
UNIT 1 AUTOMOBILE INDUSTRY AND PAINT INDUSTRY

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1.0 INTRODUCTION

Humans, from the beginning of time are known to take from the nature for their survival. The human population has grown across the globe thus increasing their needs as well. To meet our requirements in the present scenario there are various industries in place that take care of these needs. On one hand, life is becoming comfortable with markets flooded with options to choose from. On the other hand we are completely oblivious to production side and its repercussions on the surroundings. Production involves variety of processes for manufacturing products and brings environmental hazards in its wake. Putting environment at stakes at the cost of our lavish lifestyles is making all of us quite selfish. Let us all introspect and ask these questions to ourselves: Are we utilising the resources mindlessly to satiate our greed, that we fail to see its impact on our planet and environment? No doubt, these industries are helpful for the economic growth of any country but at the same time are all the countries taking conscientious steps to eliminate the pollution caused by these industries?

This unit is designed to understand the relevance of automobile and paint industry in the contemporary times. The products manufactured by these industries have increased manifold in the last one decade to compliment the enormous

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consumption of vehicles and variety of paints in the world markets. The products from these industries have become part and parcel of our daily lives. The booming population and the demand for quality products have put a lot of pressure on these industries. The disposal and handling of enormous quantities of waste generated during the manufacturing processes pose a great challenge for these industries and also for the countries where these manufacturing units are housed. To meet this challenge, the industries need to understand the deadly implication of the waste generated in the processes of manufacturing automobiles and paints. They cause severe environmental and health threats and compromise with the safety of all. The harmful impact of the wastes on the surroundings through these industries which include its own employees and the land, water, air where the waste materials are dumped is a matter of grave concern. These industries need to devise and adopt mechanism to minimize the waste generation and mitigate its hazards on the surroundings caused by waste disposal.

In this unit we will learn about the automobile and paint industries and how relevant they are in today's scenario. We will be discussing these two major industries that are contributing hugely to the economic front and are a determining factor of lifestyle led by people in urban sector. We will also learn about the mechanism in which these industries ready the finished products. We will also assess the impact these industries have on the people working in them viz. occupational hazards. We will also learn about the kind of threat these industries pose to our environment. Finally, we will learn about the measures being adopted to mitigate the adverse effects of automobile and paint industries on the workers employed in these industries in particular, and the environment in general.

How do we define an industry?

A collection of companies that operate in a related set of goods or services, which are eventually sold to purchasers, defines an industry.

Classification of industries

In any place the industries work together to produce the required goods. Industries are divided into four groups:

- Primary industries are involved in extracting raw materials (which are natural products) from the land or sea e.g. oil, iron ore, timber, fish. Mining, quarrying, fishing, forestry, and farming are all example of primary industries.
- Secondary industries deal with manufacturing as they take raw materials, convert them in various ways, and produce tangible goods (e.g., automobile factories, smelting, paint industry).
- Tertiary industries produce services for individuals and groups (e.g., advertising).
- Quaternary Industries involve the use of high tech industries. People who work for these companies are often highly qualified within their field of work. Research and development companies are the most common types of businesses in this sector.

(Source: <http://kalyan-city.blogspot.in/2011/03/what-is-industry-meaning-classification.html>)

<https://revisionworld.com/gcse-revision/geography/industry/different-types-industry>

1.1 OBJECTIVES

After reading this unit you will be able to:

- understand the types of wastes generated in the automobile and paint industries;
- describe the occupational hazards in these industries;
- explain the environmental hazards in these industries; and
- describe the management of these hazards.

1.1.1 Automobile Industry

In this unit our main focus is on the processes of automobile manufacturing, the pollution caused by the various processes of manufacturing, the health threats these units cause, and the steps or measures adopted towards the waste management. Nowadays, with the changing lifestyles owning a vehicle is a requirement. Interestingly, one will find more than one vehicle per family. The increasing demand for vehicles has led to a booming automobile market. There are different automobile companies that are trying to make a mark for themselves by giving cutting cost automobile options so majority of the population can afford a vehicle of choice.

Brief Classification of Automobiles

Passenger vehicles: These vehicles carry passengers. e.g: buses, cars, trains.

Goods vehicles: These vehicles carry goods from one place to another place. e.g: Lorry, trucks.

Special Purpose: These vehicles include Ambulance, Fire engines, Army Vehicles.

Light duty vehicle: Small motor vehicles eg: Car, jeep, scooter, motorcycle.

Heavy duty vehicle: large and bulky motor vehicles e.g: Bus, truck, tractor.
(Source: <https://me-mechanicalengineering.com/classification-of-automobiles/>)

1.1.2 Paint Industry

Paint industry has grown tremendously over the past decade. Consumer today wants to experiment with different color choices when getting their walls painted in their homes. Besides this, they want the best quality paints and value for their money. Hence, they are willing to pay the price to make their homes look inviting and beautiful. Also, India is a land of festivals and pompous weddings, the demand for paints escalates during the festivals and marriage season. Paint industry has grown huge because of the surge in demand and also due to the variety of color palettes being introduced regularly by the paint companies. There are different types of paints available catering to the needs of the consumers. Paints are also used for industrial purposes. The industrial paint is used in automobile production units for automotive coating. It also uses powder coating and protective coating, respectively. The raw materials used in the paint sector are natural and chemical based and are obtained from petro based derivatives.

There are three types of paints and they are categorized as follows:

Oil based paints: Mostly used in industries. Solvents in this paint comprises of organic petroleum distillates. These paints have concentrations of **Volatile Organic Compounds (VOCs)**.

Water based paints: Water based paints, also known as latex paints, have aqueous solvent base along with organic co-solvent in varying concentrations. This type of paint is commonly used for architectural purposes. It is less hazardous compared to oil based paint.

Powder Coating: It is in the form of a dry powder and does not require a solvent in comparison to liquid paints. The powder is made up of thermoplastic or a thermoset polymer. It is commonly used for metal coatings in home appliances and in automobile industries etc.

1.2 TYPES OF WASTES

Both the automobile and paint industry pose a great threat to the environment and are responsible for huge waste generation during the manufacturing of various products. It would be intriguing to know about the manufacturing process followed by the two industries and also the drawbacks of these sectors that cause threat to our environment due to the waste generation.

1.2.1 Types of Waste Generated by Automobile Industry

The production of automobiles gives rise to huge generation of waste materials. Our environment is at the receiving end, first by their production and then by the poisonous gases they emit when on roads. Beginning from the manufacturing of all the parts and materials that are required for the process of production to the stage where the vehicle ends in the junkyard for recycling, the entire exercise leads to some serious environmental hazards. The automobile industry appears to be the major material consumer of metals such as aluminium, copper, lead and iron; plastic; rubber; glass; petroleum products (Table 1.1). Environment is impacted from the initial exercise of mineral extraction which serves as raw materials in manufacturing of the parts of any automobile. Even if the components mentioned above are recyclable they all contribute to polluting our environment which includes land, soil, air and water. All the raw materials mentioned above in the paragraph and shown in the figures are not biodegradable. The discarded materials remain in the earth system until it is discarded using a proper scientific procedure (discussed in the below section on management of wastes) and recycled sensibly.

Table 1.1: Production processes for automobile production

Facility type	Product and process
Ferrous foundry	Castings for machining into engine blocks and heads, other components
Aluminium foundry and die cast	Engine blocks and heads, transmission casings, other cast components
Forging and heat treatment	Pre-machined parts for engines, suspensions and transmissions

Stamping	Body panels and subassemblies
Engine	Machining of castings, assembly into finished product
Transmission	Machining of castings and forgings, assembly into product
Glass	Windshields, side windows and backlights
Automotive parts	Machining, stamping and assembly, including brakes, suspension parts, heating and air conditioning, pollution-control equipment, vehicle lighting
Electrical and electronic	Ignition systems, radios, motors, controllers
Hardware and hard trim	Polymer moulded exterior body panels, trim components
Soft trim	Seat cushions, built up seats, dashboard assemblies, interior body panels
Vehicle assembly	Body shop, painting, chassis assembly, final assembly
Parts depots	Warehousing, parts painting and assembly, packaging and shipping

(Source: <http://www.ilocis.org/en/contilo6.html>)

1.2.2 Types of waste generated by paint industry

The paint industry uses importantly, the pigments, solvents, resins and additives for manufacturing various kinds of paints. These materials are used to enhance various attributes and the quality of paints. But, at the same time these materials have ill effects on human health and the environment at large. The Table 1.2 below gives the details of the components of paints and their unique attributes enhanced by these components.

Table 1.2: Components of paints and their attributes

	Components	Value factor	Types	Chemical constituent
1	Pigments	Give color, glossiness and durability to the paint	Natural and synthetic	Titanium Dioxide (white), Chrome Oxide (Green), Iron Oxides (Yellow and Red). Extender Pigments (Calcite, Talc, Mica, and Baryte)
2	Solvents	help with applying the paint to any surface easily, impart aroma to paints	made up of petroleum mineral spirits and solvents	Petroleum mineral spirits and solvents, benzol, ester, acetone, ketone and alcohols.
3	Resins	Help with drying the paint quickly	Natural and Synthetic Resins	Naturalresins (linseed, soyabean and coconut oil) Synthetic resins also known as alklyds. Alklyds are made up of acryrillics, epoxies, polyurethanes

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4	Additives	Are antifungicidal /antibactericide agents. These are also used as fillers. Fillers help with retaining the paint properties intact. Additives also provide longevity to the paint, impart smooth texture and instant drying.	Different Antifoam types that contain	Fillers (calcium carbonate and aluminium silicate). Non silicone defoaming materials (inocanol, inxylene)
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The key wastes generated by the paint manufacturing units comprises of equipment cleaning wastes (waste rinse water, waste solvent), paint sludge, redundant/expired paints, pigment dusts, spills and discharges.

Check Your Progress 1

- Note:** a) Write your answer in about 50 words.
 b) Check your progress with possible answers given at the end of the unit.

Short answer questions

- 1) Name the different types of paints available in the market.

- 2) Define industry. How many types of industries are there?

- 3) Name the raw materials (metal and others) used in automobile industry?

Essay type questions

- 1) Give an account of the types of waste generated by automobile and paint industry.

2) Why is paint industry flourishing in India?

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1.3 OCCUPATIONAL HAZARDS

1.3.1 Occupational Hazards of Automobile Industry

The production of automobiles is major worldwide industry and the majority production is done in the Asian Pacific countries. There are production units that make vehicle parts and others that take care of the assembling. The workers in the vehicle parts manufacturing units are hugely more prone to obstructive respiratory problems. Musculoskeletal conditions are caused due to vehicle assembly. There are respiratory concerns also involved along with processes like welding, painting and the use of adhesives. While working in production units with metal parts, workers are involved in processes like casting the metal, chipping of eroded metal, grinding for fixture, moulding for shape, forging or stamping etc. which make them vulnerable to the following metal working fluids (MWFs) such as silica, asbestos. They are susceptible to following respiratory and other health conditions like, asthma, hypersensitivity, pneumonitis, bronchitis and lung cancer. Workers in the assembling unit are also susceptible to respiratory illnesses. Processes like welding, painting and gluing, forces the workers to come in contact with fumes of Nitrogen dioxide, ozone particulates and isocyanates, which in turn, makes them vulnerable to asthma attack.

1.3.2 Occupational Hazards of Paint Industry

Paints and varnishes are among the major contributors to indoor air pollution, mainly through **VOCs** i.e. **Volatile organic compounds**. VOCs are organic compounds and are emitted as gases from a variety of chemicals used in paint industry for manufacturing of paints. These gases can effect health of people in direct or indirect contact with paints. VOCs can react to sunlight, and change to ozone and other pollutants that eventually produce photochemical smog in the lower atmosphere. The effects of these VOCs may be felt from two months after application to periods of up to five years or more. Various studies conducted on indoor air pollution establish that levels of many VOCs are 10 times higher indoors than outdoors. Though most of the paint companies argue and claim that the airborne concentrations of toxins are harmless, there is no complete guarantee of idealistic approach in reality.

The heavy metals used in paints, such as cadmium, mercury, lead or chromium, are bound to leave their residues in the indoor environment and these remain persistent over a long period of time. Exposure to these heavy metals, either through respiration or direct contact, can result in long-term health effects. Lead in paints is a greater source of indoor air pollution especially through lead dust.

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Windows and doors are the primary culprits in this regard as they are touched regularly. Long exposure to these paint pollutants has consequences, and the impact can be seen on the nervous system. They can also cause damage to blood and kidneys. Such exposure may also cause throat and nose discomfort, nausea, skin allergy, fatigue and dizziness.

A World Health Organization report revealed that professional painters stand higher chances of contracting lung cancer and nervous system disorders. The female painters are more prone to miscarriages. Children of professional painters are seen born with high risk of developing brain tumours, cancers of the stomach, lymph gland, larynx, kidney, liver etc. (WHO, 1989). Lead is major component of paint, and is referred to as “silent epidemic”. People working in paint industries easily come in contact with it. It is easily inhaled and ingested. Lead metal has the tendency to accumulate in human body. It impacts the soft tissues and bones and also infects the blood. The accumulation of lead for prolonged periods in human body can cause some serious health hazards. It is responsible for disturbing the calcium metabolism, may cause convulsions, create reproductive problems, result in fluctuating blood pressure, nerve disorder etc. It impacts all fundamental human body systems. Adults face the following health hazards like difficulty on concentrating and remembering things on being exposed to lead for a longer duration. They also may get joint and muscle pains.

1.4 ENVIRONMENTAL HAZARDS

1.4.1 Environmental Hazards of Automobile Industry

Automobile industry impacts the environment starting from the manufacturing to its use on roads to its end-of life on road. Environmental damage is enhanced by utilization of fuels and its emissions caused through driving. On an average, life of a vehicle is 15 years and it contributes to production of greenhouse gases by consuming different forms of fuels (gasoline and diesel). Environment gets degraded by mineral extraction for production of parts of an automobile for example iron, aluminium etc. Parts that are made up of metals like steel, aluminium, copper wires are recyclable. Components that are made up of heavy metals like lead and acid in batteries are very harmful to the environment and are not easily recyclable. Plastic parts that are made up of petroleum by products are not easy to recycle hence pose a great threat to the environment. Environment is polluted with all of these components of automobiles to varying extents and toxic substances are pumped into the environment (land, soil, groundwater, surface water and air) during their manufacture, working and final disposal. The impacts of lead are discussed in the above section on paints and here we will discuss impact of mercury emissions from this industry.

Automobile industry contributes enormously to toxic mercury emissions in India. There have been studies and surveys done to estimate the damage caused by this sector due to excessive use of mercury. Even though the leading environmental organisations are trying to spread the awareness and despite all the efforts made to bring down the use of materials that are polluting the environment, mercury still continues to be used in production of automobiles, by this industry. Mercury is known to be very toxic for humans and wildlife alike. It is let out in the environment when automobiles are scrapped in end-of life vehicles (ELV) stage. The release of mercury into the environment is alarming

after the automobiles are declared redundant for use on roads and are recycled. The melting of metallic body parts of the automobile in electric arc furnaces (EAFs) releases mercury. Automobile industry alone contributes towards the largest mercury-contaminated scrap.

1.4.2 Environmental Hazards of Paint Industry

Lead and chromium compounds are used as pigments in paint industry and are released in the environment. Both these pigments are very toxic. Paints used in aerospace and automobile industries contain chromium. The zinc chromate is being used as a pigment for zinc yellow, which is again another highly toxic pollutant and causes degradation of the environment. The details of lead toxicity are given in the above section. VOC's also have been discussed in the above section and are extremely harmful for the environment. The VOC's in the atmosphere form ozone in the presence of oxygen and form smog (dense fume clouds). VOCs are dangerous even in low concentrations, and can increase the level of air pollution drastically. Such polluted air can cause damage to lung tissues and give rise to respiratory problems.

Check Your Progress 2

Note: a) Write your answer in about 50 words.

b) Check your progress with possible answers given at the end of the unit.

Short answer questions

1) Define the terms VOC?

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2) What is a pigment? And why is it important in paints?

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3) What is the composition of Paint?

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Essay type questions

- 1) How is Mercury harmful to the environment?
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- 2) What are the occupational hazards for people working in Automobile and Paint industries?
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1.5 MANAGEMENT OF AUTOMOBILE

**1.5.1 Management of Automobile Waste and Hazards
(Treatment, Handling and Disposal)**

Many countries with automobile industries are taking an initiative to manage the solid waste generated in an effective way. The strategies adopted are recycling and reuse of the parts of automobiles, landfilling and incineration of vehicles when they become redundant. These strategies convert the unusable waste to reusable waste. 75% percent of the vehicle waste which is metal is reusable; hence reuse and recycle help minimize the waste to great extent. In many developing countries including India, Pollution Control Board is also taking measures to bring down the hazardous waste generated by the automobile service stations and is also checking to make sure proper disposal of waste. Measures are being adopted to control the air and noise pollution caused by vehicles in day to day life.

There are phases of implementation under which the ELVs are taken to the separate assigned areas. The components of vehicles are assessed and dangerous and toxic substances are removed. The toxic substances are oils and different types of fuels, the battery used in automobiles, the oil filters, and the components containing mercury and the airbags. All these substances are explosive by nature. The recyclable components are segregated and sent to respective units for further processing and reuse. This helps in bringing the cost of the vehicle down and deals with the environmental issues. Glass is one component that is vital in the automobile industry. It can be re-melted and reused after an appropriate treatment. The process of recycling glass is quite expensive and not very feasible. Automobile tyres are made of synthetic rubber. Synthetic rubber comes from petroleum. Earlier natural rubber made from liquid latex was used for making

tyres. The growing demand for automobiles has also given rise to huge waste of tyres and their successful disposing has become a challenge. The present practice of disposing off the tyres takes place at the landfill, crumbing, remoulding and incineration. Automobile scraps contain metal waste. The vehicles are made up of 70% of metal (steel and aluminium) including the body frame and the other parts inside of the vehicle. When the vehicle reaches the ELV stage majority of the metal is dismantled and reused. This helps in reducing the volume of waste generated.

1.5.2 Management of paint waste and hazards (treatment, handling and disposal)

The paint industry produces a variety of paints that ideally need to be environment friendly. But, are we sure of that? There have been several studies conducted about the same, by various environmental organisations and also, it has been a very sought after topic for research scholars. The studies indicate that the claims made about the non hazardous nature of these paints are not entirely true. There is tampering with the percentage of toxicity these paints may ideally contain.

However the scenario is changing lately, the environment friendly organisations and the media, are doing a great job in making people aware of the health effects linked to these paints. The companies are using ways to bring the ignitability and toxicity of paints by using less metallic pigments and organic solvents. They are also taking measures of curtailing the amount of waste generated by this industry that was earlier left unattended and polluted the environment. Such waste is recycled now. There needs to be a check on understanding the requirement for raw material and keeping a check on purchase to avoid excessive material at hand. The materials need to be stored in airtight containers for VOCs. The solvents purchased need to be in covered containers or sealed when not in use. Water can be used to wash and clean the equipment manufacturing water based paints. The wastewater can be collected to reuse several times for different purposes. Water is always a better option over caustic solution washing and helps eliminate the toxicity caused by these materials. The hazardous materials should be taken care of before disposing the waste. The plant automation is encouraged to improve production efficiency and reduction of waste material generated.

Check Your Progress 3

Note: a) Write your answer in about 50 words.

b) Check your progress with possible answers given at the end of the unit.

Short Answer questions

1) What is the full form for ELV?

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2) How is synthetic rubber made?

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3) Name some toxic substances generated by automobile industry?

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Essay type questions

1) Describe some measures of waste management for waste generated by the paint industry?

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2) What steps will you take to create awareness amongst people about the pollution generated by these two industries?

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1.6 LET US SUM UP

The above content presents the pollution threat caused by the automobile and paint industry. The evolving measures have been discussed in details in the above section to mitigate the negative impact of these industries on the environment. The latest elite technologies are evolving to develop automobiles and paints which will cause minimum harm to the environment. Stringent measures are required to be in place for disposing off the old vehicles. People need to be advocated about the health and environment hazards caused due to the waste generated by the automobile industry. Understanding the waste hierarchy like recycling, reuse and reduction helps in managing the waste generated. Using the public transport, indulging in pool rides can bring down the vehicle purchase, which can eventually save fuel and bring down the toxic emissions caused by these vehicles.

The paint industries cause some alarming damage to the environment. There has been an effort globally to make people aware of the toxicity of the paints. Some countries already have laws in place that forces the paint industries to choose the natural materials that are less toxic, to safeguard the environment. The natural raw materials do add to cost. There needs to be a widespread awareness amongst the customers so they understand the implication of chemicals in the paint industry and their consequences on health and environment. The paint industries also need to make an initiative by taking strong measure to reduce the waste from paint industry and safeguarding the work environment of the employees who work in these industries. They need to be educated on how to keep themselves safe wearing safety suits and masks while working. There still is a long way to go to improve the scenario in the paint industries and a continuous joint effort from business houses and people is required to deal with this situation.

1.7 KEY WORDS

Toxicity - the quality of being toxic or poisonous, contaminate (water, the air, etc.) with harmful or poisonous substances

Environment - habitat, territory, domain; surroundings, environs, conditions

Pollutant - a substance that pollutes something, especially water or the atmosphere

Pigment - coloring matter, coloring, colorant, color, tint, dye, dyestuff

Emission - controlling the emission of carbon dioxide: discharge, release, outpouring, outflow, leak

Hazard - danger, risk, peril, threat, menace; problem

Biodegradable - capable of being decomposed by bacteria or other living organisms and thereby avoiding pollution

Incineration - burn, reduce to ashes, consume by fire, carbonize; cremate

1.8 REFERENCES AND SUGGESTED FURTHER READINGS

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<http://www.biologydiscussion.com/wastes/wastes-sources-classification-and-impact/7091>

1.9 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress 1

Your answers should include the following points:

- 1) To answer this question look through section 1.1.2. Paint Industry
- 2) Your answer would be in section 1.1 Introduction
- 3) Your answer would be in section 1.2.1. Types of waste generated by automobile industry

Answers to Check Your Progress 2

Your answers should include the following points:

- 1) Your answer would be in section 1.3.2. Occupational hazards of Paint industry

- 2) Check Table1: Components of paints and their attributes for answer
- 3) Check Table1: Components of paints and their attributes for answer

Answers to Check Your Progress 3

Your answers should include the following points:

- 1) End-of-Life Vehicle
- 2) Synthetic rubber comes from petroleum
- 3) The toxic substances are oils, different types of fuels, battery used in automobiles, the oil filters, and the components containing mercury and the airbags.

