5 CHEMISTRY IN DAILY LIFE

WHAT WE HAVE LEARNT

- **Medicines, insecticides, textiles and food materials that we use in daily life are chemical substances.**
- **Cement is used for building purposes becauses it has the ability to 'set' when mixed with water.**
- **Natural rubber is the exudation from rubber plants.**
- **Polymers are very large molecules formed by the combination of small molecules.**

CHEMISTRY IN DAILY LIFE

We live in a world of matter. From the food that sustain our lives to various objects that have built up our physical culture, everything is made up of matter. The human body itself is a mixture of matter of differing types. The humans who used materials obtained from nature for centuries, later made new materials out of these to suit their needs. Now the humans have thousand of materials for their use - both natural and human made. The ability that humans acquired to make new materials from natural materials is the basis of human progress. When the structure of the material world and the nature of physical and chemical changes in them were studied, humans were able to make new materials and to control their different properties. The development of chemistry made this progress possible. The contribution of chemistry to fields like, agriculture, industries, health care, food industry, habitat, transport and research has been invaluable. Through chemical processes that scientists develop chemistry comes up every day with answers to ever increasing human needs.

Polymers

Cotton is the material used for the manufacture of clothes for our daily use. Clothes are made by weaving together thick strands that are obtained by twisting together delicate fibres. Different kinds of fibres are utilized for different purposes.

- Cotton
- Coconut fibre
- Jute
- Silk

The hair of animals, paper, wood and rubber also contain such fibres. The varied properties of such fibres are due to the polymers present in them. From very early times, humans have been using many polymers that are obtained from plants and animals. In modern times, we have been able to make substances that are similar, and with better qualities with the help of chemistry.

Some natural and human made polymers that are used in daily life are given below.

Human-made	Natural
• plastic	rubber
• polythene	cellulose
• nylon	starch
• rayon	silk
• teflon	wool

Table 5.1

The protein known as insulin is a small polymer formed by joining about fifty amino acid units. In big polymers, hundreds of different units may be joined in different ways. The form, hardness, strength, heat-enduring capacity and elasticity of a polymer can be changed by incorporating alterations in the constituents of the polymer and in the way in which these units are connected. For example, by heating natural rubber with sulphur, we get a stronger form of rubber. This happens when the polymers contained in natural rubber become new polymers with the addition of sulphur.

In the manufacture of polymers, monomers are allowed to undergo chemical reactions and get united to each other.

Chemical equations showing the formation of some polymer molecules are given below.

$$n\ CH_2 = CH_2 \rightarrow \left(CH_2 - CH_2\right)_n$$

ethylene polyethylene

$$n\ CH_2 = \underset{\displaystyle Cl}{\underset{|}{CH}} \qquad \left(CH_2 - \underset{\displaystyle Cl}{\underset{|}{CH}}\right)_n$$

Vinyl chloride Polyvinyl chloride (PVC)

Here, monomers combine and form polymers. The polymer is named by prefixing the word 'poly' to the name of the monomer unit.

Eg : polyethylene, PVC.

There is only one kind of monomer molecules. Polyethylene, PVC, rubber etc. are formed by same type of monomers.

They are formed by different types of molecules.

Living polymer factories

We have started making polymers since only the last two years. But for centuries we are familiar with two living beings who make and use polymers, the spider and the silk worm. The web of a spider and the silk fibre of a silk worm have always aroused the curiosity of humans. Both are polymers. In 1665, a scientist, Robert Hook, declared that if certain suitable gum-like substances are drawn out as thin fibres, substances similar to spider-web and silk fibre can be made. This method is still used to in the industrial production of polymers.

Rubber

Rubber is a naturally available elastic polymer. There are double bonds in its polymer molecules. To change the properties of rubber, changes are to be made in the structure of its polymer.

If sulphur is added to rubber and heated, its shape can be maintained and its hardness increased. The process of heating rubber with sulphur for the betterment of its properties, is called vulcanisation. In this process, the various chains in rubber are joined using sulphur.

Vulcanisation enhances the following properties of rubber.

- **tensile strength**
- **hardness**
- **elasticity**
- **ability to withstand heat changes**

These properties can be varied by changing the quantity of sulphur, temperature and time taken for vulcanisation. When we heat rubber adding 40-45% sulphur, we get ebonite, a substance with low elasticity.

With the growth of chemistry, we have been able to make artificial rubber with better qualities than natural rubber in the laboratory. Analyse the differences between natural rubber and synthetic rubber given in table 5.2.

Natural rubber	Synthetic rubber
Low hardness	high hardness
easily flammable	not easily flammable
Dissolves in organic solvents	Does not react with organic solvents
Loses stability at high temperature	Keeps stability at high temperature
Less elastic	More elastic

Table 5.2

Some commonly used synthetic rubbers, their properties and uses are given in table 5.3.

Plastics

Different kinds of plastics are familiar to you. These are also polymers. Plastics are now used as substitute for wood, stone and metals in many instances. Prepare and present a project about the various possibilities of use of plastic objects and the problems of excessive usage.

Burn a piece of polyester cloth, cool it and feel it. Does it melt if it is burned again? Repeat the activity using a polythene cover and record the results of your observation in your science diary. You can experiment using the following.

- **nylon rope**
- **buttons**
- **PVC pipe**
- **bottle caps**

You have understood that polyester, on burning, underwent a chemical change and polythene, a physical change. Plastics that undergo a chemical change when heated are

Synthetic rubber	Property	Uses
Styrene butadiene rubber (SBR)	High frictional force Not easily broken Resists ozone Gets easily oxidised	tyres foot wears
Neoprene rubber	Not easily flammable Does not easily react with oils and solvents Stable at high temperature	Cable insulation Conveyer belt in coal mines Making hose
Thiokol	High elasticity Hardness Doesn't dissolve in organic solvents	Tanks for storing solvents Making seal

Table 5.3

known as thermosetting plastics and those that undergo a physical change on heating, are known as thermoplastics. These are listed in the table below.

Name	Monomer unit	Properties	Uses
Thermoplastics			
Poly ethylene $+CH_2 - CH_2+_n$	**ethylene** $CH_2 = CH_2$	**Insulator Flexibile**	**as insulator, as wrappers for making pipes**
Polyvinyl chloride $+CH_2 - CH+_n$ (Cl)	**Vinyl chloride** $CH_2 = CHCl$	**insulator**	**manufacturing of pipe, tanks for chemical process, rain coat, helmets etc.**
Nylon	**Adipic acid and Hexamethylene diamine**	**has lusture strong firm elastic**	**Fishing nets, clothes, parachutes, chords etc.**
Thermosetting plastics			
Bakelite	**Phenol + formaldehyde**	**Insulator, black in colour**	**making switches, soap dishes, electrical appliances etc.**
Polyester	**Esters of unsaturated alcohols**	**Low density Transparent Strong and firm**	**Making body of vehicles home appliances, clothes etc.**

Table 5.4

Since thermoplastics become soft on heating, they can be used again (recycling) to make new things. Thermosetting plastics cannot be used again, Why? Try to find out the various uses of the two types of plastics and the differences in their properties.

Fibres

Centuries ago, humans learned to make strong and beautiful things from the thin natural fibres like coconut husk, cotton, hemp, silk and animal hair. Before the emergence of modern technology, such materials were used by us. All of them are polymers. Polymers of plant origin are made of cellulose and those of animal origin with proteins. Though these polymers could be used for different purposes, their basic qualities could not be changed. With the development of modern chemistry we were able to study more about the qualities of such substances and make them artificially with better qualities. Artificial fibres are an important contribution of polymer chemistry. Many artificial fibres with wide variety in qualities like colour, strength, weight, reflective property, ability to maintain shape and smoothness are now industrially made. The astonishing variety in the clothes that we now use is due to the growth of chemistry.

Artificial Fibres

Rayon is regenerated cellulose. Substances that contain cellulose (e.g. wood pulp) are first dissolved in carbon disulphide and then made into pulp by adding alkali. This is viscose. This viscose is then passed through very small holes into a dilute acid solution. In this acid solution, the cellulose fibres are regenerated. This is known as artificial silk.

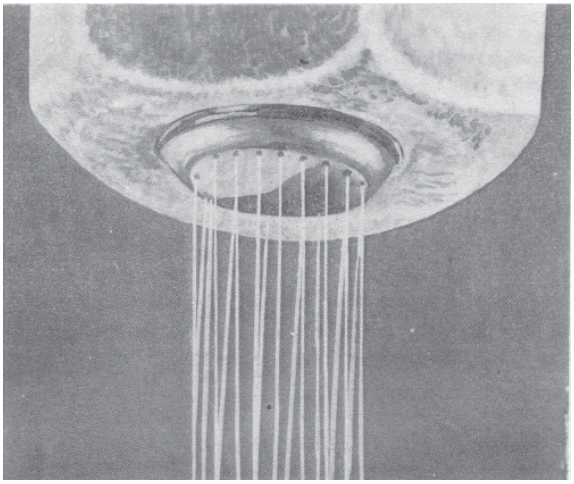

Figure 5.1

Making artificial silk

Dissolve about 10 g of copper sulphate in water in a beaker. To this, add dilute sodium hydroxide. Copper hydroxide precipitates. Remove this precipitate using a filter paper. Dissolve it in concentrated ammonium hydroxide. To this solution, add some cotton. Cotton dissolves in it. Take this solution in a syringe and inject it into dilute sulphuric acid in a beaker. You get synthetic fibres.

Glass

Glass is one of the widely used substances. What are the commonly used objects made of glass?

- **lenses**
- **utensils**
-
-

Glass is used to make various household utensils and laboratoryware. The windshield of a motor vehicle is also made of glass. Are the properties of all these glasses similar? Table 5.5 shows different types of glasses, their constituents and uses.

Examine the table, find out the difference in properties of each type of glass and record it in your science diary. Which is the common ingredient in the above glasses? The ingredients needed to make soda glass, heat resistant glass and flint glass are given in the table. These ingredients are heated at a certain temperature. We can make glasswares by pouring the molten substance into moulds or by blowing.

Safety glass is made by pressing and binding two glass sheets with a thin plastic sheet held in between them. These are laminated glasses.

Fibre glass is made by passing molten glass through very minute holes in metallic cylinders. Fibre glass is as strong as steel.

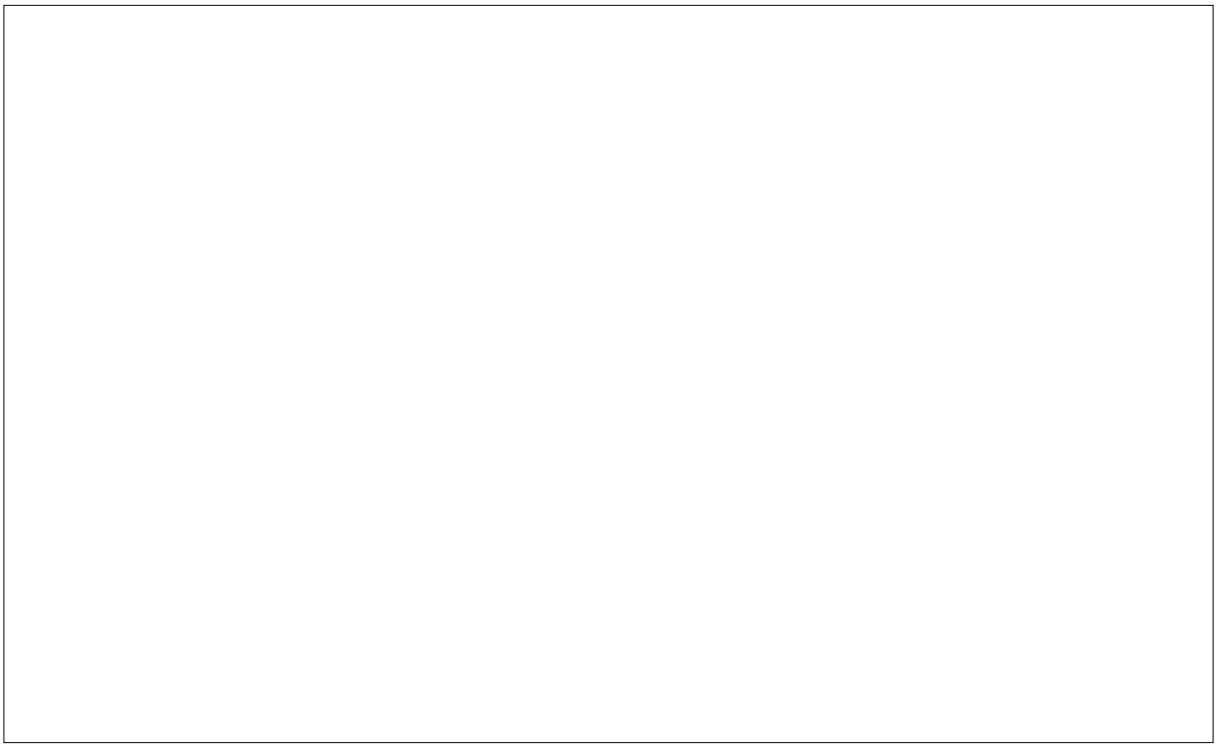

Table 5.5

Different colours can be given to glass using different metallic oxides or ions.

Metal compound/ion	Colour
Ferric ion	Yellow
Ferrous or chromium	Green
Cobalt ion	Blue
Manganese dioxide	Purple
Nickel salt	Red
Cupric oxide	Red
Cadmium sulphide	Lemon yellow
Uranium oxide	Greenish yellow
Cryolite/Calcium phosphate	Opaque milk white colour

Table 5.6

Cement

Cement is a man made substance that has changed the very face of earth. It was with the large scale manufacturing of cement that we were able to construct big townships, cities, factories and many types of buildings. Cement which becomes soft when mixed with water can be moulded into desired shapes, subsequently sets and becomes very hard. This is what makes cement suitable for construction works.

What is cement?

Cement is a complex mixture of aluminates and silicates. Given below are the raw materials used for this (Table 5.7).

Cement of olden days

A building material with properties similar to cement was widely used in the past. This substance is made from lime and is known as slaked lime. When sea shell or lime stone which contain $CaCO_3$ is strongly heated, CO_2 is liberated.

$$CaCO_3 \rightarrow CaO + CO_2$$

Water is added to the CaO thus obtained and the following reaction takes place.

$$CaO + H_2O \quad Ca(OH)_2$$

$Ca(OH)_2$ - slaked lime - can be shaped as one likes and used for construction works. Subsequently, on reacting with the CO_2 in the atmosphere, it becomes $CaCO_3$ which is very firm.

$$Ca(OH)_2 + CO_2 \quad CaCO_3 + H_2O$$

The process which starts with $CaCO_3$ and ends with the same substance.

Compound	Chemical composition	%
Lime	CaO	60-67
Silica	SiO_2	17-25
Alumina	Al_2O_3	3-8
Iron oxide	Fe_2O_3	0.5-6.0
Magnesia	MgO	0.1-4.0
Sulphur trioxide	SO_3	1-2
Soda + potash	$Na_2O + K_2O$	0.5-1.3

Table 5.7

Manufacture of cement

The raw materials are ground into a fine powder and mixed in the fixed proportion. This is heated in a furnace at a high temperature (1500^0C). Clinkers, which is a complex mixture of calcium silicate and calcium aluminate is formed. Gypsum is added to clinker and the mixture is powdered to make cement.

The portland cement that we use commonly contain the following ingredients. (Table 5.8).

Compound	Chemical composition	Percentage
Elite	$3\,CaO.SiO_2$	40 - 65
Belite	$2\,CaO.SiO_2$	10 - 25
Aluminate	$3\,CaO.Al_2O_3$	Up to10
Ferrite	$4\,CaO.Al_2O_3.Fe_2O_3$	Up to 10
Gypsum	$CaSO_4.2H_2O$	Upto 2 – 5

Table 5.8

Action with water

Have you ever thought how cement hardens when water is added? Many reactions take place at the same time when water is added to cement. The aluminates and silicates in cement react with water and undergo hydration. The hydration of aluminates takes place very fast. This is the "setting of cement."

$$3CaO.Al_2O_3 + 6H_2O \rightarrow 3CaO.Al_2O_3 6H_2O + \text{heat energy}$$

Substances like gypsum can control the setting time. You can now explain why gypsum is added to cement during its manufacture. Is the setting of cement exothermic or endothermic?

The mixture of cement, sand and water is called cement mortar. You are familiar with its use in building construction.

Gravel is added to cement mortar to increase its strength. This mixture is known as concrete. This can again be reinforced using steel or iron rods.

Medicines

The living body is made of chemical substances. Any foreign chemical substance that enters a living body can hence react with body tissues and fluids. By inducing suitable chemical reactions in the body through chemicals, diseases can also be controlled. Chemicals used in this way are known as medicines. Chemistry helps in identifying chemical substances that can control disease. Chemicals that can react with protein molecules are usually used as medicines. All the processes in the living body are controlled through enzymes which are proteins. This is why chemicals that react with proteins are used as medicines. For example, when antibiotics react with enzymes in the bacterial cell they are destroyed or their growth stopped.

There are certain receptors on the cell-surfaces which can receive chemical messages that come from nerves and, also, react with hormones. These are also proteins. It is through the reactions with these that medicines attain the intended effect. Analgesics (pain killers) work in this way.

From nature to chemistry

Alexander Fleming discovered penicillin in 1929. This medicine, which could destroy bacteria, was extracted by him from a mold. Medical science was able to eradicate and control many lethal diseases through this medicine. Though it was Alexander Fleming who gave us this medicine that could save the life of millions of people, chemistry too has a claim in this success.

Since the quantity of penicillin separated from mold was very little, it was sold by pharmaceutical companies at very high prices. Very soon scientists discovered techniques to synthesise penicillin. The anti-bacterial properties were analysed and scientists were able to synthesise chemicals with similar properties. This was made possible by the progress of chemistry. Chemistry has enabled us to make many new medicines.

Along with the ability to conduct such reactions, chemicals that are used as medicines must be those that do not cause damage to other cells and chemical systems.

Antibiotics

Certain chemicals produced by bacteria, fungus etc. destroy other micro oganisms or hinder their growth. These are called antibiotics. Penicillin is an antibiotic that is widely used. The names of some antibiotics are given below:

- **penicillin**
- **tetracycline**
- **ampicillin**
- **amoxicillin**
- **chloramphenicol**

Chloramphenicol is an antibiotic that is effective against many disease-causing germs. Since this substance is easily absorbed in the alimentary tract, this is applied as oral medicine in diseases like typhoid, cholera, meningitis, pneumonia etc.

- **Though medicines greatly help protect and maintain our health, does not their indiscriminatory use bring about dangerous side effects?**

  Discuss the above and conduct a seminar.

Agriculture and chemistry

Agriculture is another field where revolutionary changes have come about through the growth of chemistry. When world population increased rapidly, the need for food materials also increased. It was impossible to cater to this increased need through traditional ways of agriculture. Through modern methods of farming, food production multiplied tenfold. 'Green revolution' could take place in a country like India. It was through the application of knowledge of chemistry that the methods of farming could be improved. The most important factor in the modernisation of agriculture was the use of fertilizers which helped the growth of plants. What are fertilizers? How do they act?

Fertilizers

Plants get elements like carbon, hydrogen, oxygen etc. which are essential for their growth, from the atmosphere and water. Besides these elements, sodium, potassium and phosphorous and small quantities of calcium, magnesium and sulphur are also needed. Fertilizers are used mainly to provide these elements. The elements contained in the soil are lost through rain water and repeated farming. Elements needed by the plants can be immediately made available through fertilizers. It has been observed that agricultural yield more than doubles if fertilzers are used in the proper way.

Nitrogen, phosphorous and potassium are the most important constituents of fertilizers. Fertilizers are classified into three types - nitrogen fertilizers, phosphorous fertilizers and potassium fertilizers. The problems that arise due to lack of these elements and the fertilizers that can be used in such situations are given in table 5.9 below.

Element	Problems caused by deficiency of the element	Fertilizer containing the element
Potassium	Yield and disease resistence reduced	Potassium chloride Potassium sulphate
Nitrogen	Cannot make proteins	Sodium nitrate, Calcium nitrate, Ammonium nitrate Ammonium sulphate
Phosphorous	Yield reduced, Fruits does not ripen easily Ability to absorb nitrogen and other elements reduced	Bone powder Calcium phosphate

Table 5.9

Find out the percentage composition of nitrogen in different nitrogen fertilizers. Can you say which fertilizer is the better one?

Insecticides

You know that insecticides have had a great impact in the field of agriculture. Tabulate the various insecticides and their uses.

Insecticides	Uses
1. DDT Baygon	Control mosquitoes and flies
2. Parathion Sevin	Kills insects that destroy crops
3.	
4.	

Weed killers

These are chemicals that destroy the weeds.

Eg: Treflan

Calcium cynamide

Germicides

You have heard of purification of drinking water. What are the methods for this?

- **chlorination**
-

How is water purified by chlorination? Find out and write it in your science diary.

Chemicals that are used to kill harmful virus, fungus etc. are called germicides. Find out more examples.

Like human beings, plants too have enemies and diseases. Worms, insects, rodents and weeds are some of these. To protect the plants from these, we use many chemicals. These chemicals pollute our soil, water and air and many harmful effects have become apparent. Do you know that many insecticides pose grave threats to generations of humans and destroy whole ecosystems?

- **Do the insecticides that we apply to the soil decompose and perish?**
- **Does their use cause air pollution?**
- **Do they cause water pollution?**
- **How do they affect our ecosystem?**
- **To avoid this, can you propose alternatives?**

SUMMARY

- **Thermoplastics are those that undergo physical changes when heated.**
- **Thermosetting plastics are those that undergo chemical changes when heated.**
- **Natural rubber is a polymer obtained from nature.**
- **Vulcanisation is the process of improving the properties of rubber by adding sulphur and heating it.**
- **Glass is a mixture of silicates.**
- **The compounds of transitional elements can provide colour to glass.**
- **Cement is a mixture of silicates and aluminates.**
- **The 'setting' of cement is due to the hydration of aluminates and silicates.**
- **Pharmaceutical chemistry is of great importance. Chemistry has contributed greatly in the manufacturing of fertilizers, insecticides, fungicides, weed killers etc. in the field of agriculture.**
- **Chemicals which have the ability to react with proteins are commonly used as medicines.**
- **Fertilizers, insecticides, weed killers and germicides which are the contributions of chemistry have greatly helped in the improvement of agriculture.**

MORE ACTIVITIES FOR YOU

1. Conduct a study on the dyes used in cotton and polyester clothes.
2. Find out the chemical ingredients of insecticides that are commonly used.
3. Write the balanced equation for making polypropylene.
4. Find out and list the uses of ebonite.
5. Why is flint glass used for making lenses?
6. Find out the common ingredient in medicines used for fever.
7. Polythene is not used for making handles of cooking vessels. Can you explain the reason?
8. Why is water sprayed repeatedly after cement plastering has been done?

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