Chapter
18

Carbon and fuel

Study points

18.1 Presence of carbon

You might have seen the blackness on kitchen walls, glass of lantern, temples where Deepak is lighted. Likewise we have seen smoke from burning of paper, sugar, wood, food oil, clothes and even smokes from vehicles. All the above material contains carbon in major quantities which is seen as black residue. Do following activity to understand the presence of carbon.

Activity 1

Fill a mud Deepak with oil. Now put lamp light (cotton batti) in it. Light it with the help of a match stick. You will observe that cotton starts burning with a yellow flame. Now put a transparent glass slide on this flame in such a way that flow of air does not block. After sometime remove glass slide and observe it. What do you observe over it? You will notice a black layer which is oily on touch. This is a type of carbon called lamp black. This we obtained due to incomplete combustion of oil.

Till now is known as 98 natural elements obtained on or 118 elements. Carbon is the only element which is found in every living organism and in maximum food materials. It is an important element among the 92 elements found in nature. Its symbol is C. The word carbon is formed from a Latin word 'carbo' means coal. The black mark on paper with pencil, kajal of eyes, coal, etc. are carbon only. Carbon is found in free or combined state in dead (life less) things also.

Substances found in nature like sugar, glucose, tea, milk, coal, petrol, diesel, natural gas kerosene, urea, diamond, graphite, etc all contain carbon. Let us discuss in detail the presence of carbon.

18.2. Allotropes of carbon:-

Coals, lamp black, graphite, diamond, are all examples of free forms of carbon. All these are different forms of carbon which we called as allotropes of carbon.

An element found in two or more forms with same chemical properties but having different physical properties, called as Allotropes. The property of element is called Allotropies

Crystalline allotropes of carbon

The allotropes which have a particular or specific structure are crystalline allotropes of carbon. Example: diamond, graphite, fullerenes.

Non crystalline forms of carbon

The allotropes which do not have any fixed structure or geometry of carbon atoms are called as Non crystalline structure of carbon. Examples - coal from wood, lampblack. Etc.

Difference between graphite and diamond

We can differentiate between graphite and diamond as shown in given table 18.1 & 18.2.

Fig 18.1 structure of diamond

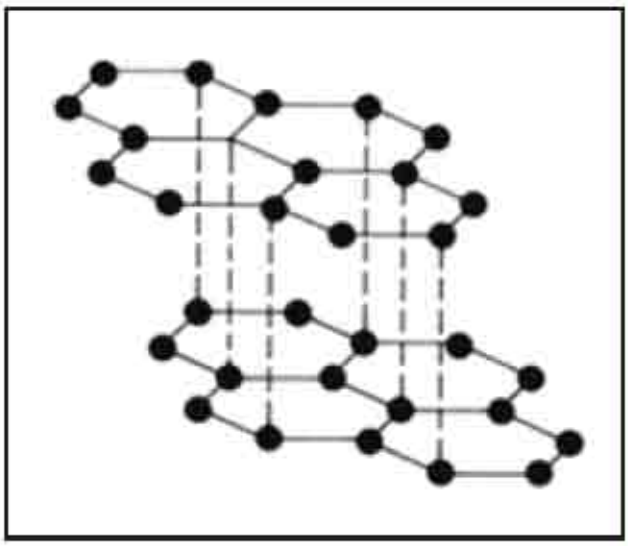
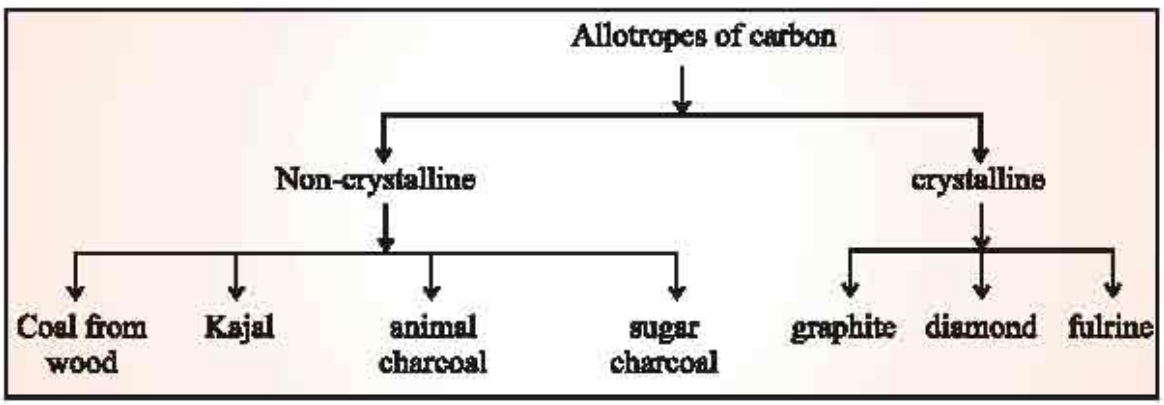


Fig 18.2 structure of graphite

Table 18.1 Difference between graphite and diamond

Properties	Graphite	Diamond
Soft/hard	Graphite is a powdered substance which is oily and gliding in nature	Diamond is transparent and hard.
Structure	Graphite form a hexagonal structure by attaching with three other carbon atom in one dimension only Likewise many layers remain attached to each other through weak bonds, so that one layer slides on another layer. Therefore they are soft.	Carbon atom in diamond forms a tetrahedral structure by joining with 4 carbon and form a three dimension structure.
Electrical conductance	This is conductor of electricity	This is insulator of electricity but conductor of heat
Uses	It is used in pencil, dry cell and in electric arc.	It is used in jewellery, in cutting glasses, in grinding, in making holes.



18.3 Carbon - Important component of fuel.

In daily life we use LPG (Liquefied Petroleum Gas), wood biogas etc as fuel to cook food. Fuel is that substance by the combustion of which heat is obtained. In most of the fuel carbon is found in element or in compound form.

The source of energy in modern age is fuel. Its consuption is rising day by day. Fuel is used as a source of energy in industries, roadways, sea and air transport. Carbon is an important component in all fuels like - petrol, diesel, kerosene, wood coal etc.

We use fuel as a source of energy in our daily life. Write the name of fuel used in following work in table 18.2

Table 18.2 Fuels used in different work.

S.No.	Work or Machine	Fuel used	S.No.	Work or Machine	Fuel used
1	Cooking	LPG	5	Car	Petrol or diesel
2	Heating of water		6	Tractor	
3	Prepare tea		7	Pumping set	
4	Generator		8	Thresher	

18.4 Sources of fuel:-

1. **Biomass:-** The substance present in plants and animals is called biomass like-wood, agricultural waste, cow dung etc.
2. **Crude oil wells:-** Fractional distillation of crude oil yields petrol and other fuels.
3. **Coal mines:-** Coal is obtained as stone from mines.

Fuel is found in all three states of matter.

- Solid fuel: Wood as coal, coal of mines, cow dung, and agriculture waste are all solid fuel.
- Liquid fuel:- Kerosene, Diesel, petrol, gasoline, alcohol etc are liquid fuel.
- Gaseous fuel:- biogas, water gas ($H_2 + CO$), coal gas, producer gas ($N_2 + CO$), natural gas, LPG (Liquefied Petroleum gas) etc are gaseous fuels.

Coal (Solid fuel):

Millions of year ago there were dense forest at eastern lower watery region. Due to natural disaster like flood, these forests buried inside the land and they got compressed due to heavy deposition of soil. Because of high temperature and pressure inside the earth they get converted into coal. The gradual process of formation of coal from dead vegetation in called carbonization. Carbon is the dominant element of coal. As it is formed from plants it is also an organic fuel.

Coal is divided into four types on the basis of carbon content in it.

1. Peat (60% carbon)
2. Lignite (67% carbon)
3. Bituminous (80% carbon)
4. Anthracite (90-98% carbon)

Petroleum (Liquid fuel)

Petroleum is used in almost all vehicles like scooter, motor bike, car, bus, truck etc.

Let us know how petroleum is formed.

Petroleum is formed from the organisms and vegetation of sea. Because of geographical disturbances many plants and animals get buried under sea. Due to high pressure and temperature and absence of air these dead plants and animals converted into petroleum and natural gas in laces of year.

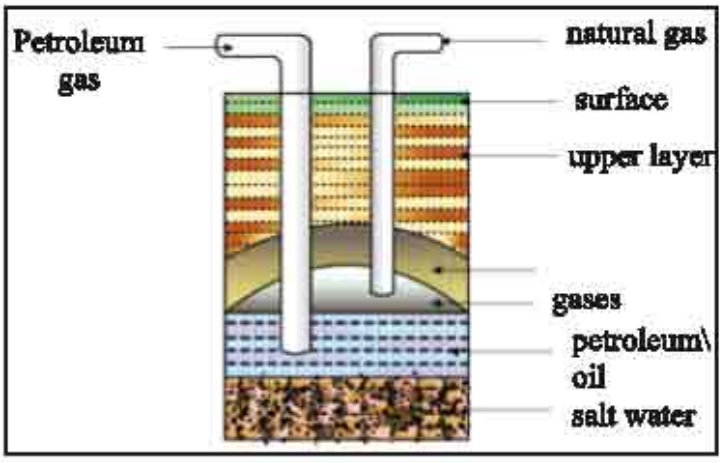


Fig 18.3 extraction of petroleum

First petroleum well of the world was drilled in Penisiluama, America in 1859. After eight years of this discovery in 1867, Mecum of Assam is discovered as oil storage place.

In Rajasthan, Mangla, Bhagyam, Aishwarya, Guda, Rajeshwari, Saraswati, Kameshwari well was discovered in Barmer, Besider there Gujarat, Mumabi, Godawari, Krishna river basin also discovered as oil well in India. The Petroleum is formed from two words of Latin Petra means rock and oleum means oil. It is also called mineral oil as it is found under rocks inside the earth.

Petroleum is also called as liquid gold. Petrol is more expensive than gold for any country in present era. It is used in agriculture, industry, communication, transport etc.

Extraction of Petroleum:-

Petroleum is extracted from fractional distillation of crude oil.

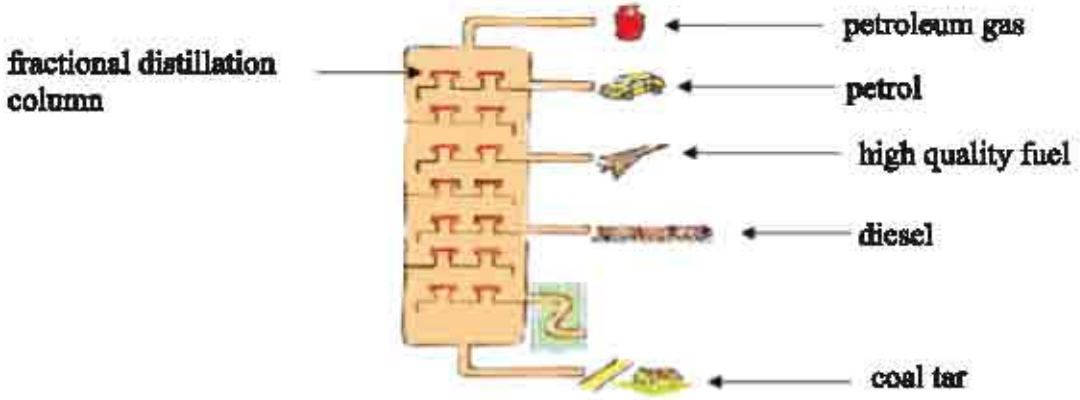


Fig 18.4 fractional distillation of petroleum

Look at picture 18.4. Petrol and petroleum gas is above the layer of diesel in the diagram. Why oil and gas are lighter than diesel?

Petrol is dark brown in colour and is dense oily liquid. This is a mixture of many hydrocarbons. Extracted petroleum is in the form of crude oil and is not used as it is. The component of petrol like petroleum gas, petrol, neptha, diesel, kerosene etc. has different boiling points. Crude oil is filled in fractionating column (vertical cylindrical container) and heated slowly. First petroleum gas, than petrol, neptha, kerosene, diesel change into vapor and moves upward in the column, which are then condense at different level and collected separately. This process is called fractional distillation.

1. **Petroleum Gas:-** Petroleum gas get separated at 250°C to 300°C temperature in fractionating column. It is mainly used in vehicles and in Kitchen as fuel. It is mainly a mixture of ethane, propane, butane, isobutene etc. This gas can be easily liquefied at high pressure, which is called Liquefied Petroleum Gas (LPG). At the time of packing Mercaptan (Thiol) is mix with it so any leakage of gas can be identified with its smell. Use of LPG is increasing day by day. This gas gives more heat in less time. It do not pollute atmosphere and does not produce ash.
2. **Petrol:-** At 30°C to 120°C temperature in fractioning column petrol in obtained. It is used as fuel in vehicles and in Dry cleaning.
3. **Neptha:-** It get separated at 120°C to 180°C. temperature. It is used as fuel and in chemical reactions.

Fig 18.5 Mangla petroleum, Barmer

4. **Kerosene:-** It get separated at 180° C to 260° C. Used in stoves, lamps, jet planes, chimneys etc.
5. **Diesel:-** Obtained at 260°C to 340°C. Used in heavy motors, truck, tractors, generators etc.
6. **Lubricants:-** At 350°C lubricants are separated.
7. **Paraffin wax:-** Used in wax, shoe polish, wax paper etc.
8. **Dammar/coal tar:-** It get separated at 600°C of temperature. It is the last residue of fractional distillation. It is used in construction of road.

Let us know it also

Compressed natural gas (CNG):- The gas obtained from extraction of petrol is called natural gas. The main gas is methane (CH_4) in it. It is used in vehicles as fuel. It is compressed and fills in cylinders, and hence called as compressed natural gas.

Petroleum is a non-reversible source of energy as it is a product of a process of million years. The sources of petroleum are limited, which can last for only few years. The use of petrol and diesel like fuels increases the pollution level, so we should use sensibly. If we use more petrol, diesel etc. then it may possible that in few years these get finished.

18.5 Combustion:-

The combustion is burning of any substance in the presence of oxygen

Activity 2

Burn a candle. It produces light and energy. If you cover this candle with any container what will you observe? The candle stops burning after sometime. Why does it happen? Let us understand:

For burning of any substance oxygen is required. The temperature at which any substance burn is called burning temperature. If any substance gets sufficient oxygen it burns with blue flame and is called complete combustion. Example combustion of LPG.

If a substance burn in insufficient amount of oxygen, it burns with yellow flame. It is called incomplete combustion. Example: combustion o wood. The incomplete combustion of any substance pollute environment.

Combustion: a chemical reaction that occurs when oxygen combines with other substances to produce heat and usually light. It is called combustion

List the substances undergoing complete and incomplete combustion. For combustion of any substance the following three things are necessary.

1. Oxygen
2. Particular or optimum temperature
3. Fuel

You might have heard that in summer season due to high temperature, dry grass capture fire and even forests came under fire. Sometimes coal dust in coal mines starts burning automatically. Why it happens? Think and Discuss with your classmates.

18.6 Energy conservation:-

You have learned about natural source of fuel in this chapter. These can be exhaust at any time. You know that coal and petroleum are Biomass fuel, laces of year required for the conversion of dead plants and animals into fuel. On the other side these get exhausted in few hundreds of year. These are related or responsible for global warming. Therefore it is important for us that these fuels should be used at utmost necessity. Due to which environment may be conserved, less chance of Global warming and fuel will be available for longer time.

PCRA (Petroleum Conservation Research Association) in India advice people how to conserve petrol and diesel while driving:-

1. Drive your vehicle with constant and medium speed.
2. Switch off the engine on red lights.
3. Maintain your vehicle and keep the air presence absolute in tyres.

What you have learnt

- The blackness on burning lantern, lamp etc is of carbon.
- The symbol of carbon is 'C'.
- Carbon is found in as free or combined state.
- Allotropes are substances with similar chemical proportions but different physical properties. Carbon has two allotropes, crystalline and non crystalline.
- The structure of graphite is hexadiagonal. (Structure of diamond is three dimensional and it has continuous network of tetrahedral carbon atoms.)
- Carbon is important component of fuel.
- The sources of fuel are Biomass, wells of crude oil, coal mines etc.
- Fuel is of three types (1) Solid fuel (2) liquid fuel (3) Gaseous fuel
- LPG gas is used for cooking as domestic fuel.
- Fractional distillation is done in industries and many substances are obtained from it - like - Natural gas, petrol, diesel, kerosene, Neptha, wax, lubricants coal tar etc.

Exercises

Choose the correct option:

1. The coal in which carbon content is highest?
   (a) Peat (b) Lignite
   (c) Anthracite (d) Bituminous ( )
2. The residue of fractional distillation of petroleum is.
   (a) Lubricant oil (b) wax
   (c) Coal tar (d) Diesel ( )

3. The crystalline allotrope of carbon is.

(a) Coal (b) Kajal

(c) Charcoal (d) Graphite ( )

Fill in the blanks:

1. _____ is the domestic liquid fuel.
2. In graphite each carbon atom is attached to _____ nearest carbon atoms while in diamond each carbon atom is attached to _____ nearest carbon atoms.
3. _____ is necessary for combustion.

Put right (✓) for correct and wrong (×) for incorrect of the following.

1. The carbon content in Lignite is 67% ( )
2. Peat coal is an example of liquid fuel ( )
3. Lubricant oil is used as fuel in vehicles and kitchen ( )
4. The crystalline allotropes of carbon are diamond, graphite and fullerin. ( )

Short answer type questions:

1. Write uses of petroleum gas.
2. We should sensibly use petrol and diesel like substances? Explain why?
3. Write differences between diamond and graphite.
4. Compare LPG and wood as fuel.
5. Name five compounds of carbon.

Long answers type questions.

1. Draw a well labeled diagram of diamond and graphite and explain their difference.
2. Write your views in the following table and also discuss with other students.

Advantages of uses of petroleum as fuel	Disadvantages of uses of petroleum as fuel

3. The use of petrol, diesel and kerosene is rising day to day. Their smoke is mixing with air and causing air pollution. Write your suggestions and views for reducing air pollution.
4. List the fuel used in daily life.
5. Draw the diagram of extraction of petrol and label it.
6. Differentiate complete and incomplete combustion. Explain with example.

Activity work

1. Prepare of comparison between types of coal.
2. Prepare a model of fractionating column with the help of cardboard and plastic pipes.
3. Write a note on extraction of petroleum in Rajasthan.

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Road Safety

Road Accident

If we do not follow rules while moving on road ways. What will happen? Let us think on it.

Driver do not follow rules while driving then vehicle collides with another vehicle. It means due to road traffic minor or major injuries are caused.

This is called 'Road Accident'. Because of this, sometimes it lead to death of a person, so on the road driver should obey the road traffic properly.

Reason of Road Accidents

What is the main reason of road accidents? Did you ever try to know? Let us try to know main reasons of road accident. Road accidents do not occur only because of carelessness but also because of high speed.

In developing countries 64% to 95% road accidents happen due to driver's mistake. Important points is that there is a reason behind every road accident. Which are as follows -

1. Fast speed of vehicle,
2. Carelessness of driver
3. Drinking while driving
4. Not following the traffic rules.
5. Ignoring wearing helmet and seat belt while driving.

Do you Know?

- Every year 1.38 lakhs people die in road accident in India and about five lakhs people are injured.
- In Rajasthan, every year about 9000 people die in road accident and about 23000 are injured.

Adworse effects of road accident

Effect of a road accidents fall on family, society, state and on country. Road accidents badly affect the patient and their family. Some examples are as follows -

1. Lost of vehicle or property
2. Economical loss
2. Government and Legal actions taken
4. Person being handicapped or died.

Some basic ideas to stay away from road accidents - What can reduces in these road accidents? Let us know about it, how can be safe from road accidents - e.g. use of helmet or seat belt, compulsion of license for drivers, so follows informational indication which is shown on roadways, to drive vehicle normally, to park vehicle on appropriate place, to use white zebra crossing while ready to cross a road, do not driven when drunk, use of indicator while changing lane, well known about traffic light and drive by its indication.

Do you know ?

1. After completing about 16 years old age, a temporary license can be provided for non-gear vehicle.
2. After completion of 18 year old age, permanent license card is provided for gear vehicle.

Road security, a public issue

Being a civilian, everyone should follow the rule of road security. By which we can stop road accidents. So that, we can give safe and secure future to our society and country.

Important Numbers :	
• Police	100
• Fire	101
• Ambulance	102
• Emergency helpline	108
• Women's security helpline	104