limited partly because of the costs associated with the materials and manufacturing. In modern word composites are used in all fields like utomotive, aerospace, construction industry, entertainment industry etc.

Characteristics of composites

- ✓ They are rigid with high strength to weight ratio
- ✓ Good electrical resistance
- ✓ Resistance to chemical and weather is high
- ✓ They have good stiffness (to limit buckling)
- ✓ Good corrosion resistance.

Why composites in automotive?

- < To improve fuel efficiency by reducing mass of the vehicle
- < To improve safety
- < To enhance styling and part consolidation
- < To provide aerodynamic design

The applications of CFRP (carbon fiber reinforced polymer/plastics) includes the trunk lid, wheel rims, the floor, the roof, pillars, the hood, front and rear bumpers, the instrument panel, inner door modules & etc. Additionally, the dashboard gauges, switches, air conditioner vents, door handles, floor mats, seat belts, airbags and many other parts are all made from different types of plastics.

In addition to the dashboard parts, many of the tiny parts inside the engine, such as the handle on the oil dipstick, are also made of plastic. Because of their lightweight nature, plastics are being increasingly used in body structures and in engines during automotive manufacturing.

One of the important materials in plastics is rubber which is used to manufacturing of tires. The rubber tire protects the rest of the wheel and its internal parts from wearing down, which can be good for fuel mileage and road safety. In addition to the all-important tires, parts such as wiper blades, engine mounts, seals, hoses and belts are also made from rubber. Rubber is a plastic which is durable, cheap and flexible material that has a wide array of uses in automobiles.

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