MOTOR VEHICLE: A CONGLOMERATE OF INDUSTRIAL MATERIAL

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Abstract

The purpose of this paper is to identify industrial materials used in making a motor vehicle and different parts of motor vehicle that are produced from the materials. The industrial materials include different kinds of metals, plastic, rubber, ceramics, asbestos, wood, cotton and glass. Secondary data obtained in textbooks and journals are used in this paper. It is finally concluded that the chassis and the body are two main divisions or parts of the motor vehicle. The chassis is further subdivided into three main components, and namely: running gears, power plant and power transmission system. Each of these three parts is further divided into separate units. All these parts of motor – vehicle when looked at critically, are manufactured from the industrial materials.

Introduction

According to Stahn (1976), an automobile by general definition, is a vehicle provided with a self – contained power plant, depending on no external power or control for its operation. These include: cars, trucks, trains, ships and aeroplanes. The Longman dictionary of contemporary English, Collins today English dictionary and oxford dictionary, defines automobile as a motorcar. For the purpose of this paper, we will consider the second definition of automobile.

Automobile industries use different kinds of industrial materials, such as: metal, metal alloys, plastic, rubber, glass, ceramic, wood, asbestos, cotton and paint to achieve its finished motor vehicle. These industrial materials (standard stock) obtained in the form of raw materials are found in or on the earth or sea. After obtaining the raw industrial material, they are changed into finished products by numerous processes called secondary processes, such as:

i. Casting, molding and or rolling,
ii. Forming,
iii. Separation – machining which changes materials size and shape by removing excess materials,
iv. Conditioning which uses heat, mechanical force or chemical action to change the internal properties of a material,
v. Assembling and
vi. Finishing which protects or improves the appearance of the surface.

These materials are further separated into their different grades and treated to match the correct strength and stress required for its use for the different parts of the motor vehicle. For instance, the metal, which is obtained

from iron ore, has to under go series of processes to obtain the required steel or alloy steel for the appropriate use in the automobile industry.

The automobile is divided into two parts, namely: the body, and the chassis. The chassis is further divided into three namely: running gear, power plant and power transmission system. These divisions are further sub-divided into various functioning parts, and these divided parts are made up of the different industrial materials earlier mentioned. Many automobile students in Technical Colleges, Polytechnics, Colleges of Education, Universities, automobile Technicians and motor vehicle drivers have no adequate knowledge of the industrials materials used in the production of motor vehicle. Lack of adequate knowledge of these industrial materials and their uses in motor vehicle construction will lead to improper utilization and handling of the parts that are produced from them which in turn, causes the vehicles to break down before the time envisaged. Outlining the industrial materials used in manufacturing motor vehicle is the focus of this study.

Purpose of the Study

The purpose of the study is to outline the industrial materials used in making a motor vehicle and the different parts of motor vehicle that are produced from them.

Research Questions

1. What are the industrial materials used in manufacturing a motor vehicle?
2. What are the different parts of motor vehicle and their respective industrial materials?

Significance of the Study

The findings of this study will make a significant contribution to knowledge in the area of awareness creation among the students and teachers of automobile technology when they come across it in a journal. The findings of the study will also educate the automobile technicians, electricians and drivers on how they should handle the various parts of the motor vehicle when carrying out their repairs and routine maintenance.

The Industrial Materials and Their Uses in The Automobile

Metals

As stated by Bamiro, Oluyide, Ladoye, Nurudeen, Akuru and Olopade (1999), the metals used in the automobile can be classified into two thus:

1. Ferrous metals and alloy ferrous metals. These groups of metals are based on iron, and because of the presence of iron, they are magnetic. Examples are; wrought iron, cast iron, and steel in various grades.

2. Non-Ferrous metals and alloy non-ferrous metals. These groups have no iron content and so they are not magnetic, examples are aluminum, copper, brass, lead, etc.

The ferrous cast iron comes in gray cast iron, white cast iron, malleable cast iron or chilled cast iron (Bamiro et al 1999). All these names came as a result of colour, composition, strength, and method of obtaining the cast iron. Steel also fall under the ferrous metal and come in the form of: low carbon steel or mild steel, medium carbon steel, high carbon steel and alloy steel. The first three derived their names from the amount of carbon present in the iron, while the last (alloy steel) is outside the range of plain carbon steel, but in the group of ferrous metals. Alloy steels are: high speed steel, silver steel, high tensile steel, and stainless steel.

According to Bamiro et al (1999), ferrous alloy metals are another ferrous metals, which are gotten by mixing or alloying two or more metals melted together to form a new metal, which is different from either of the original metals. A good example is the high-speed steel made from alloying carbon + tungsten + chromium + molybdenum + vanadium + cobalt + iron. Because of the different parts of the automobile performing different functions, and requiring different strength, the kinds of metals used in making the different articles and their different parts will also be different as shown in the following tables:

Table 1
Ferrous Metals and Their Uses in the Automobile Industries

	Metal	Uses
1.	Mild steel	General structural work. For making bolts, nuts, some car bodies, and exhaust pipe
2.	Wrought iron	Frames and springs
3.	Cast iron and alloy cast iron	For making cylinder blocks, piston rings, piston, brake drums, clutch-casing, crankshaft, clutch plate exhaust manifold etc.
4.	Alloy chromium steel	Used in crankshaft, axles, crown wheel, differential pinion, camshaft, connecting rods, steering arms, ball and roller-bearing
5.	Nickel-chromium steel	Highly stressed parts in aero and automobile engineering: differential shafts, stub axle and connecting rod, clutch gears

6.	Nickel-chromium-molybdenum steel	Differential shaft, crankshaft and other high stressed parts (if tempered at 200^0C, it is suitable for automobile gears), connecting rod, inlet valves, cylinder-studs, valve rockers.

Table 2

Non-ferrous Metals and Their Uses in the Automobile Industries

	Metal	Uses
1.	Copper	Used for rivets, electrical wiring, manufacturing of radiator
2.	Lead	Battery elements
3.	Aluminum	Electrical wiring
4.	Cast aluminum alloy not heat treated	Used in the manufacture of radiator, sump, gear-boxes etc.

Table 3

Non-ferrous Alloy Metals and Their Uses in The Automobile Industries

	Metal	Uses
1.	Brass	Sheet, rivets, casting, rods, wire and screws, radiator
2.	Aluminum bronze	Electrical works, air craft parts, engine parts
3.	Phosphor bronze	Mainly used for bearings and springs
4.	Manganese bronze	Propeller for ships machine parts and engine frames
5.	Gun metal	For making gears
6.	Solder (Lead/Tin)	For joining most non-ferrous materials (not aluminum or its alloy)

Plastic

The word plastic originates from the Latin word *plasticus*; meaning that which can be shaped or molded (Bamiro et al, 1999). Plastics are molded or shaped at very high temperature. It is only at such temperature that plastic can be made to flow like liquid and used to make various object. They are derived from organic materials obtained from petroleum.

According to Higgins (1987), Charles Goodyear in 1940 established a vulcanization process, by which raw rubber was made to 'set' and produce a tough, durable material, later to be so important in the growth of the motorcar industry. Plastics are classified into three groups:

1. Thermoplastic; these groups loose their rigidity when ever heated so they can be molded repeatedly.
2. Thermosetting; which under go a definite chemical change during the molding process, causing them to become permanently rigid and incapable of being softened again, examples are shirt buttons.
3. Elastomers; these are thermosetting materials, but are characterized by very high elasticity, but a very low modulus of elasticity.

The raw materials used in the manufacture of plastic are also divided into three classes, namely:

1. Animal or vegetable products, which include casein, obtained from cow's milk and cellulose from cotton fiber and wood pulp.
2. Coal by-products obtained during the distillation of coal to produce gas (pvc, nylon, polyesters, phenolics, urea and melamine).
3. Petroleum by-products obtained during refining and cracking

A popular make of British car contain about 20kg of plastic components (Higgins, 1987). They are used to produce components like: side and internal mirror stand and frame, door handle, bumpers, rear and direction indicator lights covers, some radiator, fuel filter, master reservoir, battery casing, distributor cover, dash board frame, steering column cover etc.

Rubber

Bamiro et al (1999), defined rubber as a non-metallic organic material like plastic. It however, differs from plastic in that it is more elastic. It can be easily stretched, unlike plastic, metal and ceramic, and return to its original shape and length as soon as it is released. Elasticity is a characteristic of rubber. There are two types of rubber; natural and synthetic rubber. Natural rubber is made from milky liquid called latex, which is obtained from trees called rubber trees, while synthetic rubber is artificially made from different organic materials derived from petroleum.

According to Wadawasina (1988), natural rubbers are much more stronger than synthetic ones, that is why they are used in the manufacture of items which requires or receives excessive force and pressure in their operation, example is in the manufacture of aeroplane tyres. The automobile industries use rubber in the construction of the following parts of the motor vehicle: doors and window frame lining and in between the body and frame of the automobile are packed with rubber, in order to avoid squeaks and noise. The tyre, which is the primary shock absorber for the entire vehicle is made from rubber. The sidewall provides most of the tyre flexibility and is covered with only a thin layer of rubber to allow heat to dissipate easily. The tube is another rubber material, used as an air container inserted in the tyre. Oil seals around oil duct of the different parts of the engine, connecting hoses between plastic and metal pipes, such as upper and lower radiator hose, windscreen wiper blades, are other areas where rubbers are used in the motor vehicle.

Ceramic

According to Higgins (1987), ceramic is derived from the Greek word *keramos*, meaning potters clay. This gradually was extended to include all products made from fired clays such as bricks, tiles, fire clay refractory, and electrical porcelain, as well as pottery tableware. Many substance now classified as ceramic contain no clay, though all are relatively hard, brittle materials of mineral origin, with high fusion temperatures.

From the aforementioned statements, materials like glass vitreous enamel, and hydraulic cement are now included under the general heading of ceramics, while a number of metallic oxides such as alumina, beryllia, zirconia, and magnesia form the basis of high temperature ceramics. As far as engineering purposes are concerned, the main features, which make ceramics useful, are:

1. Refractoriness, or ability to withstand high temperatures with out deterioration,
2. Strength and rigidity, freedom from creep at high temperatures, and
3. Hardness and resistance to wear

These are the reasons for its choice and use in the following parts of the automobile construction: spark plugs, lamp bulbs filaments, power resistors, cigarette lighter unit etc. High-temperature ceramics are also used in gas turbine and turbo jet blade. Another grade of ceramic with very high melting point known as cermets are used in rocket engine components, cutting, drilling, and grinding tools, friction parts, bearing and magnetic-core materials (Higgins, 1987).

Asbestos

This is an industrial material, which contains minerals in the form of long fibers, and posses' good heat resisting properties. These minerals exist as a number of chemical compounds containing varying amount of two or more of the following substance: magnesia, lime, iron oxide, alumina and silica. All varieties of asbestos have high melting points and low thermal and electrical conductivity. After mining the material, it under goes series of crushing and milling process in order to separate the fiber from the rock to which the asbestos are attached.

Asbestos has properties such as: strength in the region of $1500N/mm^2$. This strength begins to fall at temperature above 200^0C, though chrysofile will begin to melt at temperature of about 1500^0C. Asbestos is the only naturally occurring mineral which can be woven into clothe and resist flame, heat, time, weather, and many acids like alkalis and other reagents. For this reasons, asbestos materials are used in the automobile, where there is application of excessive friction and strength requirement, as in the brake linings, clutch plates and some gaskets.

This is so because, to bring a car quickly to a standstill, the energy of motion has to be overcome, and friction overcomes motion very effectively by producing heat. As the energy of motion is converted into heat energy, the speed of the vehicle decreases. It comes to stop when conversion of energy is complete.

Wood

Wood is about the oldest structural material and is still employed in almost every industry today. Woods are gotten from trees generally and are of different grades called timber. They are either soft or hard woods, depending on the type of tree from which they are obtained and treatment.

Wood has many engineering applications today though for the purpose of this paper, we shall look at its usage in the automobile industries. Road-transport vehicles and shipping use large quantities of both soft and hard woods in many varieties. For example; Railway wagon, coaches, lorry bodies could be made from wood. Olden days truck seat frames are also made from wood.

Cotton

As put by the oxford English dictionary, cotton is a white fiber of plant, called cotton plant. Cotton fibers are normally yarn, spun, and thread used to make the cord plies for motor vehicle tyres (Stahn, 1976).

Glass

Glass is prepared from sand (silicon iv oxide), limestone and sodium carbonate. When these ingredients are heated strongly, they fuse (melt), forming a transparent liquid mixture of; sodium (I), silicate (IV), calcium (II), and silicon (IV) oxide (silica). The transparent mixture known as soft glass does not crystallize on cooling but hardens into a transparent solid (Bandtock and Hanson, 1980).

Molten glass can be blown or shaped into any desired form. The addition of appropriate metal oxides during manufacturing gives colour to the glass. Cobalt (II) oxide, for example produces a deep-blue colour. Generally, glass can withstand wide temperature variations because of its small coefficient of expansion.

Glass is one of the industrial materials used in the automobile industry. According to Stahn (1976), the glasses used in the automobile body construction are called shatterproof glass, used for all windshields (windscreen). Shatterproof glasses are used to prevent flying pieces of glass which could cause injuries during accidents. A thin plastic sheets of glass is the basic means of construction, the plastic sheet hold the pieces of glass together even when shattered. Glasses are also used in the headlamp covers and driving mirrors.

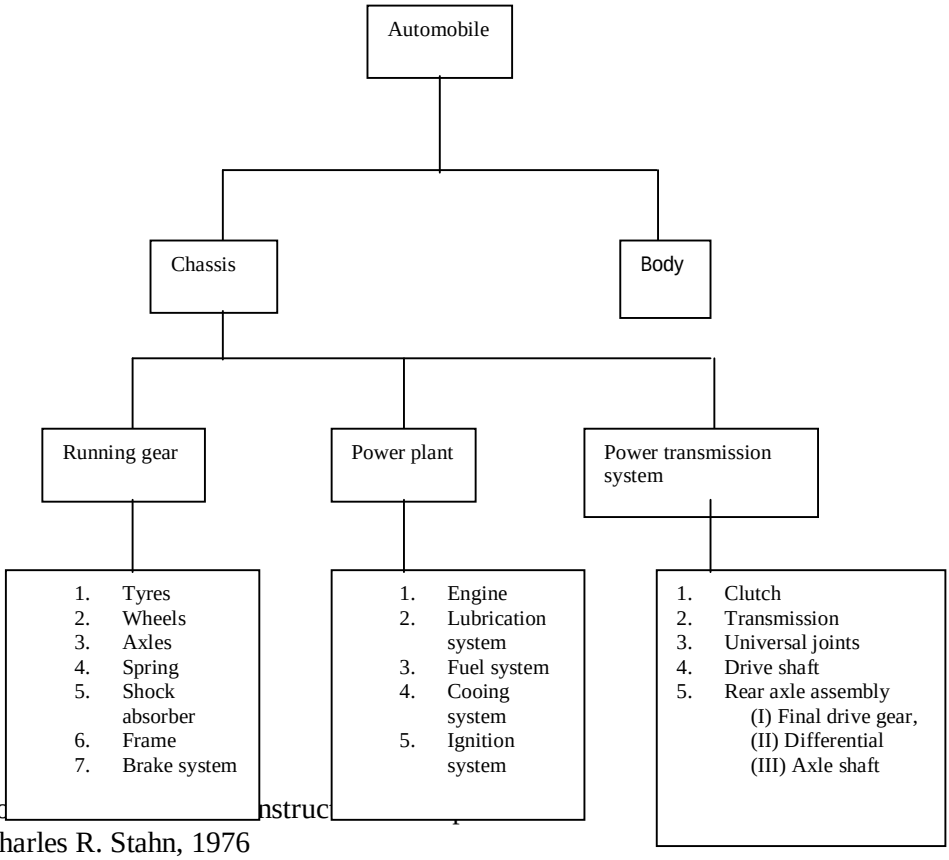
Summary and Conclusion

Figure 1 below shows the division of the automobile. The chassis and the body are the two main divisions. The chassis is further divided into three main components, namely: running gear, power plant and power transmission system. Each of these three parts is further divided into separate units or parts.

The running gear is made up of; Tyres, wheels axles, springs, shock absorbers, frame, steering system, and brake system, while the Power plant

consists of: engine, lubricating system, fuel system, exhaust system, cooling system, and ignition system. The power transmission system comprises of clutch, transmission, universal joints, drive shaft, and rear axle assembly (final drive gear, differential axle shaft).

All these different divisions or parts of the automobile when looked at critically are manufactured from different industrial materials such as; metal, metal alloys, rubber, glass, plastic, ceramic, wood and cotton of different grade, depending on its advantage. Thus, automobile could be considered as a conglomerate of industrial material.



Sc nstruc
Charles R. Stahn, 1976

Figure 1:
A Division of the Motor Vehicle

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