

## Module-4

## Notes

**BIOGAS CONSTITUENTS**

Biogas is the mixture of gases, consists mainly of methane ( $\text{CH}_4$ : 60%) and carbondioxide ( $\text{CO}_2$ :40%) plus traces of hydrogen sulphide ( $\text{H}_2\text{S}$ ) and several other gases.

Biogas may be used in the following three ways:

- (i) Direct combustion for cooking,
- (ii) Generation of electricity, and
- (iii) Purification and export as compressed gas or in liquid form, just like CNG gas cylinders

**FEED**

Following feed is generally used in most of the biogas plant:

1. Cow dung,
2. Human excreta,
3. Non edible oil cake (like Mahuva),
4. Food waste,
5. Any material which has starch content.

**Advantages of Biogas**

1. The technology is cheaper and much simpler.
2. Slurry is very good manure and can be used as fertilizer and also in preparation of vermicompost.
3. Waste material is used to generate electricity as well as good fertilizer.
4. The digested material coming out of the plant will not have any odor and there will not be any mosquito/insects breeding on the same.

**3.4 BIOGAS PLANT**

A typical biogas plant is shown in the figure.

Biofuels: how Bio Gas is Generated.

Floating gas holder type of plant. The diagram below shows the details of a floating gas holder type of bio gas plant.

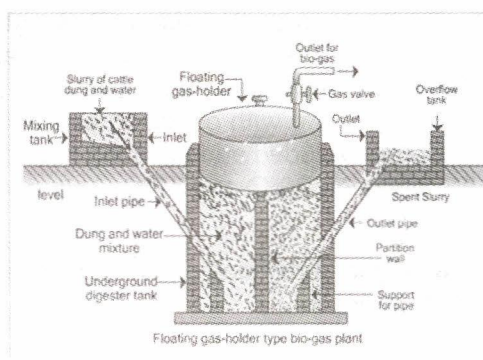
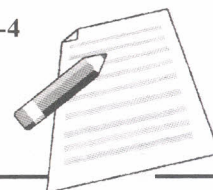


Fig. 3.1 : Biogas Plant

*Notes*

It has following components:

1. Feed Inlet: From where feed is fed into the system.
2. Digester tank: Where the feed and water will stay for some and bacterial operation will get completed.
3. Gas holder: It stores biogas generated.
4. Outlet gas: Gas generated is supplied through outlet valve.
5. Outlet slurry: Slurry is discharged from outlet pipe.

### **Types of Biogas plant**

Based on various designs of digester, biogas are classified as:

1. Floating Dome type (KVIC Model).
2. Fixed Dome type (Janata Model).

#### **1. Floating Dome type (KVIC) type:**

In this model the gas stored in a tank. The tank is floating in slurry. Tank goes up as the gas gets generated and it lowers when the gas is consumed. The size of tank depends on the size of the feed. Normally, it is 50 times the amount of feed available per day. For Example if 20lits. of dung water mixture is put into a plant every day. We need tank of  $20 \times 50 = 1000$  Ltr. capacity.

Generally, tank is made out of iron sheets. Therefore, cost of the biogas goes up. Recently many organizations started using PVC tanks.

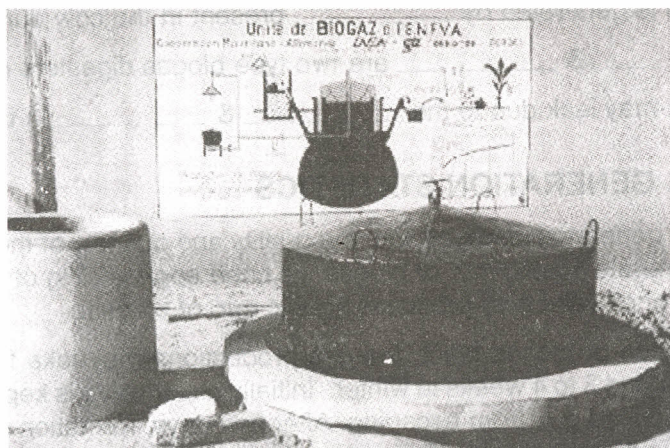


Fig 3.2 : Photo of Pabal biogas plant

#### **2. Fixed dome type (Janata Model):**

It is built either of cement-concrete or brick-walled. The gas is stored in the upper dome. With increase in gas, pressure in dome rises up. It pushes of the digested material out of the tank. The cost of a fixed-dome biogas plant is relatively low. It is simple as no moving parts exist. There are also no rusting steel parts and hence, a long life of the plant (20 years or more) can be expected. Fixed-dome plants are not easy to build. They should only be built where con-



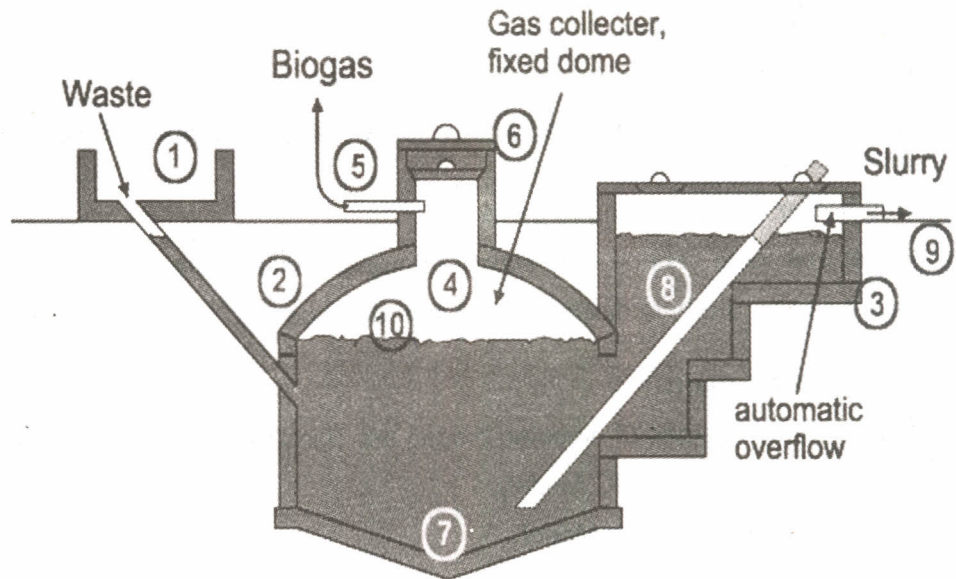


Fig. 3.3

struction can be supervised by experienced biogas technicians. Due to the porosity & cracks, gas generated may leak.



### INTEXT QUESTIONS 3.1

1. Fill in the blanks:

1. Biogas is generated by \_\_\_\_\_ present in the cow dung.
2. \_\_\_\_\_ & \_\_\_\_\_ are two type biogas digesters available.
3. Biogas may leak due to the \_\_\_\_\_ & \_\_\_\_\_ in the tank.

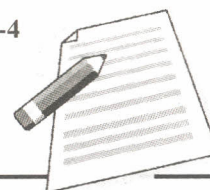
### 3.5 BIOGAS GENERATION STATISTICS

Amount of gas generated changes with the quality and quantity of the feed. For example to generate 1 cubic mtr. of biogas we need approx 25kg of cow dung. Whereas 3 kg of oil cake also produces 1 cubic mtr. of biogas.

After installation of biogas plant, the gas productions may take from a few days in summer and 3 to 4 weeks in winter. Initially outlet valve is kept closed to prevent the produced gas from escaping. After few days, formation of bubbles will be noticed in the outlet tank. The gas is allowed to accumulate till it almost pushes the slurry to the level of outlet opening.

The initial gas has more carbon dioxide ( $\text{CO}_2$ ) and less of methane ( $\text{CH}_4$ ). It has oxygen as well as some other gases. This mixture of gases is allowed to escape by opening the outlet.

The gas is again accumulated for 3 days, now the biogas will burn with a blue flame and ready for use. This gas will not have any odor while burning. Proportion of fresh dung and water for feeding is 1:1 i.e. (50% fresh dung(kg) and 50% water (ltr).


*Notes*

Daily feeding of fresh cow dung per capacity of biogas is as below:

Capacity of Biogas	Required Dung	Water (LTR)
1 M <sup>3</sup>	25 Kg	25
2 M <sup>3</sup>	50 Kg	50
3 M <sup>3</sup>	75 Kg	75
4 M <sup>3</sup>	100 Kg	100
6 M <sup>3</sup>	150 Kg	150

### 3.6 BIOGAS STOVE

Biogas gets generated at atmospheric pressure hence normal LPG gas stove will not work directly on biogas. You need to remove the pressure reducing pin from the LPG stove to operate the stove on biogas.

### 3.7 BIOGAS GENERATOR

Normally, 15KW above genset are available in the market which can be directly run on biogas. We can use dual fuel (Diesel + biogas) attachment on any diesel generator, can produce the required power.

Alternatively, if all other gases (CO<sub>2</sub> + H<sub>2</sub>S + moisture etc) are removed from the biogas, then only methane remained. This methane can be compressed and used like Compressed natural gas (CNG) to run automobiles, generator.



#### INTEXT QUESTIONS 3.2

Fill in the blank:

- 1) Biogas is a mixture of \_\_\_\_\_ and \_\_\_\_\_ gases.
- 2) Proportion of fresh dung and water for feeding in biogas is \_\_\_\_\_.
- 3) Daily the fresh dung slurry is added back in biogas plant to maintain the \_\_\_\_\_.
- 4) 2 M<sup>3</sup> biogas requires \_\_\_\_\_ Kg dung & \_\_\_\_\_ Ltrs. of water.
- 5) Initially biogas has a bad odor, due to the presence of \_\_\_\_\_ gas.
- 6) To produce electrical power, \_\_\_\_\_ Attachment is used on any \_\_\_\_\_ Generator.

Factor affecting production of gas:

Temperature – Lower the temperature, lesser is the gas yield. If the temperature goes down especially in winter it is advisable to use hot water to make slurry.

### 3.8 MAINTENANCE TIPS FOR BIOGAS PLANT

1. We must feed the biogas continuously. If biogas plant shuts down, it will take again 40 days to generate the biogas.



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2. Check biogas plant for leakages using soap solution.
3. In floating dome type, paint the dome regularly to avoid rusting.
4. Check for any blockages in pipe line etc., frequent observation is must on the regular basis.

**3.9 WHAT YOU HAVE LEARNT**

In this lesson you have learnt

- What is biogas?
- Different types of biogas plant.
- Feed to be used and procedure to use biogas.
- Uses and precautions while maintaining the plant.

**3.10 TERMINAL QUESTIONS**

- 1) Write flow chart of operation of biogas plant.
- 2) Write the major differences between the floating dome & fixed dome.
- 3) What are the other feeds used to generate the biogas.
- 4) Why biogas can't work over the LPG stove? How we can make it to run?
- 5) Why in winter the gas production diminishes?

**ANSWER TO THE INTTEXT QUESTIONS****3.1**

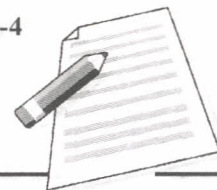
1. bacteria
2. floating dome & fixed dome
3. porosity & cracks

**3.2**

- 1) Methane and Carbon dioxide
- 2) 1:1
- 3) The microbial population
- 4) 50 Kg & 50Ltr.
- 5) Hydrogen Sulfide
- 6) Dual fuel, diesel

**SUGGESTED ACTIVITY**

Visit the nearby biogas plant & study the details discussed in the lesson.



## SOLAR ENERGY

### 4.1 INTRODUCTION

Since the evolution of the earth, SUN is being the main source of human & plant life, as source of light, food production (photosynthesis) and growth. After the advancement in the solar technology the sun's energy is utilized for various energy applications like heating water, cooking food, power generation, etc.

Sun gives us energy, which arrives on Earth as a mixture of light and heat. Both of these are incredibly important—the light makes plants grow and provide us food, while the heat keeps us warm enough to survive. We can use the Sun's light or heat in many ways like Solar Cooker, Solar Heater, Solar Cells etc. In this lesson, we are going to study how solar energy can be utilized in different ways in our day-to-day life.

### 4.2 OBJECTIVES

After reading this lesson, you will be able to:

- understand the basic principle of solar cells and their structure.
- learn skills required in installation & maintenance of solar cells.
- understand the types and function of solar cooker.
- how to use solar cooker efficiently.
- make maintenance of solar cooker.
- discuss the use of smokeless chullah.

### 4.3 SOLAR CELLS

Solar cells are becoming more popular in places where it is not possible to provide electricity from the power grid and load shedding areas. The cost of solar cells has come down because of advancements in the semiconductor technology and mass production of solar cells. On an average, every square



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meter of Earth's surface receives 164 watts of solar energy. This solar energy, in the form of solar, cells can be used directly to run a television or a car.

### Basic principles of solar cell lighting system

The solar radiation falls on solar cells which converts sun light directly into electricity. Some solid materials like semiconductors generate free electrical charges upon absorption of a photon from sunlight.

Most solar cells are made from silicon. Silicon cell has property of both - a conductor and an insulator. When light falls on semiconductors, electrons starts flowing in semiconductors and current is produced. In order to get the desired voltage and current, solar cells are connected in series - parallel arrays is called 'solar panel'.

### 4.4 STRUCTURE OF SOLAR CELLS

A solar panel is a large rectangular flat plate, made up of many individual **solar cells**, covered with a protective sheet of glass.

Solar cells are also called **photovoltaic cells(PV cells)** because they use sunlight. "photo" comes from the Greek word which means 'light' and 'Volt means to generate electricity ( Volt ). Also 'Photon' means the energy packet which collects the energy from the sun & further transfers to the next cell through the motion of electrons.

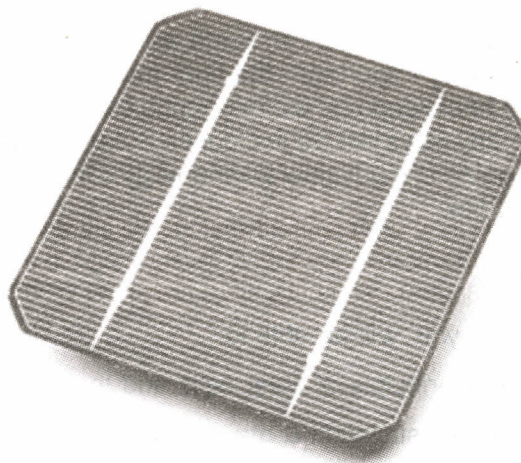


Fig. 4.1 : Solar Cell

### 4.5 ADVANTAGES AND DISADVANTAGES OF SOLAR LIGHTING SYSTEM

#### Advantages of Solar Lighting System:

- Once solar panels are installed, they produce energy without generating waste or pollution. They operate with little maintenance or intervention.
- Solar power generation is economically competitive where grid connection or fuel transport is difficult, costly or impossible. For example, satellites,



- hilly areas, remote locations and where power is not available.
- The DC power generated from the panels will be supplied to batteries to get charged.
- Inverters can also help us in conversion of DC to AC.
- This pumps can also be operated for lifting the water (moderate height)
- Operational cost is almost negligible.

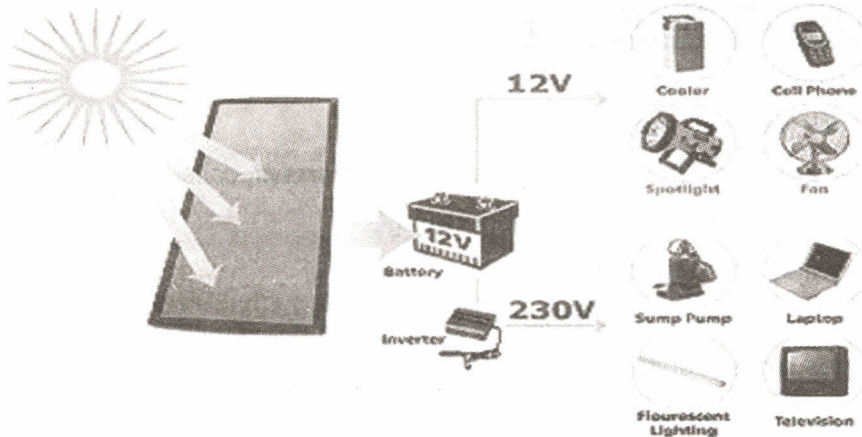


Fig. 4.2 : Schematic fig. shows the varied application of solar panels

## Disadvantages of Solar Lighting System:

- Solar energy systems do not work at night.
- Solar cells are currently costly and require a large initial capital investment. At present, solar panel cost about approx. Rs.300 per watt.
- For larger applications, big size batteries are required.
- Maintenance of batteries is always the critical issues.
- Solar cells are very delicate (need to be handled carefully)
- Need high precision machinery for the assembly of panels.
- The dust from the silicon cells is dangerous to health (while assembling the panels)

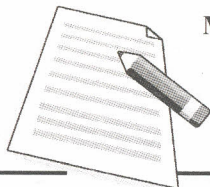
## 4.6 LIGHTING SOLUTION

Selection of proper lighting device is very much important for optimum usage of solar energy. Following is comparison of different light sources.

Sr. No.	Parameter	Kerosene Lantern	Incandescent	Compact Fluorescent	Wled
1	Efficiency (Lumens/watt)	0.03	5-18	30-79	25-50
2	Rated Life (Hours)	Supply of kerosene	1000	6500-15000	50000



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3	Durability	Fragile & Dangerous	Very Fragile	Very Fragile	Durable
4	Power consumption	0.04-0.06 Liters/hour	5W	4W	1W

From the table it is clear that White Light Emitting diodes (WLED) gives maximum lumens per watt. (Lumens is unit to measure light intensity). This means we save almost 1/5 of energy compared to incandescent bulb if LEDs are used.



### INTEXT QUESTIONS 4.1

Fill in the blanks:

- 1) The solar cells are made up of \_\_\_\_\_.
- 2) A solar cells are connected in series – parallel arrays, called \_\_\_\_\_.
- 3) Solar energy system does not work during \_\_\_\_\_.
- 4) Energy packet is also called \_\_\_\_\_.
- 5) \_\_\_\_\_ cells dust is hazardous for the health.
- 6) Requires higher capital for the manufacturing of \_\_\_\_\_.
- 7) \_\_\_\_\_ is method by which \_\_\_\_\_ produce their food.

### 4.7 SOLAR COOKER

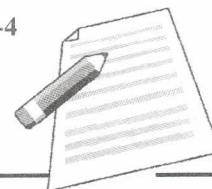
A **solar cooker** is a device which uses sunlight as a source of energy. It requires no other fuel to run. In India we get almost 250 sunny days. In this way solar cooker is an important substitute for cooking purpose in India. All solar cooker use sun light and heat to cook food.

Generally, cooking requires a temperature around 100°C (Boiling Point (BP) of water). From sun we get the temperature near about 35°-40°C. By making proper arrangements in solar cooker device we can trap the heat cook very efficiently, saving huge amount of wood, kerosene and other possible fuels. Owing to this reason, the need of solar cooker has increased domestically.

#### Principles of Solar Cooker

All solar cookers use the sun's heat and light to cook food. The basic principles of solar cookers are:

- **Concentrating sunlight:** Initially sun rays are scattered and need to concentrate for higher temperature & heat. Mirrors or reflective metals are used to concentrate light and heat from the sun into a small cooking area.
- **Converting light to heat:** Sunlight heats the pan. A black pan will absorb almost all of the sun's light and turn it into heat. Solar cooker absorb maximum heat from sunrays.
- **Trapping heat:** Air flow will cool the surface. Therefore, air inside the cooker is isolated from the outside air. For better efficiency the collected heat need to be trapped.



Notes

## 4.8 TYPES OF SOLAR COOKERS

### 1) Box Type Solar Cooker :

The box type solar cooker consists of a rectangular box insulated on the bottom and sides & having two glass covers on the top.

A single glass reflector whose inclination can be varied with the attachment to the box. Temperature up to 150 deg. C can be reached in the cooker. But food containing water can be heated up to 100 deg. C.

Since temperature is not increasing beyond particular limit, there is no danger of food getting over cooked.

Various parts of Box type solar cooker are :

- (1) Outside lid
- (2) Glass reflector
- (3) Cooking utensils
- (4) Inside cover
- (5) Double glass cover
- (6) Box
- (7) Handle
- (8) Inclination Adjustment.

### 2) Concentrated Type Solar Cooker :

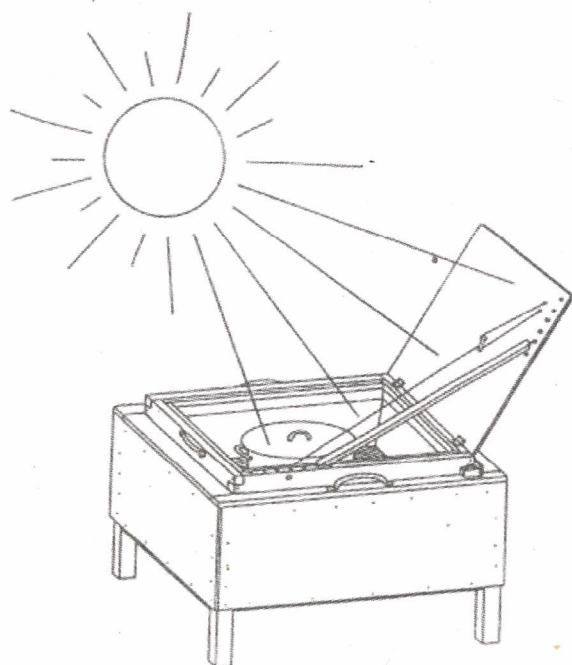


Fig. 4.3 : Box type Solar Cooker



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In this type the radiation is concentrated by a parabolic (Curved) reflecting surface concentrating the radiation towards the focus. The cooking vessel is hence placed at the focus of the parabolic mirror. These cookers requires system to track sunlight. Temperature above  $200^{\circ}\text{C}$  can be achieved in such cookers. The reflecting surface can be glass mirrors, aluminum sheet and aluminum foil.

The main limitation with these cookers is that it requires constant attention to track the sun, as a result the operator has to be all the time in sun but can be compensated by automatic tracking system. Another disadvantage is that except for glass, the reflectivity of all other surfaces decreases with the passage of time. The concentrated cookers are useful where large number of meals to be prepared at the same time on daily basis like hostels, hotels, pilgrimage places etc.

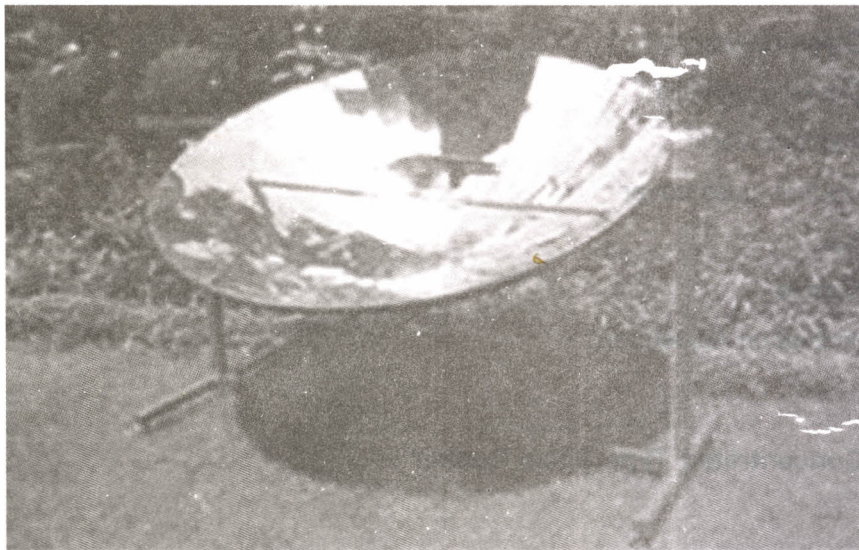


Fig. 4.4: Concentrator Type Solar cooker

#### 4.6 USE OF SOLAR COOKERS

Following are the basic principles for using solar cookers:

- 1) Food should be cut into smaller pieces for better cooking.
- 2) For food items like rice, use minimum amount of water.
- 3) Make sure that the shadow will not come on the sunlight facing area of the cooker.
- 4) Do not open the cooker for stirring because it will allow trapped heat to escape.
- 5) The reflecting surface need to be cleaned regularly for better performance.
- 6) Cooking time changes according to the place, climate & availability of sun. Time mentioned in the recipe books are indicative under standard conditions and need to check.

**Advantages of Solar Cooker:**

*Notes*

- (1) It does not require constant presence while cooking.
- (2) Since food cooks slowly, it becomes more nutritious.
- (3) The fibers in the cereals remain intact.
- (4) It does not require fuel. It requires only sunlight.
- (5) It can also be used as an oven for baking.

**Limitations of Solar Cooker:**

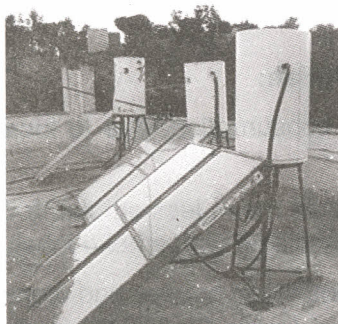
- (1) Solar cooker does not work on a cloudy day and during night.
- (2) It can not be used for frying and making chapattis.

**Cooking Time & duration :**

The best time for cooking is between 9 am to 4 pm during summer & 10 am to 3 pm during winter. The time taken for cooking depends upon type of food and sunny days.

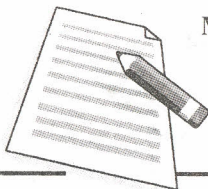
**INTEXT QUESTIONS 4.2****Write True or False:**

1. Solar cookers can be used in a rainy (Cloudy) season. ( )
2. Solar cookers can be used for frying. ( )
3. Temperature around 100°C is obtained in a solar cooker. ( )
4. Red colored utensils are used in a solar cooker. ( )
5. Solar cooker requires sunlight. ( )
6. Solar cooking is advantageous in maintaining the nutritious value of the food. ( )

**4.7 SOLAR HEATER**

Solar heaters are used to heat water for bathing, for industrial use etc and they are very economical.





Photograph showing typical solar heater installed for domestic purpose.

#### How it works?

A cold water is passed through series of pipes ( black coated ) inside a insulated box with glass fitted on it. Due to continuous flow of water under the sunlight, the water gets heated and stored in the collection tank. The equipment is working on the basic principle of "Thermo symphon"

Department of Renewable energy, Govt. of India, provides financial help to use solar energy.

### 4.8 SMOKELESS CHULAH

A **stove** is a very basic device used for cooking by burning wood. Most of the people living in rural areas use wood as fuel. Major problem with old stove is that it increases health problems from smoke particularly respiratory problems and eye ailments. The use of wood leads to deforestation. Therefore, we must work to increase efficiency of the stove.

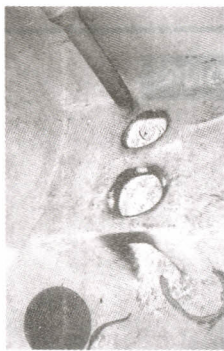
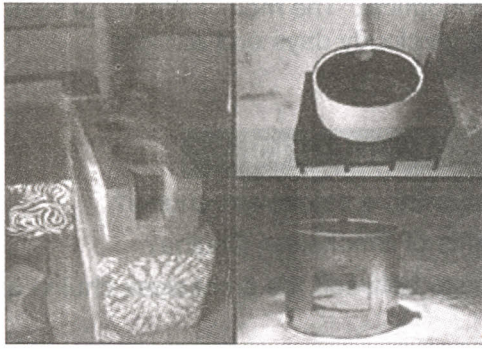
The traditional method of cooking in rural areas is on Chulah. The fuel is burnt under cooking pot. The thermal efficiency of this chulah is about 5 to 15 %. It requires large quantity of fuel. The smoke makes the cooking pots dirty and increases the work load of women. The smokes also create the problem of eye and chest diseases in women, take more time to cook. Smoke entering into the kitchen room leads to 'Indoor air Pollution' ( IAP).

Smokeless chulha doesn't mean without smoke. It generates smoke but it is vented out of the room using pipe. The idea of a smokeless chulha is to not let all of the smoke come out and get on your face while cooking.



#### Benefits of Smokeless Chulah:

1. The reduction in wood consumption, due to increase thermal efficiency (20-25%)
2. The chimney system would mean less smoke in the kitchen, lessening of respiratory problems associated with smoke inhalation.
3. Removal of smoke means clean houses and utensils.
4. Reduces the cooking time.
5. Utensils bottom won't get blackened.



#### 4.9 MATERIAL NEEDED FOR SMOKELESS CHULAH CONSTRUCTION

- 1) Bricks or mud made out of:
  - a) Clay – 1 Part
  - b) Sand – 5 part
  - c) Bhoosa or paddy husk or cow dung.
- 2) Chimney made of metal or asbestos cement pipe.
- 3) Cap on the chimney top, to protect chimney from entering rain into and also controlling sparks leaving the chimney area.



#### INTEXT QUESTIONS 4.3

Write True or false:

- 1) Smokeless chulha is a pollution free stove.
- 2) Smokeless chulha saves wood.
- 3) Smokeless Chulha blackens cooking pots.
- 4) Smoke creates problem for eyes.
- 5) Three stone cooking stove decreases the Indoor air Pollution.

#### 4.10 WHAT YOU HAVE LEARNT

In this lesson, you have learnt about the uses and application of Solar cooker, Solar cells, solar heater and smokeless and that food cooked in solar cooker is



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**4.11 TERMINAL QUESTIONS**

more nutritious and economical. The main limitation of solar energy devices is that they can't be used on cloudy days and at night.

- 1) What is the need of using a smokeless chulha?
- 2) What are the benefits of Smokeless Chulha?
- 3) What is the difference between the smokeless chulha and a conventional Chulha?
- 4) What is IAP? What are its problems?

**4.12 ANSWER TO INTEXT QUESTIONS****4.1**

- 1) Silicon
- 2) Solar Panel
- 3) Rainy Day
- 4) Photon
- 5) Silicon
- 6) Solar Cell
- 7) Photosynthesis; plants

**4.2**

- 1) False
- 2) False
- 3) True
- 4) False
- 5) True
- 6) True

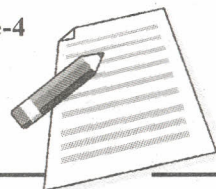
**4.3**

- 1) True
- 2) True
- 3) False
- 4) True
- 5) False

**4.13 SUGGESTED ACTIVITIES**

Find out cost & time of fuel required to heat 10ltrs. of water using kerosene, wood and LPG. Also find out the time required for the same on solar heater. Find out cost of the solar heater suitable for one family and find out in how many years the investment will be recovered from the saving in fuel cost.

Similarly find out the cost, time required to cook 1 kg of rice on kerosene, LPG, wood and solar cooker. make a study and find out, which is the feasible method for cooking application.



## GROUND WATER RESOURCES

### 5.1 INTRODUCTION

70% of earth surface is occupied by water. If we start measuring water on the earth then the figure will be too big even if we measure it in cubic kilometers.

If all water on earth is imagined to be filled in kerosene bottle (700ml) then available drinkable water will be equal to maximum one tablespoon. Out of which only 7 drops from it will be in the lakes and rivers. Remaining water is percolated as ground water.

### 5.2 OBJECTIVES

After reading this lesson, you will be able to:

- Understand the effects of water level in well.
- Know different resources of water.
- Learn advantages of ground water.

### 5.3 RESOURCES OF WATER

There is more ground water than the water in the rivers and lakes. Ground water means water percolated in the ground through cracks and pores of the sand/soil.

Total water on the earth always remains constant. It never increases or decreases. Water from ocean evaporates. These water vapors form clouds. When clouds get condensed due to low temperature, it rains. Rain water percolate in the ground, flows through the rivers and at the end goes to the sea. The same water again evaporates to form cloud. In this way same water gets rotated in different form. This is called the hydraulic cycle.



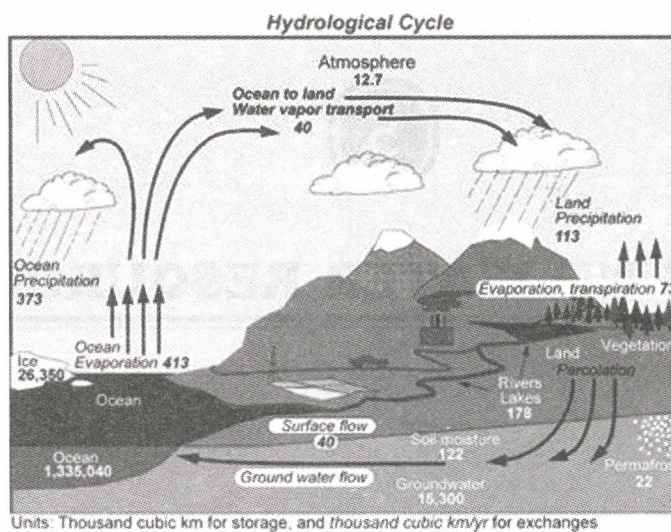


Fig. 5.1 : Hydravloc Cycle

**Total water available in the world**

	World(Km <sup>3</sup> )	India(Km <sup>3</sup> )
1) Evaporation:		
On the ocean	350,000	
On the ground	70,000	2,300
2) Rain, Snow & water:		
On the ocean	320,000	
On the ground	100,000	4,000
3) In the Ocean:		
Flowing water		
Through the river	28,000	1,100
Through the land	600	

**5.4 GROUND WATER**

While raining some amount of water gets evaporated. Some water gets percolated in the ground. If it rains heavily then water gets accumulated and starts flowing toward downward side. Water which gets percolated inside the ground is called ground water. There are sand, soil, cut stones and rocks on the ground. Rock has cracks in between and water gets percolated slowly through it.

**When less water gets percolated?**

- 1) When soil particles are small  
For example Chikni mitti.
- 2) When land slope is more.
- 3) When heavy rain pours in  
Less time.

**When more water gets percolated?**

- 1) When sand or soil particles are like  
beach sand for example  
Bhusabushit.
- 2) when land is flat.
- 3) when same rain falls over longer  
duration of time.



Soil and rocks are porous. Water, which enters into it, tries to go deep due to gravity. Soil retains some amount of water through capillary action. Extra water goes deep. If the pores are big and well connected to each other, then water goes in easily. Permeability of such soil is good.

If water comes across rocks with no crack, then it doesn't go much deep (Permeability less or zero). Then such water gets accumulated. Stock of such ground water is called as Aquifer. The area where water fills the aquifer is called the **saturated zone** (or saturation zone). The top of this zone is called the **water table**. When a well is drilled it strikes water once it reaches below the water table.

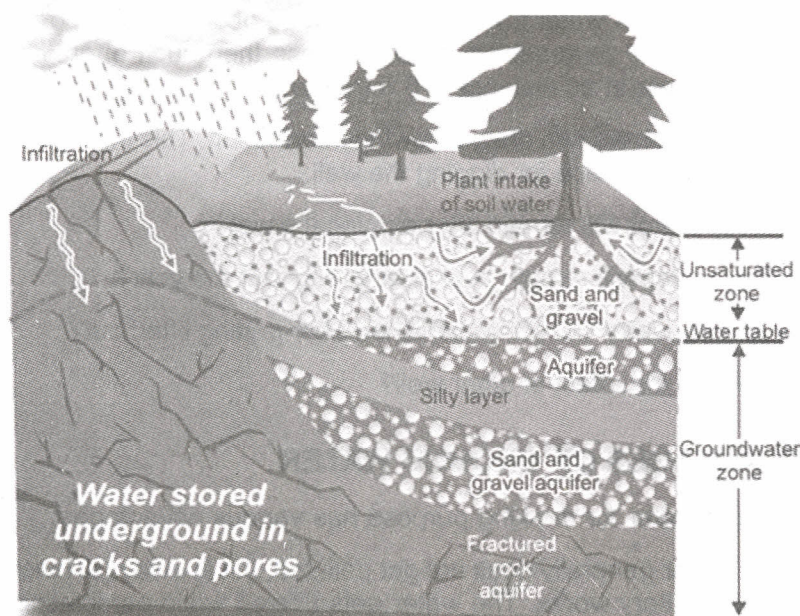


Fig. 5.2



Fig. 5.3

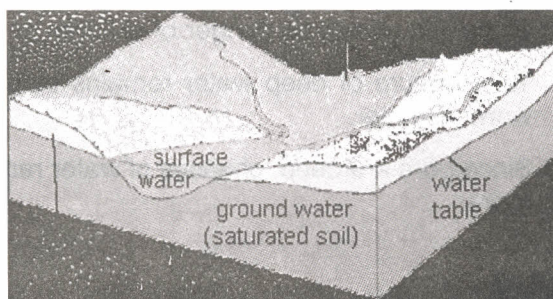


Fig. 5.4

When water percolates under ground and tries to flow through cracks and soil. It flows slowly. The flow of water is measured in meter/day.

## Slope of water level and permeability of land:

If slope is steep then water will not percolate much, hence permeability of land is less. If slope of water level is 12 to 15 mtr/km then permeability is very less. If slope is 2-6 mtr/km then permeability is very good. In such places water gets percolated easily and comes into the well early.





## 5.5 WATER CONTOUR

Contours are drawn on the maps to show up and down on the earth. Similar to show water level under ground, water contours can be drawn. Land Contour remains unchanged over the years but water contour change with the season. In rainy season water level comes upwards and in summer it goes down.

## 5.6 EFFECT ON WATER LEVEL IN WELL

When water is taken out of the well, water level in the well goes down. Therefore, outside water starts percolating inside the well. If there is another well nearby then water level in that well drops down. If permeability of land is good then effect of lifting of water from one well can be observed even on well at 50 mtrs distance. But if permeability of land is less then such effect can be observed only on river at as distance 5-6 mtrs from it.

From water level, we can draw following information. This information will be useful while locating place for digging the well:

1. How deep water will remain after digging the well?
2. Whether water will remain available throughout the year?
3. How quickly water will get replenished after getting lifted out?
4. What will be the effect of other well?

## 5.7 ADVANTAGES OF GROUND WATER

Use of ground water for drinking purpose has various advantages:

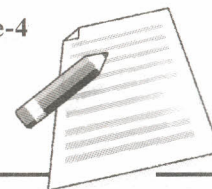
1. Ground water generally does not get polluted, if it is away (at least 20 mtr.) from the sanitary works. The water gets filtered while percolating through sand & stones. Therefore, groundwater remains pure and clean.
2. Since bore well is closed, no risk of getting contaminated.
3. Since it is closed no danger of children or animals falling into it.
4. Temperature of deep water remains stable. It feels cool in summer and warm in winter.
5. Since bore are deep, chances of water remaining available in summer are more.



### INTEXT QUESTIONS 5.1

State True or False:

1. Water level on the earth remains constant (True / False)
2. Earth surface is covered with 70% of water (True / False)
3. To dig a well, water percolation details will not help. (True / False)



Notes

## 5.8 WHAT YOU HAVE LEARNT

In this lesson you have learnt about different resources of water and their advantages.

Availability of water on earth is as follows:-

Approximate water in the world	$1.36 \times 10^9 \text{ Km}^3$	100%
Salty water		97%
Drinkable water (Including snow)	$3.7 \times 10^7 \text{ Km}^3$	2.7%
Water in the form of snow		2%
Water in liquid form	$9.5 \times 10^6 \text{ Km}^3$	0.7%
Ground water	$8.16 \times 10^6 \text{ Km}^3$	0.6%
Water in river & lake	$1.34 \times 10^6 \text{ Km}^3$	0.1%



## 5.9 TERMINAL QUESTIONS

1. Find out various resources of water on earth.
2. How ground water can be utilized in useful purposes.

## 5.10 ANSWER TO THE INTEXT QUESTIONS

1. False
2. True
3. False

## 5.11 SUGGESTED ACTIVITY

Visit the nearby village / field well, study its water details from the owner. Also get details about the water pecculation, -availability of water during the summer.





## FOOD PRESERVATION

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### 6.1 INTRODUCTION

All living organism needs food. Food gives energy to do work. Hence, food is the basic need for all organisms. Therefore, proper knowledge and care of the food is first priority of all human beings. Food science plays an important role in the study of food.

Food science is a study concerned with all technical aspects of food, beginning with harvesting, and ending with its cooking and consumption.

In modern life style, use of preserved food is tremendously increased. There is very high demand for the preservation of food. So there is very large scope for carrier in the food preservation. We always use lot of food items in preserved form e.g, milk and milk products, pickles, bakery products like cakes, biscuits, cold drinks, fruit juices etc. We can preserve food for long time by using different methods of the preservation. Let us study some methods of food preservation in this lesson. We must ensure that the quality of nutrients is not affected in the process of preservation.

### 6.2 OBJECTIVES

After reading this lesson, you will be able to:

- 1) Understand the importance of the food preservation.
- 2) Realize the causes of food spoilage.
- 3) Learn different methods of food preservation.



Notes

### 6.3 PRINCIPLES OF FOOD PRESERVATION

Food preservation means keeping food in such a state that it does not get spoilt.

Food is said to be spoilt if there is rotting i.e. bad smell, fermentation like bubbly gas in the food or spongy growth on the food.

In the food, there are millions of microorganisms present. In which some are useful and some are harmful. These microorganisms produce some acids, enzymes as their metabolic products which leads to damage to the food. Insects, rats and birds are also responsible for the food spoilage.

Basic principle of the food preservation is that keep food safe from agent of spoilage.

#### Method to prevent food damage:

1. Controlling microorganisms
2. Controlling enzymes
3. Controlling insects, rodents, birds and other physical causes of food deterioration

#### Preservation of the food helps in necessary shelf life for different food is given below:

1. Perishable foods:

Not processed and having shelf life less than 60 days. E.g. Meat, vegetables, fruits, milk.

2. Semi-perishable foods:

Shelf life is between 2 to 6 months as results of the preservation method. E.g. Ice cream, cheese.

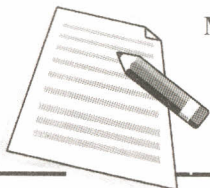
3. Shelf-stable foods:

Shelf life is more than 6 months. E.g. Cereal grains, dehydrated pasta, frozen food, canned food, dehydrated vegetable.

#### Role of food preservation:

1. Eliminates any potential microbiological harm to the consumer.
2. Maintains quality of food (sensory perceptions).
3. Maintains nutritional value within of food product.



**INTEXT QUESTIONS 6.1**

1) What is food science?

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2) What is the principle of the food preservation?

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3) Match the following;

<b>Food</b>	<b>Shelf life</b>
i. Perishable food	more than 6 month
ii. Shelf stable food	2-6 months
iii. Semi-perishable food	below 2 months

**6.4 PRESERVATION METHODS****Thermal processing (Heating)**

Application of heat:

- Heat inactivates enzymes.
- Kills microorganisms-most bacteria are killed in the range 82-93°C.

Thermal processing can be done by following methods:

- Blanching-The process of dipping the vegetables in boiling water for a specific period. E.g. Carrot, Cabbage etc.
- Pasteurization-In this method food is heated at very high temperature and then quickly cooled. e.g. Milk, for example.

**Removal of heat (Cold processing)**

Application of cold processing:

Low temperature decreases the rate of enzymatic, chemical and microbial reactions in food so it slows down microbial growth. The storage life of food is extended.

Cold processing can be done by following ways:

- Refrigeration-Food stored in low temperature, about 5°C. E.g. Milk and milk products.
- Freezing- Food stored at 0°C e.g. Ice creams.

*Notes***Control of water content (Drying)**

Microorganisms require free water for activity. After removing free water from the food microbial cells multiplication will stop because water is unavailable for biochemical reactions. Hence, shelf life of food gets extended.

Control of water in food can be done by following ways:-

- Physical removal of water from food (dehydration)
- Removal of some of the water from food (concentration)
- Addition of substances that bind water in food, making it unavailable (sugar, salts)

**Radiation (Use of microwave)****Application:**

- Ionizing radiation inactivates microorganisms in food.
- Treatment with microwave inactivates enzymes in food.
- Ultraviolet rays are used to sterilize air and water used in food processing.

**Atmosphere composition****Application:**

Removal of oxygen from food inhibits oxygen dependant enzymatic and chemical reactions which inhibits growth of aerobic microorganisms.

This can be done by following ways:-

- Paraffin wax- coated on cheese cube.
- Nitrogen back flushed bags -Oxygen replace by nitrogen in the packs. E.g. Potato chips.
- Canning food (cured meats).

**Addition of chemicals (Preservatives)**

Additives in the food increase the shelf life of food by controlling the growth of the microorganisms. Preservatives are of 2 classes

- 1) Natural Preservative- Salt, sugar, lemon juice, spice;
- 2) Chemical preservatives-Organic and inorganic acids.

Here are some preservatives used for the food preservation:-

**1) Salt**

How salt work as a preservative? Salt in food changes composition of the food and osmosis starts in the food. Which result in water comes out of the food. And when there is less water less growth of the microorganisms. Salt is used in pickle, Chatni, sauce etc.