ENGINEERING MATERIALS AND AUTOMOBILE CONSTRUCTION

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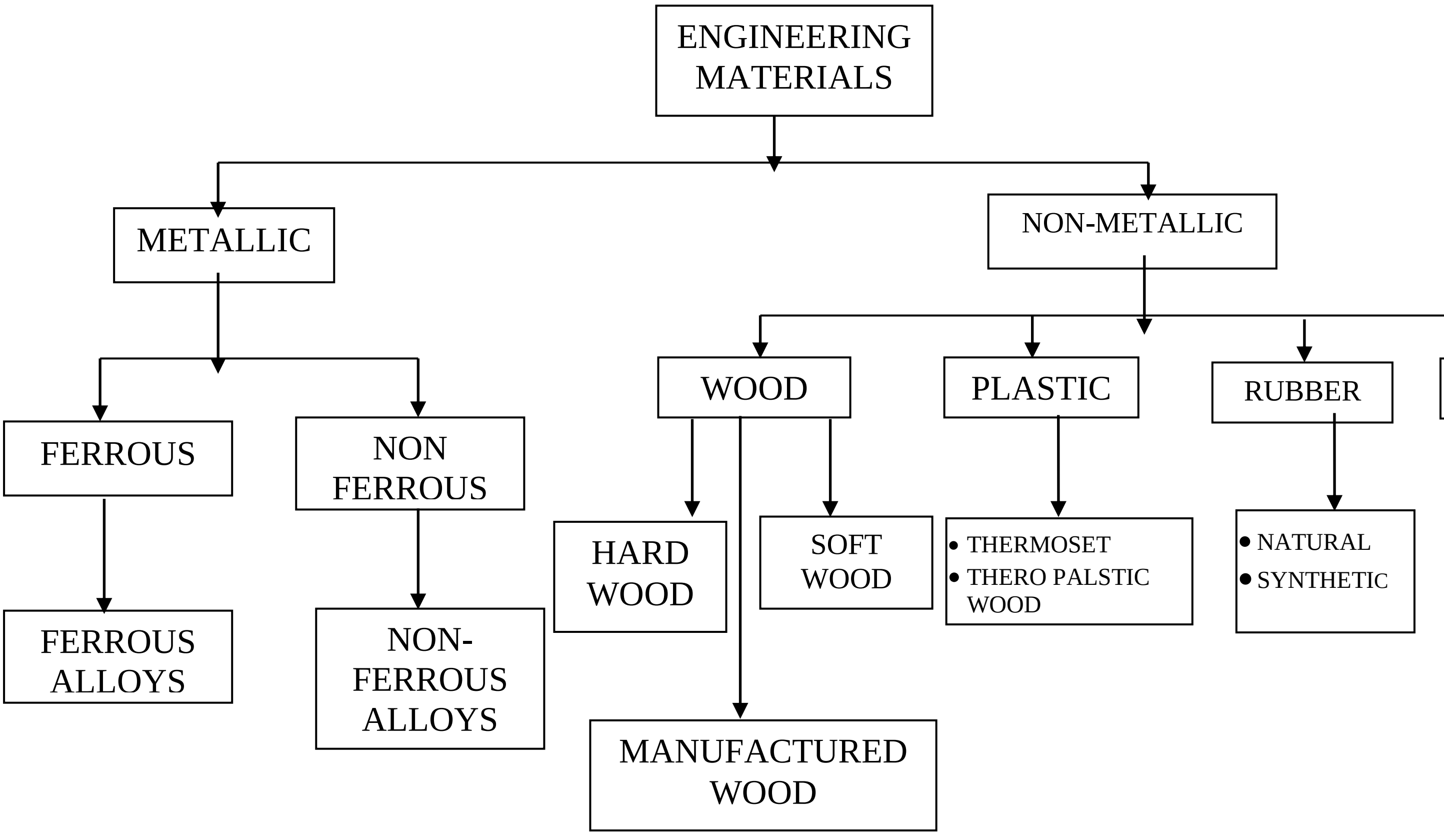
ABSTRACT

Engineering materials are the substances out of which something are designed, constructed or produced. Automobile construction or manufacturing is done through combination of materials. Materials for automobile construction, comprehensively employs both metallic and non-metallic materials for the production of the different components. The metallic materials include iron, steel, copper, zinc, aluminum, magnesium among others, the non-melodic materials in vehicle manufacturing are plastics, rubber, glass, carbon and fiber. The choice of materials for any component depends upon the condition the component will encounter during operation vis visa the physical, mechanical and chemical properties of such material.

KEYWORDS: Materials Engineering Materials, Ferrous, nonferrous, meals metallic Material Non-metallic, Iron, Steel, alloys, rubber, plastics, Glass.

Introduction

Material is any substance out of which something is made. It can be in raw form or processed form. Engineering materials are therefore those substances out of which something is designed, constructed or produced. In automobile construction, various materials are employed. MAYCO International (2019) listed 10 top materials used in Auto manufacturing. These include steel, plastics, Aluminum, Rubber, Glass Fiber, lead and copper. Others are Titanium and magnesium. George (2021) identified top five materials used in Auto manufacturing. These are, steel, plastic, Aluminum, Rubber and glass. These materials are broadly classified as metallic and non-metallic materials as presented in the chart below.



Essien (2015)

These materials have different constituents, composition and properties. Based on their constituents, composition and properties, the metals are further classified into ferrous metals and non-ferrous metals. Ferrous metals are those metals which certain iron as major constituent while non-ferrous metals are those metals that contain no iron or very little iron. The non-metals are those materials which are non-conductors of heat and electric current, good insulators, highly transparent and high water resistant. When choosing materials for a component, the conditions the material wound encounter during service should be considered paramount. Would it be required to be strong, tough or to be twisted and bend without breaking or would it be a good resistance to wear, corrosion or heat as well as good or bad conductor of heat or electricity? Sometimes the choice of materials is also influenced by the process of manufacture (Narang, 1980). For instant, a metal which could change shape readily under pressure could only be used for forged parts while metals which will flow easily when in molten form could be used for parts which are to be cast. Pure metals are very weak for most engineering purposes. Their strength, toughness or hardness are increased by blending them with other metallic or non-metallic substances to form alloys. Define alloys heat treatment will further improve their properties.

Ferrous Materials and Motor Vehicle Construction

Different types of ferrous metals are used in motor vehicle construction these include cast iron, plain carbon steels, alloy steels, stainless steel and alloys. These metals are described with their important properties, compositions and uses as follows: -

Cast Iron

Cast iron is considered the cheapest material used for motor vehicle construction. It's melting points is 1200°C. It is an alloy of iron and carbon in the proportion of 2.54 to 4% with a small percentage of manganese, silicon, Sulphur and phosphorus. It flows easily in molten state with increased carbon content but its strength is reduced. Cast iron are of two types – Grey Cast Iron and white cast iron. The two types are used in motor vehicle construction. The appearance of the fractured part provides the name to the cast irons. White cast iron is used for the production of malleable iron which is rarely used for construction of different components. Cast iron is used for parts of complicated shapes not subjected to tensile or shock loads such as cylinder blocks, cylinder heads, water jackets elbows, piston rings, flywheel, pressure plate gear box and clutch housing (Narang, 1995).

Grey Cast Iron

Grey cast iron is very cheap. It has machinability and is easy to cast. It has low tensile strength and poor shock resistance. The carbon content in it is only 0.4 to 0.8% which combines chemically with iron and majority of it exist as flakes in the metal. Grey cast iron has a steel structure with flakes of graphite interspersed. The dry machining of cast iron has been made possible by the pressure of the graphite or carbon flakes which act as a lubricant. These flakes also make grey cast iron to have good bearing surface which favours its use for cylinder bores and liners. In order to refine and harden the grey cast iron, small quantities of nickel and chromium are also added. The percentage of these elements to be added depends upon the purpose for which it is to be used. Grey Cast Iron has a higher percentage of manganese and silicon as compared to ordinary cast iron. Considering the physical, chemical and mechanical properties of grey cast iron, it is mainly used for engine block, cylinder heads, cylinder liners, brake drum, clutch pressure plates tappets guides and piston rings. For the manufacturing of crank shafts and camshafts, a special type of cast iron which nickel, chromium and copper are added is used.

Special Cast Iron

This is otherwise known as mechanite. It is produced by carefully controlled heat treatment with nickel, copper, chromium or molybdenum added. It is used for highly stress parts like crankshaft, camshaft, brake drum and rockers.

Malleable Cast Iron

White cast iron is converted and used for the production of malleable iron. It is done by either changing the graphite flakes into rounded form which has less weakening effect or by reducing the percentage of graphite in malleable cast iron content to less than 1% carbon. Due to improved ductility, malleable cast iron is typically used for parts which are to withstand shock. It is comparatively cheap and is easy to machine. Malleable cast iron is mainly used for the manufacturing of rear axle casings, wheel hubs, differential casing and differential carriers, gear box or cases, dumb irons, camshaft, pedals and brackets (Narang, 1995).

Plain Carbon Steels

The contents of carbon make the difference between cast iron and steel. Plain carbon steel has a maximum of 1.5% carbon while cast iron has 2.5% to 4% carbon. Increase in carbon content of steel makes it stronger and harder, while ductility and malleability are reduced. In automobile construction carbon steels used are classified as follows:

Low Carbon Steel

This category of steel is the cheapest and highly ductile. The carbon content is up to 0.25%. It should be heat treated to produce a hard case and a soft centre or core. It is used for all structural purposes. In automobile construction, it is primarily used for components having less or no need of strength and wear resistance as in auto body work with maximum of 0.12% carbon and for chassis and frame members with 0.15 to 0.3% carbon, panels, nuts, washers, fuel tanks, exhaust systems, wheels and low stress bolts tubing, brackets and levers.

Medium Carbon Steels

This category of carbon steels has 0.25 to 0.55% carbon content. They are much harder and stronger than mild steel. When quenching them from red heat, the hardness and strength can be further increased. Furthermore, the ductility can be improved if the quenching is followed by tempering. These steels are mostly used for stressed components requiring light sections for proper hardening during quenching such as castings like rear axle and differential housings, hubs, pedals and covers. This steel is probably used where toughness is an essential characteristic. Other uses of mild steel are found is keys, dowels, chain, wheels, crankshaft, connecting rods, front axle beams, pushrods, gears and transmission shafts.

High Carbon Steels

High carbon steels have 0.55 to 1.50% carbon content. Due to this increased carbon content, hardness and strength of the metal increases white ductility is reduced. This class of steels are of two types, tool steels with 1.2 to 1.4% carbon, and cast steel with 0.7 to 1.2% carbon. They are used in leaf springs, coil springs, tension bars and high duty spring like valve springs.

Alloy Steels

In order to increase the sensitivity of steel to heat treatment process and to increase their physical properties other metallic substances are combined together with carbon. These metallic substances include nickel, chromium, manganese, molybdenum (Narang, 1995). Most of the modern vehicles components like leaf spring, connecting rods, valves, ball and roller bearings, gears, half shaft and high tensile bolts are made from alloy steels. The alloying elements are added in a variety of proportion and ways to produce suitable steels. The effect of the different elements added, according to Narang (1995, 1980) are as follows:

- Nickel: Nickel prevents excessive grain growth thereby improve ductility and toughness as well as heat mist resistance.
- Chromium: Chromium increase tensile strength, hardness, elasticity, heat and rust resistance Manganese: Manganese improves mechanical properties such as wear resistance.
- Silicon: Silicon increase elasticity in steels and at the same time decrease weld ability and forge ability.
- Molybilenum: Molybdenum eliminates temper brittleness and increases strength at high temperatures. It is specially used for thick sections. It also has hardening effect on steel.
- Tungsten: Tungsten increases hardness in steels.

- Vanadium: It improves the elasticity, strength and fatigue resistance of steel
- Aluminum: When aluminum is added to steels, nit-riding is improved.
- Copper: Copper is added to improve rust resistance. There are many alloy steel available but only few are suitable for modern vehicles. These alloy steels include Nickel steels. In modern motor vehicle construction nickel steels most preferred are nickel-chromium or nickel-chromium- molybdenum steels. These steels have greater tensile strength, elasticity, ductility and toughness. They are mainly used as case hardening steels as used in the production of axles. crankshafts, connecting rods, bolts, stud's tappets gears, crankshaft and guenon pins.

Chromium Steels

Chromium steels have high compressive strength and the grain structure. It is used for components subjected is wear. These class are alloy steels or preferred for the production of synchromesh gears and all bearings.

Nickel-Chromium Steels

These steels are most widely used of all alloy steels with composition of 0.1-0.55% carbon, 1.0-4.75% nickel, 0.45-1.75% chromium and 0.3-0.8 manganese. These category of steel has combination of high tensile properties, good wearing qualities and high shock resistance. For automobile parts, it has a material composition of 0.3-0.4% carbon, 0.5-1.2% chromium and 2.5-40% nickel. It resists heat and corrosion. In motor vehicle construction, it is mainly used for crankshaft, gears, transmission components, stub axle, rocker arm, crown wheel and pinion, high tensile studs and bolts, differential gears and cross pins in differential unit.

Nickel-Chromium-Molybdenum Steels

These steels have similar characteristics to nickel chrome steels with similar uses. But it is stronger and is used even in those cases where the forgone material materials would be inadequate. It is because 0.3-0.6% molybdenum is added to nickel steels, the temper brittleness defect due to slow cooling of the steel from tempering is eliminated. In addition to molybdenum also enables manganese to be used in high percentage without producing and reduction of impact strength. This increase in amount of manganese also enables nickel content to be reduced making the steel cheaper. In vehicle construction these steels are preferably used in gears and transmission components for heavy vehicles crankshaft, connecting rods, axles laminated and coil springs, differential gears cross pins in differential units and crankshafts for compression ignition engines.

Chromium-Molybdenum Steels

These steels have chromium from 0.04-10% and molybdenum from 0.2 to 1.5%. These steels are used for general purposes due to low percentage of chromium and molybdenum. They have mechanical properties similar to those of low alloy structure steels. The steel containing high percentage of chromium have ultimate strength up to 12.25 tones'/cm^2 and elongation of 18-20%. They also have good acid and corrosion (resistance) resisting properties as rolled section, foregoing and cast as well as for cylinder liners.

Chromium-Vanadium Steels

These steel contain 0.8 to 1.1% of chromium; 0.95-1.1% of chromium; 0.95-0.35% carbon and 0.25% vanadium. This small percentage of vanadium has a significant effect on the properties of the steels and improves its elasticity and fatigue resistance. It is distributed between both the ferrite and the carbide resulting in the improvement of both. Due to its greater deoxidizing effect, it produces cleaner steels the less percentage of iron oxide. These steels are used in those components where greater strength, toughness and resistance to fatigue are necessary as in axles and shafts of aero planes, automobiles, high grade coils and laminated springs. The wire made from these steels is used for the manufacture of valve springs.

Manganese-Nickel-Molybdenum Steel

These steels have good resistance to shock and mainly used in front axle and steering levers

Carbon-Manganese Steels

These steels have 1.0 to 3.0 manganese and 0.20 – 0.55% carbon or 1.8% manganese and 0.9% carbon or 11 – 14% manganese and 1 to 1.3% carbon. They pose high combination of strength and toughness as well as excellent to wear and shock with good ductility. Carbon0mangenes steels are used for manufacture of axles, shafts crankshaft and connecting rods.

Silicon Manganese Steels

These steels are otherwise called spring steels. They contain 0.2 to 0.5% of silicon with 0.5 to 1.1% carbon and 0.6 to 0.9 manganese. They possess high fatigue strength, resilience and toughness. They are used for the manufacture of coil and laminated springs and torsion bars. Chromium and molybdenum are added to the steel for large diameter torsion bars and larger section springs.

Silicon Chrome Steel

This steel contains 0,55 to 0.65% carbon, 0.5 to 0.9% silicon; 0.4 to 0.8% manganese and 0.8% chromium. Silicon chrome steel is mainly used for leaf and coil springs.

Stainless Steels

Stainless steels are alloys of iron and chromium which are highly resistance to corrosion and oxidation at high temperature and maintain considerable strength at these temperatures. They have important applications to motor vehicle construction due to their significant resistance corrosion by the atmosphere and a range of acids and alkaline solutions. There are several fairly distinctive type of stainless steels having large percentage of chromium (4 – 22%) and sometimes nickel 10 - 26%. According to their microstructure stainless steels are grouped as:

(a) Martensitic with about 10 – 14% chromium

(b) Ferrite with 14 – 18% chromium and 10 – 17% nickel. These steel are used for exhaust and inlet valves preferably. Since the temperature encountered by exhaust valves is much higher than the inlet valves, therefore, the composition curves for these valves is slightly different (Narang, 1980). The inlet value steels possess 0.5% nickel, 7.5 to 9% chromium, 0.4% carbon while exhaust valves have 10% nickel, 12-16% chromium and 0.74 – 0.84% carbon. A typical composition of stainless has steel used by all the principal car manufacturers for motor vehicle trim is 0.5% nickel, 13 to 15% chromium and 0.08% carbon. These stainless steels are generally used for radiator grills, windscreen and back light surrounds, roof drips and waist molding, door pillar moldings, wheel discs, quarter light and side window frames, petrol caps, hub caps and instrument panel surrounds.

Tungsten

Due to high melting point of tungsten (3,380^{oc}) it is used to tip contact breaker point. It reduces the pitting caused by arcing the highly inductive current due to the separation of the points.

Non-Ferrous and Motor Vehicle Construction

Non-ferrous and their alloys are very crucial to the construction of motor vehicle. According to Narang (1980) the present high standard of efficiency of the motor cars in our modern time is due to their presence. According to the author, the total weight of non-ferrous metal in an average car is only a fraction of the weight of steel present. But their uses are very indispensable because of their peculiar advantages in certain cases. Certain alloys of these metals are also use but the percentage of alloying elements very according to the characteristics require in the vehicle components (Dolan, 1999).

Different Types of Non-Ferrous:

Metals use motor vehicle construction are aluminum and its alloys; copper and its alloys, zinc; tin; lead

Aluminum and its Alloys

Pure aluminum having a melting pint of 600^{oc} has little strength. But it is ductile, malleable, light in weight with good induction of heat and electricity in its pure form, it is used for vaporization on the headlamp reflectors as well as for decorative purposes or transparent plastic. It has a tensile strength of 62 – 130 MN/M^2 which can be increased to about 587MN/M^2 on allaying, cold working or heat treatment. It extensively uses for cylinder heads of high efficiency engines, engine pistons, starter motor windings.

Aluminum Alloys

The alloying element used with aluminum are copper, magnesium iron, manganese, nickel and zinc. Aluminum alloys are mainly use for crankcase, cylinder-blocks, cylinder heads, gear casing, inlet manifolds.

Aluminum Silicon

To improve flow ability in castings silicon is added to aluminum the percentage of silicon from 5 to 13%. The alloy is mainly used for cylinder blocks, gearbox cases, crank cases and brake drums.

Y-Alloy

This is among earliest and the best alloys of this group. It has a high strength casting alloy which retains its strength and harness at high temperatures. Y-alloy contains 3.5 – 4.5%

copper, 1.8 – 2.3% nickel and 1.5% magnesium with silicon, manganese, iron each 0.6%. It is excessively use for piston, cylinder heads and crank cases.

Aluminum Magnesium Alloy

These alloys are extremely strong, have good physical characteristic and resistance to corrosion. They have wide range of utility in automobile construction such as in air intake grilles, hub caps, wheel discs and car bodies.

Aluminum Copper-magnesium Alloys

This is aluminum alloy known as Duralumin. It is composed of 3.5 – 4.5% copper, magnesium and below 0.5% iron sometimes. It develops maximum properties as a result of heat treatment and age hardening which can be worked readily at about 500°C and after quenching ages over a period of 4.5 days. It tensile strength increases from 1.55 – 1.86 tones'/cm^2 to 4.01 tones'/cm yield point from 1.04 – 2.323 tones'/cm^2 and hardness from BHN 65 to 95. It is use for high strength applications like high stressed structural components and automobile parts like front axles, levers, bonnets, connecting rod, chassis frame and body framework of commercial vehicles (Dolan, 1999).

Coppers

Coppers have ductility and malleability with good resistance to corrosion. It is good conductor of heat and electricity. Coppers have a melting point of 1083°C. It can be joint by soldering, brazing and welding. It is used for making oil and petrel pipes, gaskets, plug washers, oil coolers, radiator, wire in electrical cables, commentators bars of dynamos and starter motors.

Copper Alloys

Copper alloys with other metals are used to produce a number of other useful metals. Some of the alloys use in motor vehicle components are

- Zinc Base Alloys: zinc base alloys have good mechanical strength and ability to reproduced close dimensional terraces, the form of mold casting as well as to produce good surface finish casting are consumed in large quantities in automobile industry. Die casting alloy containing 3.5 – 4% aluminum, 0.03 – 0.08 magnesium and copper (0.1 maximum or 0.5 – 1.25%) are most widely used for different purposes. The impurity contents of these alloys particularly their contents of lead, cadmium and tin is kept very how to ensure maximum resistance to corrosion. Zinc base alloys were initially used widely for radiator grilles (it is now replaced with pressed steels). These alloys are used for wide variety of products and several purposes in automobile industry like door handles, carburetors and fuel pump bodies, windshield wipers, speedometer frames, hydraulic brake parts, brackets, instrument panels, body molding. Door handles, radiator components and other decorative components made of zinc base alloys are finished by placing with nickel and chromium to provide good luster and resistance to atmospheric effects (Dolan, 1999).

- Brass: Brass has 70% copper and 30% zinc. It is called cartridge brass and used for deep pressings due its high ductility. The higher the percentage of copper, the more ductile it is. For a bright and attractive finish, it is plated with nickel or chromium. A cheaper grade alloys with 65% copper and the rest zinc is used for component like reflector pressing and radiator, shells. In modern cars small cast and press component like small bushes for high duty, exhaust manifold nuts, wheel nuts, oil and petrol pipe unions, fire extinguisher bodies, electrical terminals and contacts, screws, rivet and nipples. An alloy of 58.5 – 6% copper and the rest zinc; the alloy may also contain 1 – 2.5% lead to facilitate matching of the stamping; it is typically used for carburetor parts, door handles, grease gun fittings, petrol and oil filler caps, pipe line connections.

- Bronze: All metal in thus class of alloy have one thing in common, they all contain cooper (an alloy of copper and tin) and sometime contain zinc and lead or only aluminum or copper, e.g. aluminum bronze. Phosphor bronze suitable for casting contain about 10% tin and 0.35% phosphorous and is an excellent bearing materials for resistance to heavy loads. These alloys having excellent load carrying characteristics and resistance to abrasion are generally used for bearing bushes, worm wheels, small end bushes. An alloy known as gunmetal is formed when phosphorous is replaced by zinc. These alloys have 2.6% zinc 5% tin and a slightly large percentage of lead (5%). These alloys are typically used for pump casting, petrol pipe filling, bushes and small gears.

- Zinc: Zinc has a meeting point of 419^{oc}. It is used in its pure state for galvanizing steel body on some commercial vehicles when zinc is alloyed with aluminum or copper and aluminum, its strength in increased and it becomes a very useful material, cheap and easy to cast pressure die casting in zinc alloy accounts for 200 to 300 components on modern motor vehicles. A typical zinc alloy contains 0.1% magnesium, 4% aluminum, zinc and 30% copper. It is known as Mazak (Narange, 1995). Zinc alloy casting can be electroplated with nickel or chromium to give protective or decorate finish. Zinc is typically use for door handling, radiator grilles, petrol pump, carburetor bodies, light fittings, electric horn casting, distributor housing dynamo and starter end plates, brackets and locks.

- Tin: Tin has good resistance to corrosion. It possesses property of ductility but lacks strength. It is harder than lead. In its pure state, tin is used to plate engine piston surfaces to slow down the rate of wear. Tin has a melting point of 232^{o}C. When it is alloy with lead it forms solder use in automobile industry for radiator fabrication, for body fittings and for making of joints in electrical system solder contouring 27 – 40% tin are sued in varying composition for filling corners and angles to welding (27% tin). For radiator dipping solder with 28% or more tin are used. For the manufacture of radiator cores and the radiator fabrication, solders with 27 – 40% tin are use. For hand soldering of electrical joints solders of 45% or more tin are preferred.

- Magnesium: Magnesium casting are generally used for small component in which light stresses are involves and protection against corrosion can be provided. Cast magnesium alloys are usually used for the top half of the commercial vehicle crankcase. Often 6 – 10% aluminum, 1.0 to 0.2% zinc and 0.3% manganese are the constituent for sand and die casting. Magnesium alloys like 'Electron' crank cases improve the power to weight ratio of engine. They are used for transmission casing on front wheel drive and rear engine cars.

- Lead: Lead in its pure form is only used for accumulator plates on the motor vehicles. Lead has 327^{oc} as its melting point. It is preferred for bearing material when alloyed with tin, copper or indium. Copper-lead, lead-tin, lead-bronze and lead-indium are the usual combination for bearing materials. Indium which improves the resistance of bearing to corrosion and wear is quite expensive.

- Bearing Alloys: Bearing alloy could be allowing of tin, antimony and copper, lead, antimony, tin, copper and arsenic, copper, lead and silver, aluminum-tin alloys. These allays are categorized as follows

- Tin-Base Allay: Babbitt is one of the most important tin base alloys which has been used for motor car engine bearing many years ago. Although it has been replaced with alloys that have higher fatigue strength due to increased bearing load. For average loads Babbitt in still preferable on same car engines (Mayco International, 2019). There are three types of Babbitt bearing metals. These are two types of lead base alloys

a) Lead 86%; Antimony 9.25 – 10.75%, Tin 4.5 – 5.5% copper 0.5% maximum and Arsenic 0.6% maximum.

b) Lead 76%; antimony 14-16% Tin 9.25 – 10.75%; copper 0.5% maximum and Arsenic 0.6% maximum. At working temperature, as compared to tin base alloys, lead base alloys have higher fatigue resistance but their fatigue strength is very show to withstand the high working loads encountered in most modern vehicles.

Copper-Base Alloys

Copper-base alloys are widely used for heavy loads in motor vehicles
Two types are commonly used:
Copper 67 – 74%; lead 25 – 32%; silver 1.5% Copper 60 – 70%; lead 30 – 40%
Sometimes a little tin is added to facilitate casting. This addition also make the bearings hardened. Consistent with high fatigue strength, a bearing alloy should be very soft to reduce shaft wear. These copper-lead bearing alloys are harder and more prone to cause wear resulting to better performance only against harder shafts. Most of the modern car engine big-end and crankshaft main bearings are of the thin walled type (0.075mm maximum thickness of bearing alloy) except the aluminum-base bearing.

Aluminum-Base Bearing

Engine bearings are widely produced from aluminum tin alloy. These alloys which generally contain about 69% tin with a little nickel and copper are used for different engine bearings. When there is increase in tin content of these bearings, the softness anti-friction properties and anti-scuffing tendencies of the alloys develop enormously. Compared to copper lead alloys they are softer and have a high fatigue strength.

Non Metallic Materials

Various components of motor vehicle are mad from non-metallic materials. Although they are very small in number but their use is very important and impressive. Out of the many non-metallic materials used in integral vehicle construction are plastics, glass, rubber, asbestos, natural fibre wood carbon, mica and laminates (Mayco International, 2019). These materials are described as follows:

Plastic

Plastic use in car manufacturing are petroleum by-products (oil and gas). According to George (2012) plastics are challengers to steel because of their prominence in car manufacturing. They are malleable and still strong enough to hold the structure in shape. According to the author, plastics constitute almost half of the total car parts being the main components in manufacturing the dash beards, doors hands, pipes and air vent. The author further added that, the durability, versatility and light weight characteristic of plastics make them the ideal materials of different parts. There are a good number of different types of plastic materials which are prepared by mixing different chemicals to produce new materials which can perform specific purposes and characteristics. Most types of plastics use on motor vehicle for different components are:

a) Polyvinyl Chloride Plastics (PVC). These are resistant to water abrasion and chemicals. They are also good electrical insulators. They are used for cable insulation and sheathing, car upholstery and roof, lining

b) Thermosetting Plastic: It is a plastic reinforced with cotton e.g. Tufnell. It is used for turning wheels and identical parts (Maverick, 2022).

Perspex

Perspex have good weathering characteristic. It is supplied in different colours and shapes; it is as clear as glass. Jason (2015) noted that its characteristics of easy shaping favour its use in different components such as bubble car roofs, windscreens, anti-mist panels, window capping

Polyethylene Methacrylate

Polyethylene methacrylate is an acrylic materials similar is Perspex. It is a crystal plastic that can be produced in large ranges of plastic that can be produced in large ranges of colours. It is generally strong, light and weather resistant. It is commonly used for rear lamp housing, reflectors, instrument panel, horn bottoms and insignia

Teflon and Fluon (Polytetra Fluroethylene)

PTFE are used for unlubricated brushes in brake, steering and clutch joints.

Nylon

This is another type of plastic; it is highly resistant to abrasion. It is unaffected by oil and most of other chemicals. It is strong, tough and sound proof. Gear made of Nylon are silent in operation. It is commonly used for tyres and driving belt foundation cords fabric, speedometer, gear, wind screen wipers gears, door lock wedges, fan blades taps electrical equipment (Narang, 1995).

Glass

Currently glass is use in navigation screen, back-up camera's lenses and mirrors in cares. The windshields are made of laminated glass; lamination involves putting a them layer of vinyl between two glasses (Umrau, 2019). According to Narang (1995) glass is used for lamps, instrument and windows

Fibre Glass

Fibre glass is made of small thin strands of glass. It is mostly air and not glass. When the glass is woven in these small sheets and resin painted on it, small lighter things can be made. Fibre glass offers a lot of benefits to automotive industry. It is non-corrosive, so it helps to replace steel in areas where steel can get easily corroded. Fibreglass is fire proof. It can be used in front bumper, doors, roofs casing and the wheels (Maverick, 2022).

Natural Fibre

Natural fibre is used for hoods upholstery foundation cords in tyres and belts.

Rubber

Rubber is an inevitable non-metallic material use in Automobile manufacturing. It is flexible, absorbs vibrations and is a good electrical insulator. When sulphur in added to rubber it becomes hard and strong and also known as synthetic rubber. There are variety of synthetic rubbers that have high abrasive resistance and high energy absorption properties as well as permeability to air and resistance to oxygen and ozone attack. It also has resistance to oil and hydrocarbons. In automobile manufacturing rubbers are generally used for inner tubes, diaphragms and gaskets as well as hose linings. Natural and synthetic rubbers are equally use for the following vehicle components. Spring shackle bushes, grommet, bump rubber, fan belts pedal rubbers, high tension lead insulation, anti-vibrations mountings (Vibration dampers), suspensions unit, flexible pipes. Hard rubber in also used for battery cases.

Wood

Wood is commonly used for building of commercial vehicle body and decoration.

Asbestos

Asbestos have poor wear resistance but have high heat resistance. Maverick (2022) claimed that asbestos is used for brake lining, clutch facings and disc brake paddle.

The asbestos brake lining and clutch facing according to the source are made by wearing asbestos fibre into a fabric followed by impregnating with synthetic resin or binder of phenol formaldehyde or cresylic. Disc brake pads are asbestos moulded to shape.

Carbon

Carbon is used for making brushes for electrical equipment, self-lubricating thrust pad and water pump seals.

Mica

Mica is a non-metallic material used for electrical equipment. Micas are a group of silicate materials whose outstanding physical characteristics is that individual mica crystals can easily be split into extremely thin plates (Wen.m.wikipedia. Org>wiki>mica)

Mica group of materials are

Used as electrical condensers, as insulators sheet between commutator segment (geology science.com)

Low Pressure Laminates

This is a type of thermosetting plastic enforced with glass threaded and is used for fibre glass bodies cabs, bonnets, wings hard taps, van roofs.

Surface Protection

In order to safe guard the ferrous metallic surface against corrosion, or rusting, surfaces should be properly protecting by painting or electroplating.

Painting

Painting is an-anti-corrosive and decorating process. It consists of surface preparation which includes degreasing the body shell Parkerizing or bordering – a phosphate coating to provide a non-metallic crystalline surface. The primer coat - a zinc paint or resin varnish is applied which provides a non-metallic base crystalline surface. In order to fill and shallow imperfection in the metal, undercoats of surface (a resin with high solid content) are applied. In order to further delay, the onset of corrosion, additional underbody protection is provided with the help of "bit-mastic underseal" as well as by injection of anti-corrosive fluids into the sills and pillars.

Electroplating

In addition to painting electroplating is a method used to protect ferrous parts. For small component, zinc or cadmium plating is used while chromium plating is employed for decorative purposes on steel surfaces, the best combination is copper plating with corrosion-resisting plating of nickel (Narang, 1995). To provide it an untarnishable skin, a final thin chromium deposit is provided. A typical car body finishing include De-grease, Rinse, Binderies, Primer Coat stove, surface coat I surface coat II, stove, Rinse, Sealer Coat, Stone, Glass Coat I, Glass Coat II Stone (Narang 1980).

Conclusion

Motor vehicles are made of numerous components. Each of these components are made of materials of various physical, chemical and mechanical properties depending on the functions they perform.

Recommendations

Materials selected for each component must satisfy the condition in which they are to function. Both metallic and non-metallic materials are indispensable in automobile construction but such material should be able to withstand the condition it will encounter during operation.

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