# Structure and Working of Science Models

38th Jawaharlal Nehru National Exhibition for Science and Environmental Education for Children

Patna, Bihar

2011

## *The Spirit of Science*

*Most countries normally do not like*
*to change. The human being is*
*essentially a conservative animal.*
*He is used to certain ways of life and*
*any one trying to change them meets*
*with this disapproval. Nevertheless,*
*change comes and people have to*
*adapt themselves to it. They have*
*done so in the past.*

**– Jawaharlal Nehru**

# Structure and Working of Science Models 2011

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# Preface

The learning of Science is instrumental in developing well-defined abilities and skills such as spirit of enquiry, creativity, objectivity and aesthetic sensibilities among children. They learn through interactions with the environment around, nature, thing and people. The structuring of ideas is one of the essential features as children progress in learning. They actively engage with the world around them in exploring, responding, inventing, working things out and interpreting. Science Exhibitions offer an opportunity to the children to express and exchange their creative ideas with joy of scientific investigation. It helps them to learn the methods of science, provide them with opportunity to develop their problem-solving skills and creative abilities.

The National Council of Educational Research and Training (NCERT) organises the Jawaharlal Nehru National Exhibition for Science and Environmental Education for Children — 2011 (JNNESEC) as an annual event in collaboration with a State or Union Territory. The JNNESEC is the culminating activity of a series of exhibitions organised at school, zonal, district, regional and state levels. A large number of students and teachers participate in such events.

The present publication i.e., 'Structure and Working of Science Models' includes write-ups of a few exhibits selected for display in the 38th JNNESEC — 2011 is being organised in Patna, Bihar. Other materials like List of Exhibits which contains the titles and synopsis of almost all the exhibits selected for participation in the JNNESEC — 2011 along with an information brochure stating objectives and other details of the exhibition have also been published. It is expected that these publications will motivate and help children to participate in future Science Exhibitions.

The write-ups included in this publication were selected out of the entries received from all the states/UT's agencies. These were reviewed and edited by an expert committee comprising Dr V.P. Singh, Dr Gagan Gupta, Dr Alka Mehrotra,

Dr R. K. Parashar, Dr Anjani Koul, Dr Shashi Prabha and Ms Sunita L.Varte of the Department of Education in Science and Mathematics (DESM) of NCERT. I appreciate their sincere efforts.

I appreciate and specially thank Dr Gagan Gupta for Coordinating the 38th JNNESEC — 2011 and seeing this manuscript through the press. I thank Ms Priti Tomar and Ms Sanju Tatwal of DESM for their consistent help. I also thank the Publication Department, NCERT for the cooperation in bringing out this publication.

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New Delhi
*11 November 2011*

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## Other Laboratory Manuals by NCERT

In English

- Science Laboratory Manual - Class IX and X
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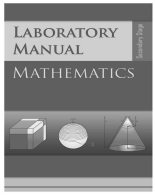
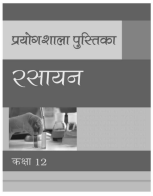
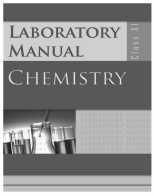
In Hindi

- *Vigyan Prayogshala Pustika* - Class 9 and 10
- *Rasayan Prayogshala Pustika* - Class 11 and 12
- *Ganit Prayogshala Pustika (Madhyamik Star)*



# 1

# AGROBOTS

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## INTRODUCTION

The growth of any nation in the world depends upon the agricultural production. Ours is an agriculture-based country which is facing problems like, less land with still less fertile land, more dry land, drought prone regions, less availability of labour, expensive labour, migration of labour, lack of skilled labour, less perennial rivers, and especially, the traditional mindsets of the farmers.

In this situation, we use technology to get a good yield for the farmers. Our solution for all these problems are innovative and effective agricultural robots called 'agrobots'. Here we are going to present an automatic sowing machine and an automatic plant watering system which can give the farmers good yield.

## MATERIALS USED

### 1. Sowing Machine

*Micro Controller:* ATMEL 89C51 micro controller is used as control system of the entire machine. Depending upon the programme, it generates the output to control the machine.

*Keyboard:* To give input, i.e., the distance between the planting points in horizontal and vertical directions.

*Mode Switch:* Used to select the vehicle direction.

*LCD Panel:* To display the planting points.

*Stepper Motor:* It is a motor which turns in steps. The motor used here is designed to rotate 1.8 degree per step, thereby every pulse produced by the controller can rotate the motor by 1.8 degree. Hence, 200 pulses produced by the controller can rotate the motor by one complete revolution.

*Relay:* It is an electro-mechanical switch. In this project, three relays are used. Relay 1: Micro controller energises the 12 V DC motor through this relay which is used to vibrate the seeds container; Relay 2: Micro controller energises the second 12 V DC motor through this relay with reduction gear mechanism, used to pull down the seeds container; and Relay 3: Micro controller energises the solenoid valve which is used to close and open the seeds pipe.

*Power Supply:* +12 V DC, with the help of regulator micro controller uses only +5 V DC.

**2. Plant Watering System**

*Pumping Motor:* Known as a start key which is interfaced with micro controller. Initially after energising the system, this key has to be activated, thereby watering process will be continued. After pouring water to all the plants, the vehicle travels in reverse direction and will be halted at home position with the help of sensor.

*Spraying Motor:* With the help of this motor, we can spray fungicides to a particular plant.

*Water Pumping Motor:* It is a manual operation key used to empty the mobile water tank.

*Relay:* It is an electro mechanical switch. In this 4 Relays are used. Relay 1 and 2: Micro controller energises these relays to make the vehicle to move; Relay 3: Micro controller energises Pumping Motor through this relay and starts pumping water whenever it reaches a plant; Relay 4: Micro controller energises Spraying Motor through this relay and starts spraying fungicides whenever it reaches a plant.

*Reference Points:* Points at which plants are located which is identified through infrared transmitters located at each plant.

*Infrared Receiver Circuit 1:* Using this, the system is able to check its home position.

*Infrared Receiver Circuit 2:* Using this, the system will either pump water or spray fungicides depending upon the operated key.

*Power Supply:* +12 V DC, with the help of regulator micro controller uses only +5 DC.

## Construction and Working

### 1. Automatic Sowing Machine

When we switchon the power supply, the device checks its home position. Now, as per the input given, the sowing machine sows a seed at its home position and then it continues to sow in a horizontal direction. After completion of a row, it sows the seeds in the next row. The process continues till the power supply is switchedoff.

### 2. Automatic Plant Watering System

When pumping key is operated, the system identifies the plant with the help of sensors and pumps water for a particular plant. In the same way, spraying can also be done. There is also another key to empty the water from the tank which is a manual operation key.

## Applications

Uses of Sowing Machine:

- Uneven planting can be avoided.
- Distance between the two seeds can be maintained accurately.
- Large area can be covered in less time.
- Economically cheap, when compared with manual planting.
- Lot of manpower can be saved.
- Any type of seeds can be sowed.
- Number of seeds planted can be counted.
- Machine speed can be adjusted.
- Rows and columns reference points can be adjusted.
- Number of seeds to be sowed at reference points can be adjusted.

- Many other uses like leveling the soil, drilling the holes for planting seeds, etc.
- Fuel consumption is avoided, if it utilises solar energy.

Uses of plant watering system:

- Conservation of water.
- Watering for a particular plant.
- Large area can be covered in less time.
- Conservation of pesticides.
- Sprays the pesticides for a particular plant.
- Sprays the pesticides in exact quantity for a particular plant.

## Conclusion

Using these types of agrobots, farmers will get good crop yield with less effort. It also helps the development of the economy which leads to the development of the nation.

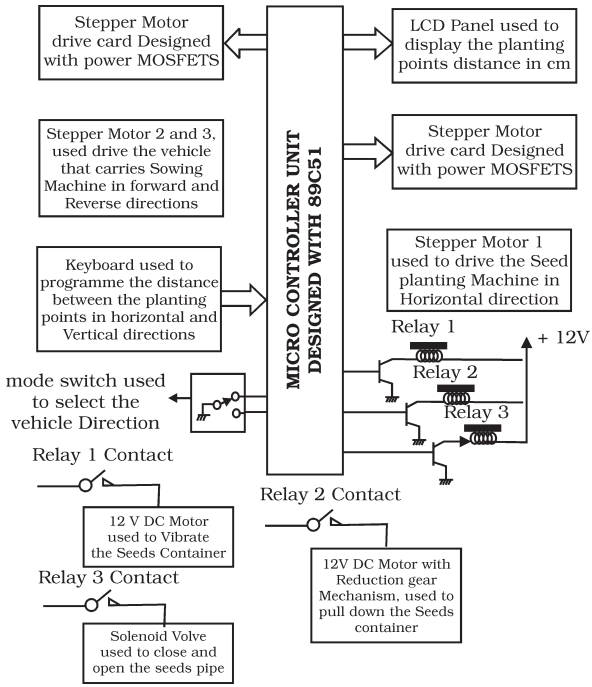


**Fig. 1.1: Automatic Sowing Machine**

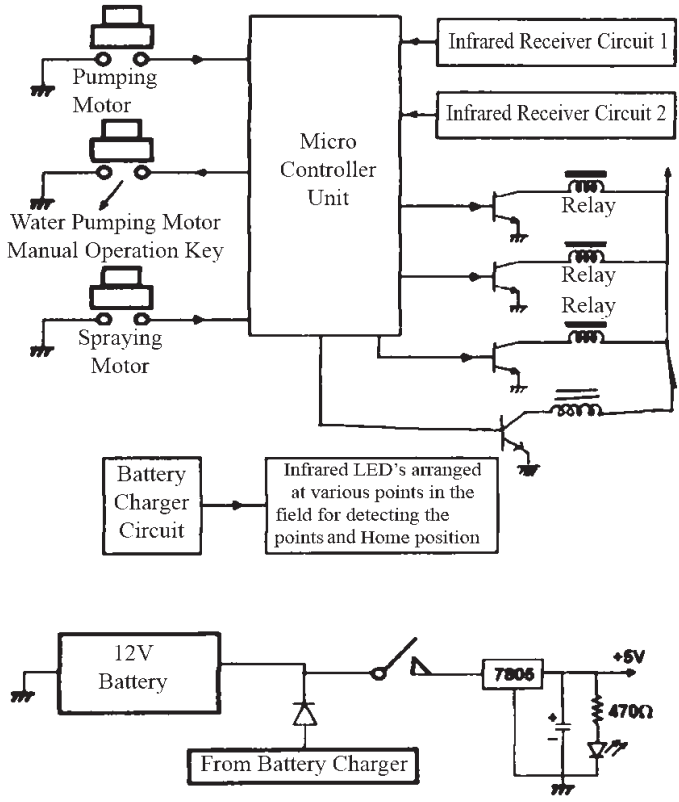


**Fig. 1.2: Agrobots Designed as Plant Watering System**

2

# WASTAGE MODIFICATION IN INDIAN RAILWAYS

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## INTRODUCTION

Indian Railway transports millions of people everyday through its wide network of trains in India. It is probably the largest network in the world. One thing, which needs desperate and immediate attention in Indian Railways, is the sanitation level in the trains.

Indian Railways disposeoff human excreta into open on the track throughout the length and breadth of the country through its toilets in the trains. Trains passing through many villages and towns continue to throw their waste in open and pollute the environment.

The toilets of the trains were made the way, keeping in view the principle that the waste will go on track, which is not habited and the heat of the sun will sterilise it. Moreover, these toilets are not meant to be used while the train is standing at the station. Many people do not follow this rule.

Human waste, especially of patients, may contain a large number of germs of many diseases like diarrhoea, cholera, typhoid, hepatitis, other water-borne and air-borne diseases besides parasitic infections. Parasites like hookworm, roundworm and pinworm are spread mainly through human waste that results in the spread of diseases. The seemingly

innocent action of the railways contaminates the environment and promotes unhygenic conditions, negating the very small strides made in sanitation and community health. Toilet discharge is also a major source of corrosion of rails and fastenings. Large amount of water used in the toilets at present needs to be minimised in order to conserve water. Waste water can be treated and recycled so that the problems of corrosion of the tracks as well as spread of diseases can be checked.

In this project, we have made an attempt to solve these problems by using bio-toilets with additional benefit of recycling the water after proper treatment. In the present model, the water used in the toilet is filtered and chemically treated and recirculated so that water usage can be minimised as well as the release of untreated water into the tracks can be avoided.

## Scientific Principle Involved

Collection, filtration, recirculation and decomposition by using bacteria.

## Materials Used

Motor with sensor, toilet and overhead tank, foecal storing tanks, chemical treatment tank, excrete pipes for water circulation, bio-digester, transparent plastic bottles and bacteria like Nitrosospira.

## Working

The collected water and faecal matter processed through different chambers where water and excreta get separated and water is purified by filtration chemical treatment and pumped to overhead tank. The collected excreta is sent to bio-digester which consists of two chambers: 1. Biological chamber, and 2. Chemical chamber.

In Biological chamber bacteria like nitrosospira which breaks down waste in 6 or 7 days by enzyme action. The resulting liquid is sent to chemical chamber where it is treated with chlorine before disposal.

In this system, 90 per cent of the liquid from the waste can be reused for flushing purpose only. In this way we can save water.

## Applications

By using this model, we can minimise the consumption of water. This system may help in keeping the trains and railway stations clean. The system may work as eco-friendly toilet and also as zero discharge toilet. This system will definitely help in preventing spread of diseases caused by germs and parasites.

# 3

# PLATONIC SOLIDS

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## BRIEF SUMMARY

### Platonic Solids

The most symmetric and fascinating figures found in the basic elements of universe, i.e., in metals, minerals, DNA, viruses etc., are barely known to us.

Our model explains the concept of platonic solids, defines the geometry behind them and tell some interesting facts about platonic solids.

Till date only 5 platonic solids – tetrahedron, octahedron, icosahedron, hexahedron and dodecahedron are known.

Our model tries to find whether any sixth platonic solid may exist.

## RATIONALE BEHIND THE EXHIBIT

(a) To create awareness about the mathematics behind the intriguing and fascinating platonic solids which are found all around us.

(b) To find why there are just five platonic solids known to us and if we can find any sixth platonic solid.

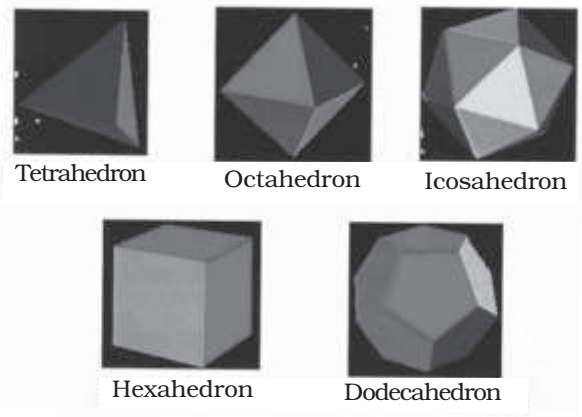
## Material Used

Hard board, pieces of card board, coloured papers, fevicol and tape.

## Introduction

Geometry is the art form of life. It is the basic construction of everything. Geometric patterns are at the root of all growth whether it is the growth of a plant, animal or mineral. Some of the primal geometric shapes from which all forms of life are created are platonic solids.

Platonic solids are unique 3D regular polyhedral, whose sides are made up of congruent regular polygons and its each vertex has same number of faces.

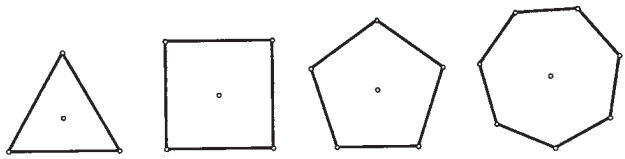



## Why are they Called Platonic Solids

Originally the platonic solids and their regularities were discovered by the Pythagoreans. They were named as platonic solids by the ancient Greek philosopher Plato who often wrote about them in greater details in his book *Timaeus*.

## Understanding the Construction of Platonic Solids

We know the regular polygons are equilateral triangle, square, regular pentagon, regular hexagon etc.



Regular Polygons

So we shall start making platonic solids with the basic regular polygon i.e. equilateral triangles followed by squares, then with regular pentagons and hexagons and so on. We know that a minimum of 3 sides are required to meet at a vertex to form a polyhedra. Therefore, let us start with 3 equilateral triangles.

**Construction of Platonic Solids Using Equilateral Triangle**

| *Number of Triangles about each Vertex* | *Number of Faces (F)* | *Number of Edges (E)* | *Number of Vertices (V)* | *Name of Platonic Solid* |
|---|---|---|---|---|
| 3 | 4 | 6 | 4 | Tetrahedron |
| 4 | 8 | 12 | 6 | Octahedron |
| 5 | 20 | 30 | 12 | Icosahedron |

We see that 3 different platonic solids are obtained by joining 3, 4 and 5 equilateral triangles at a vertex.

Tetrahedron

Octahedron

Icosahedron

With triangles we get three platonic solids:

1. Tetrahedron
2. Octahedron
3. Icosahedron

When we try to join 6 equilateral triangles at a vertex we get a flat figure. We notice that the sum of angles at the vertex becomes 60  6 = 360 . Therefore, we cannot get any solid figure with six equilateral triangles at a vertex.

6 Triangles Joined at a Vertex
(forming a flat figure)

**Construction of Platonic Solids Using Square**

| *Number of Squares about each Vertex* | *Number of Faces (F)* | *Number of Edges (E)* | *Number of Vertices (V)* | *Name of Platonic Solid* |
|---|---|---|---|---|
| 3 | 6 | 12 | 8 | Hexahedron |

We see that one platonic solid is obtained when 3 squares are joined at a vertex.

Hexahedron

But when we join 4 squares at a vertex we get a flat figure. Thus, we cannot obtain a solid figure. We notice the sum of angles at the vertex becomes 90  4 = 360

4 Squares at a Vertex
(forming a flat figure)

**Construction of Platonic Solids Using Regular Pentagon**

| *Number of Pentagons about each Vertex* | *Number of Faces (F)* | *Number of Edges (E)* | *Number of Vertices (V)* | *Name of Platonic Solid* |
|---|---|---|---|---|
| 3 | 12 | 30 | 20 | Dodecahedron |

We see that one platonic solid is obtained on joining 3 pentagons at a vertex.

Dodecahedron

But it is not possible to join four pentagons at a vertex. We see the sum of angles at the vertex becomes 108  4 = 432 which is greater than 360 .

4 Pentagons which cannot be
put together at vertex

## Construction of Platonic Solids Using Regular Hexagon

When we join three hexagons at a vertex, we again get a flat figure. Thus we do not get any solid figure. Again we notice that the sum of angles at the vertex becomes 120  3 = 360°.

3 Hexagons at a Vertex
(forming a flat figure)

## Conclusion

If the sum of angles at the vertex becomes 360  or exceeds 360 , solid figure is not obtained. Hence, we observe that only five platonic solids are possible and no sixth platonic solid can ever exist.

## Properties that Make Platonic Solids so Special

### 1. Most Symmetric

There are many ways that we can turn them around and have them still appear the same from different angles.

### 2. Dual Property

If we connect the centre of all the faces of the cube, we get Octahedron and vice-versa. Both have the same number of edges, being 12. The number of faces and vertices are interchanged. Similarly, if we connect the centre of all the faces of the Icosahedron, we get Dodecahedron and vice-versa. Both have same number of edges, being 30. The number of faces and vertices are interchanged. Tetrahedron is self-reciprocating.

### 3. Spherical Property

Platonic solids have a spherical property, where one platonic solid fits in a sphere, which alternately fits inside another platonic solid, again fitting in another sphere and so on.

### 4. Golden Ratio

The corners of octahedron fit in the centre of the cube faces, the Icosahedron can be inscribed in an octagon so that each vertex of the former divides an edge of the latter into the golden proportion. The Icosahedron and the dodecahedron are uniquely connected with the golden proportion by virtue of three intersecting golden rectangles which fit into both.

### 5. Fair Dice

Platonic solids are often used to make dice. Commonly we use hexahedron (CUBE) for a dice but all platonic solids can make fair dice because the faces are all same and there is an equal chance of landing on any face.

### 6. Useful in Packaging

All platonic solids are the most efficient at enclosing large volume. The more complex the polyhedron, the greater is ability to encapsulate cargo. Icosahedron the most complex platonic solid is, therefore, most suitable for achieving cargo encapsulation.

### 7. Truncated Platonic Solids

We have only five platonic solids but we can have many truncated platonic solids by truncation or cutting off the corners. Bucky ball is a truncated icosahedron.

### 8. Making Sphere

It is impossible to make a perfect sphere or ball from a paper. Paper can curve in one direction but cannot curve in two directions at the same time. The best way to make a sphere is to make a polyhedron. You can make a ball from a dodecahederon or an icosahedrons.

### 9. Healing Powers

Platonic Solids represent an important part of the sacred geometry. They posses great healing powers because they radiates subtle vibrations and their energy field is evenly distributed.

## Some Fascinating Facts about Platonic Solids

### 1. The Five Basic Elements of the Universe

360 BC: Plato has called them the five basic elements of the universe.

(i) *Tetrahedron — Fire:* It has the smallest volume for its surface area and represent the property of dryness. It is sharp and stabbing. So it correspond to fire.

(ii) *Octahedron — Air:* It rotates freely when held by two opposite vertices. It is light and moves freely. So it corresponds to Air.

(iii) *Icosahedron — Water:* It has the largest volume for its surface area. It flows out from one's hand. For its extensive volume it corresponds to Water.

(iv) *Hexahedron — Earth:* It is standing firmly on its base. It is solid and stable. It corresponds to Earth.

(v) *Dodecahedron — Ether/Constellation:* It's twelve faces represent the twelve zodiac signs. It corresponds to sky.

**2. Kepler's Mysterium Cosmographicium**

In sixteenth century, he modelled the orbits of the five known planets, using platonic solids. It was this discovery that led Isaac Newton, less than a century later to formulate his law of gravity that governs the planetry motion.

**3. The Building Blocks of the Atom**

Professor Rober Moon in 1980 at University of Chicago demonstrated that the entire periodic table of elements, literally everything in the physical world, is based on these five forms.

**4. Shape of Universe**

Modern physicsts have recently postulated that the shape of the universe may actually be in the shape of 'chiral' Dodecahedron — a simple twelve sides polyhedron with pentagonal symmetry which is considered the most stable three-dimensional structure possible.

## Platonic Solids in Nature and Technology

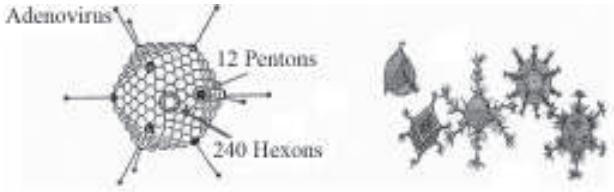
Platonic solids are important in the study of chemistry, biology, medical science, crystallography, mineralogy, sacred geometry, space science and many such fields.

(i) *In Nature:* These shapes occur naturally in crystal structure
Halite and sodium chloride crystal – cube
Garnet and Pyrite — dodecahedron
Calcium Fluoride — octahedron
Copper — Cubic and dodecahedron
Carbon and Boron-Icosahedron

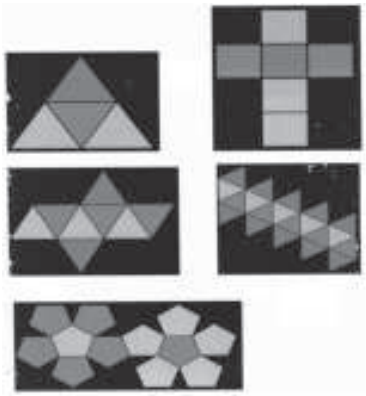
(ii) *In DNA:* Nucleotides and cadon in DNA is a sequence of dodecahedron

(iii) *In Amino Acid:* Different type of amino acids are present in our body which help us in metabolism. Every type of amino acid is tetrahedron.

(iv) *In Viruses:* Virus a highly complex molecular structure, still exhibits the symmetry of platonic solids. The genetic material and enzymes of viruses are enclosed by a surface called capsid which is in the shape of Icosahedron Herpes virus and Circoporus-Icosahedron
Circorrhegma — Dodecahedro
Adenovirus — Icosahedron
Radiolaria (mineral skeleton found at the base of ocean) — Icosahedron




Make your own Platonic Solids and have a fun



4

# PRODUCTION OF $COH_2$ GAS FROM $H_2O$

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## INTRODUCTION

Because of the global warming problem, clean and pollution-free fuel is an essential need of the modern era. It has become mandatory to find out an alternative fuel. Our globe has very large volume of water which can provide an inexhaustible source of heat and light, if the water components like hydrogen and oxygen singly or together can be employed as fuel. A new carbon arc technology is being used underwater to produce ultra-clean-burning low–cost alternative synthetic gas. This simple method of producing a hydrogen/carbon/oxygen gas holds great promise for energy and chemical production. Fuel from the water is being produced in demonstration model and is planned to test in combustion engines.

## Rationale Behind the Exhibit

Use of this hydrogen/carbon/oxygen gas fuel is more practical. No new design of the combustion engine is required as the gas fuel is suitable to the existing design of the engines used in the vehicles. Burning the hydrogen/carbon/oxygen gas in the combustion engine produces relatively less quantity of the toxic gases like carbon monoxide and hydrocarbons reducing pollution problem.

Production of the hydrogen/carbon/oxygen gas fuel is very simple and transportation cost of the gas is little because the gas production plant can be installed near working place where water and electricity are available. The fuel become greener and clean if the required electricity in the plant can be harvested from solar energy, wind energy or by using manpower.

The hydrogen/carbon/oxygen gas can be used as fuel in the boilers in a production industry. In-house production of the fuel gas in the industry will reduce the production cost further.

In general, the practical use of the hydrogen/carbon/oxygen gas fuel is much more beneficial to the society and our eco- system in many respects.

## Scientific Principle Involved

A low voltage (AC or DC) in the range from 30 volt to 50 volt at high current is used to produce an electric spark which tunnels through water between the tips of common carbon electrodes. The 500 to 700 F temperature from the spark dissociates nearby water molecules into hydrogen and oxygen atoms. Carbon atoms break loose from the carbon electrodes and form bonds in this high energy plasma soup. The resulting $COH_2$ molecules cool and bubble up to the surface in the surrounding water where they are collected and ready for combustion.

## Materials Used

Carbon rods, water, glass jar with lid, copper rods, copper tubes, brass nut-bolts, high current capacity wire, gas collecting container, control valve, burner and high current low voltage transformer.

## Construction and Working

As shown in Fig. 1, a water filled glass jar is used to construct a fuel gas production chamber. A gas collecting container is mounted exactly on the sparking zone in order to collect the gas. The output of the gas collecting container is connected to the burner through a control coke. Two carbon electrodes are connected to a low voltage high current generator through copper rods and high current capacity copper wires.

When the high current is allowed in the carbon electrode, sparking takes place deep in the water. These sparks trigger the chemical reaction between water and the carbon resulting generation of a fuel gas. It is very important to maintain proper gap between two carbon rods in order to continue sparking and hence continue fuel gas production.

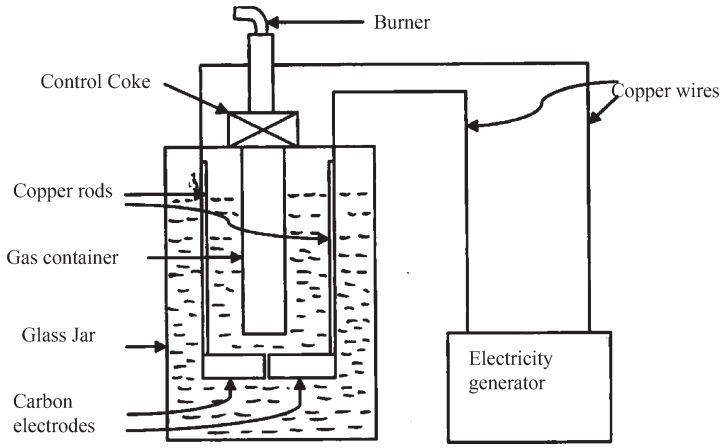


**Fig. 4.1: Fuel Gas Production Chamber**

# 5

# JUNGLE SAVER

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## INTRODUCTION

Burning of forests is a great loss of environment and money. Our 60 per cent population still depends on firewood for cooking. This adds pollution and poor health. Although our government has tried its level best by establishing Forest Departments, Village Committees, Forest Task Forces, NGOs, yet all these agencies are not able to achieve goals. When we tried to find out the reasons of forest fire, we come to the conclusion that most of our forests in Jammu and Kashmir are covered with pine trees which have resin — a highly combustible substance. It burns rapidly when comes in contact with fire and atmospheric oxygen helps to make the burning vigours.

## RATIONALE BEHIND THE EXHIBIT

Since our forests are made up of pine trees, fire breaks mostly in summer season. Our model tries to overcome this problem to great extent. Our model will help in environment improvement, monetary benefit and self-employment generation in rural areas.

## SCIENTIFIC PRINCIPLE INVOVLED

Forest fire engulp large area of forest annually. This increases air pollution and health problems.

According to this project Pine needle will be collected by the people to save jungle and to earn livelihood.

## End Product

Smokeless coal, self-employment, clean environment and good health.

## Materials Required

Specially designed container with partial supply of oxygen, one mixture container, pine needles and cow dung.

## Construction and Working

Specially designed container (as shown in Fig.5.1) with partial supply of oxygen is filled with pine needles. The pine needles are burnt in the presence of partial supply of oxygen. This container is attached to a container in which molten product is collected. Ten per cent of cow dung is mixed with the molten material to produce smokeless coal.

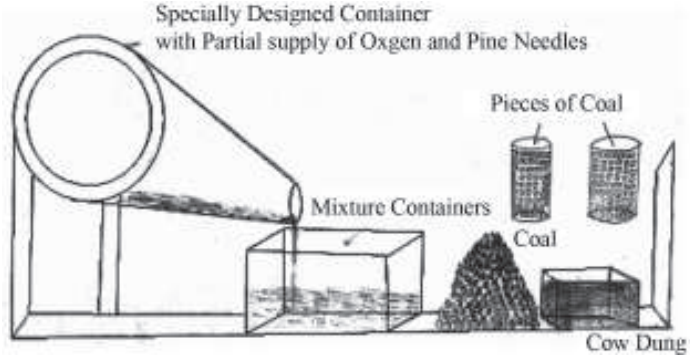


**Fig. 5.1: Production of Smokeless Coal**

## Applications

It will help in generating self-employment in rural areas. It will reduce air pollution. It will prevent forest fire to great extent. It will produce smokeless coal. This project will never face shortage of raw material. The project is of nominal cast and will expand forest cover which is reducing day-by-day.

# 6

# Power Saver AC

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## Introduction

In this scientific and modern age, people are making use of many electronic gadgets for the one purpose or the other. The use of conventional air conditioner throws a lot of heat into the environment thereby causing environmental problem. Not only this, the conventional air conditioners also require large amount of electric energy. These are costlier as well.

Our 'Power Saver AC' uses heat exchanger and does not throw any heat to the environment. Hence, it is environment friendly. Moreover, it uses only 1/10th of power as compared to an ordinary desert cooler so it is power saver. Further by simple technique one can convert any desert cooler into power saver AC by investing a small amount of money, thus making the dream to come true of a common man to enjoy the comfort of an AC.

## Scientific Principle Involved

Air is cooled by loss of heat to water in contact; evaporation causes cooling.

## Materials Required

GI sheet box, heat exchanger drum, copper pipes/transparent pipes, one khas-pad, two small exhaust fans and one small tullu pump.

## Construction

First of all GI sheet box measuring $2' \times 2' \times 1/5'$ feet is made for a water tank at its base and back side window that open like a conventional desert cooler. The window is covered with a khas pad. There are two openings on the front side, the upper one for supplying cooler air with an exhaust fan and the lower one is used as inlet for room air. The exhaust fan opening is connected to thin gauge coiled copper pipe where it is further connected to copper small cylinder (used as heat exchanger) immersed in water. The heat exchanger fans through the inlet openings on front side into the room. The second exhaust fan is fitted on one side of the box to expel out the humid air. One small tullu pump is installed at the base of the box to lift and spray water over the backside of khas pad and copper pipes.

## Working

The hot air from the room is sucked through the inlet opening on the lower side of the front portion. This air possesses through the copper heat exchanger and loses some of its heat to the water in which the heat exchanger is immersed. As a result the air becomes cool which passes through the copper pipes closely fitted in front of the khas pad. The exhaust fan at the top circulates hot air from the environment which passes through the khas pad where water is spread by means of tullu pump. The evaporation of water cools this air as well as the air inside the copper pipes. This cause further cooling of air. The cooled air in the copper pipes is now released into the room by the front side exhaust fan. The room is cooled to a comfortable limit within few minute.

## ADVANTAGES

Our model consumes very low power (1/10th of power as compared to conventional AC). Thus, it is a power saver AC. The heat of incoming air is not thrown to the outside as in the conventional AC but is utilised in further evaporation of water. Thus, making environment safe, as only one khas pad is used instead of three as in an ordinary desert cooler 3/4th of water is saved which can be utilised for other purpose. By applying simple technique, it is to convert an ordinary desert cooler into 'Power Saver AC' by investing a very small amount of money.

7

# Soda-acid Fire Extinguisher

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## Introduction

As depicted by the name, our model is a fire extinguisher that evolves carbon dioxide to extinguish fire. It works on the principle of reaction between sodium bicarbonate and sulphuric acid. As we are known to the fact that when acids react with carbonates or hydrogencarbonates of metals, metal salts are formed along with the formation of water and carbon dioxide, the same principle works here. Our main intent to make the gadget is to simplify the use of fire extinguishers to make a cheap and affordable device to extinguish fire, and obviously to minimize the damage caused by fires in our homes or school lab or other such institutions.

## Materials Required

A big steel container with a beaker attached to its airtight lid, two small beakers.

## Procedure

Make a solution of sodium bicarbonate in a beaker, with sodium bicarbonate above the level of saturation and pour it in a steel container, container water not more than 2/3 of the level of beaker.

Dilute a solution of sulphuric acid in a beaker and pour it in another beaker that is already attached to the lid of the steel container (Dilution is not necessary, it depends on the need of carbon dioxide. More the acid is concentrated, more will be the liberation of carbon dioxide).

Keep the beaker erect with the help of a copper wire and pass the copper wire through the lid so as to control the flow of acid on carbonate (Sudden flow may cause vigorous reaction resulting in the damage in the apparatus because of the sudden and bulk flow of carbon dioxide).

Fasten the lid of the steel container and without jerking the apparatus.

Thus, our soda-acid fire extinguisher is ready. Now, gently release the copper wire so that the acid gets mixed with the carbonate slowly.

## OBSERVATIONS

The following reaction occurs between sodium bicarbonate and sulphuric acid (when they mix):

$$NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2$$

In the above reaction, metal hydrogen carbonate (here, sodium bicarbonate) reacts with acid (here sulphuric acid) to form metal salt (here sodium sulphate) and water and liberate carbon dioxide gas, which is the main agent to extinguish fire.

**Fig.7.1:Soda-acid Fire Extinguisher**

The gaseous form of carbon dioxide thus formed is then allowed to pass through the pipe attached to the outlet of the air tight lid that is already made in it.

The existence of carbon dioxide gas can easily be detected. The simplest is to bring the flowing carbon dioxide gas in front of a burning candle which extinguished by doing so. It can also be detected by the lime water test.

Thus, it can be concluded that carbon dioxide, extinguishes fire because of the fact that it is a dense gas and as soon as it is sprayed, it settles down thereby insulating the supply of oxygen

to the fire which, in turn, gets extinguished when its oxygen supply is cut off.

## Advantages

As it is known to us all that fire extinguishers play an important role in day-to-day activities. Without the backup of fire extinguishers, the scientists are not able to take risks of doing such experiments which accidentally causes fire. Same is the case in our model. Our model, being a simple fire extinguisher, too, can control fire that is caught accidentally in our school laboratories, in our homes or other such institutions. Our model is simple in the terms that it is irrespective of measurements i.e., there is no boundary for a person to care for the quantity of the ingredients of the reaction and its mechanism is uncomplicated enough to understand. Our fire extinguisher costs not more than 100 bucks while the extinguisher costs a little as compared to those available in the market. Most of the constituents of our fire extinguisher are the waste materials and readily available. Another quality of our model is that the products other than carbon dioxide can be separated and used in other experiments like the metal salt (sodium sulphate) can be taken apart and used for many other experiments or tasks. Thus, our model, being an eco-friendly one is really a good effort to prevent damages caused by fires. It should also be noted down that if our fire extinguisher is built with more sophistication, it can then prevent major property losses.

8

# AUTOMATIC CRANE

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## INTRODUCTION

A crane is a lifting machine. It uses one or more simple machines to create mechanical advantage. So it can move loads beyond the normal human capability.

## RATIONALE BEHIND THE EXHIBIT

'Science and technology for challenges of life' is the topic of this year's science fair. Due to lack of awareness and training, and due to constructional defects, crane accidents are so common, resulting in loss of wealth and men. Taking this as a challenge a remote controlled, automatic crane is developed.

## SCIENTIFIC PRINCIPLE INVOLVED

A crane works on the principle of a lever and pulley. When the lever is in equilibrium Effort  Effort Arm = Resistance  Resistance Arm. Here it is a first order lever and its mechanical advantage is less than one. The other simple machines used in this crane are a fixed pulley and a system of second order movable pulleys. A fixed pulley is a first order lever having mechanical advantage one. The system of second order movable

pulleys consists of two sets of three movable pulleys, one set at the top and the other at the bottom, mechanical advantage of the system is six, which is the number of strings that support the weight. Thus, the total mechanical advantage is seven.

## Materials Required

1´ ´ Wooden plank, 2 ´ 1½´ square wooden reaper, 2½´ aluminium reaper, 6v geared motors 2 nos, electronic circuits, second order movable pulleys, thread, spoolwheel, 6v battery, 9v battery, tension springs, acrylic circular ´ dia, nails, screws, gum, paper etc.

## Construction and Working

This model consists of the following main parts which are presented here:

### 1. An Aluminium Lever Rotating about the Fulcrum

The lever is fixed with the help of a bearing on the top of a wooden pillar (square reaper) mounted on the wooden plank fitted with rolling wheels. A circular disc is mounted horizontally between the pillar and the lever. The lever is free to rotate horizontally about its fulcrum. The lever is kept in equilibrium by using weights on effort arm and resistance arm. But on the effort arm and on the resistance arm, there come the weights of motors also. Hence the lever is balanced according to Fig.8.1.

$$E_1 \ (x_1 + x_2) + E_2 \ X_1 = R_1 \ (Y_1 + Y_2) + R_2 \ Y_1$$

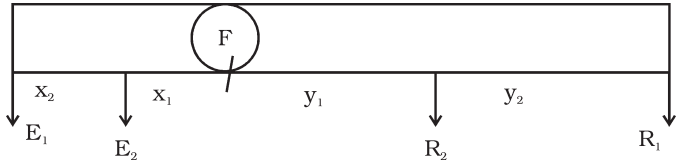


**Fig. 8.1: A Fulcrum Equation**

### 2. A Geared Motor which moves the Lever

The motor works on 9v DC. The gear system reduces the normal speed of the motor. Ends of a thread which is wounded over the axis of the motor are tied to two tension springs which are hooked in two holes on the circular disc. This thread helps the lever to rotate in a horizontal plane.

### 3. A Geared Motor which Lift and Lower Materials

This motor also works on 9v DC. The gear system reduces the normal speed of the motor. A spool wounded with thin thread is fixed firmly to the axis of the motor. The free end of the thread is tied to a system of second order movable pulleys through a fixed pulley.

### 4. Remote Operated Electronic Circuits

The above two motors work with the help of remote operated electronic circuit. This circuit consists of two parts:

(i) *Remote Control – Transmission Circuit:* Remote control circuit is same as it is in FM remote bell. When we press switch 'S', IC 567 will generate frequency of 2.75 kHz and it will be modulated by FM Transmitter (Fig. 8.2).

(ii) *Motor Driving Circuit – Receiver Circuit:* This is an FM radio receiver.

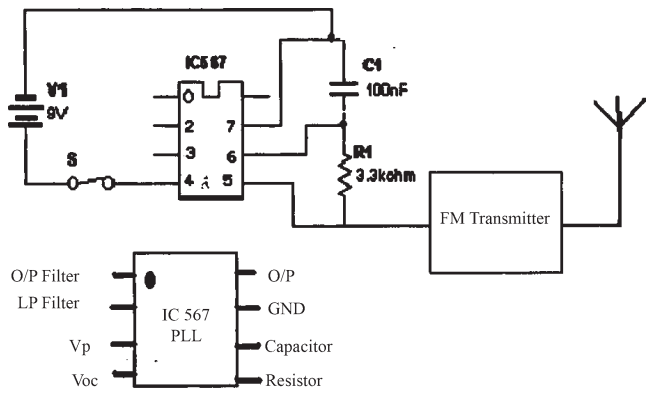


**Fig. 8.2: Transmission System**

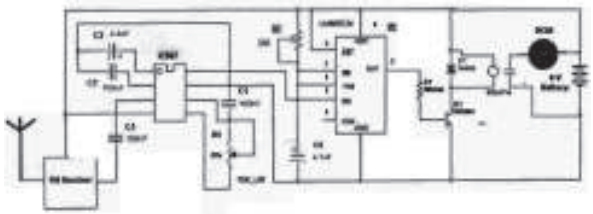

**Fig. 8.3: FM Radio Receiver**

The main components of the circuit (Figs. 8.3, 8.4 and 8.5) are IC 567 (PLL — Phase Lock Loop), IC 555 and relay. The signal output taken from FM radio coupled to input of IC 567

through 100nf capacitor. The output of PLL is given to trigger input (pin no.2) IC 555. It is connected in monostable multi-vibrator mode. Output of IC-555 drives relay which is connected with DC motors.

### Operation

- When we press switch S, 2.75 KHz signal is generated from the transmitter and it will be modulated by FM Transmitter.
- This FM modulated signal is demodulated by FM receiver and given to PLL IC-567.
- This IC detects 2.75 KHz signal and gives low output
- This low output triggers IC 555 and it will generate high pulse of 5 sec.
- This pulse will trigger the relay and motor will get DC supply from battery.
- So motor starts rotating and thus the lever will run forward, pullies move downward, and for reverse motion just use a reverse switch to change the terminals of DC Motors.

In short, using the remote, the lever can be moved horizontally and the spool can be rotated to lift or lower loads. When the remote is switchedon, radio waves are transmitted from it with a predetermined frequency of 2.75 kilo hertz. The sensor in the receiver circuit detects these radio waves and demodulated. The current thus produced, rotates the motors.

**5. A Weight Lifting Electromagnet and its Electronic Circuit**

A soft iron core wounded with insulated copper wire is used as electro magnet. This is taken from a telephone coin box. 9V D.C. current is applied to the coil through an electronic circuit. Electronic circuit consists of a transistor TSOP 1356, another transistor 18839, an IC K73023, two condensers and five resisters. Actually this circuit is a remote switch. The circuit works on an IR remote. When the remote is switched on, infrared waves of a predetermined frequency of 48 kilo hertz are transmitted from it. The TSOP1356 which is a sensor that detects these waves and allow current to pass through the coil. Now the soft iron core is magnetised and lifts the weight. When the remote is switched off, no current is allowed to pass through the coil and soft iron core is demagnetised and thus the weight gets unloaded.

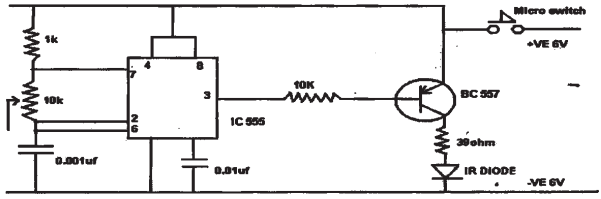


Fig. 8.4: IR Transmitter

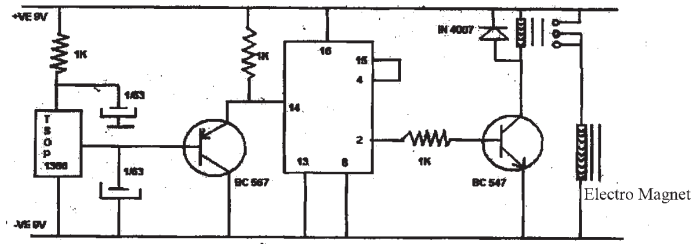


Fig. 8.5: IR Receiver

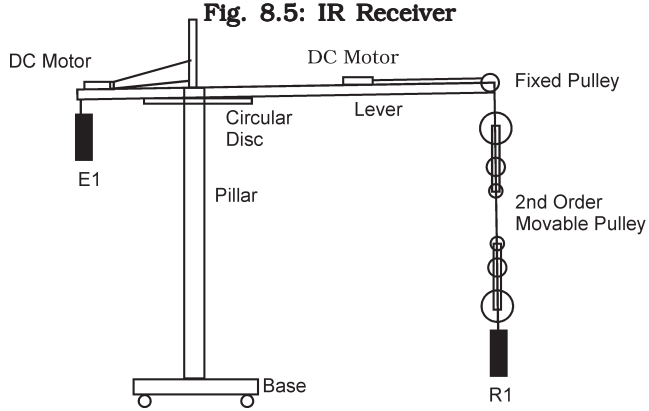


Fig. 8.6: Automatic Crane System

## Advantages

No loss of energy, obey principle of conservation of energy, can be used to move equipment and machinery, quick and easy movement, beneficial to building bridges or constructions, can be remote-controlled from the base.

# 9

# STAIR CLIMBING WHEELCHAIR

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## INTRODUCTION

For physically challenged and old persons, there should be a barrier-free entry to all public places, but the fact is that there are so many barriers in their movements as there is no provision of ramps or elevator at many public places. As a result, these persons are restricted to their home only. They cannot move around due to their physical disability.

These persons use conventional wheelchair which can run on only plain surfaces or on the ramps. But in case of stair case, these conventional wheelchairs are of no use. There is an urgent need to overcome the shortcomings of ordinary conventional wheelchair. A stair-climbing wheelchair has an edge over conventional wheelchair. It is a new innovation. It can run on plain as well as rough surfaces. Moreover it can climb and alight any staircase. It has brought new hope in the life of physically challenged and old persons. It is also useful for labours at construction sites and porters on railway stations.

## RATIONALE BEHIND THE EXHIBIT

The main object of the exhibit is to ensure barrier-free entry for the physically challenged and old persons to any public places

like railways stations, multi-storeyed buildings, gardens, hospitals, offices etc. These wheelchairs can be used for rescue operations.

## Materials Required

Frame of the old tubular office chair, 10 tricycle wheels, 2 castor wheels, mechanical disc brake, handle grip, cushions, scrap metal-parts, nut bolts, ball bearings, safety belt.

## Construction and Working

This working model consists of the following major components as shown in Fig. 9.1. These are: frame of the old tubular office chair, cushions at seat and at the back, arm rest, handle grip, brake lever with cable, mechanical disc brake, pentagonal wheel arm, wheels, axle shaft, castor wheels and foot rest.

A stair-climbing wheelchair can climb all kind of staircases where the height of a step ranges from 5 to 10 inches without any power backup. One can also alight staircase with the help of this wheelchair. Apart from plain roads, it can run easily on rough or uneven surfaces. Unlike the conventional wheelchair where two wheels are fitted to the each side of the rider, a stair-climbing wheelchair has 10 wheels, 5 of which are fitted to the each side of the rider. To move the wheelchair to any direction, it has two castor wheels fitted at the front **side.**

**Fig.9.1: A Stair Climbing Wheelchair**

When it runs on plain or rough surface, it uses 4 rear wheels fitted to the pentagonal arm castor wheels. When it rears on plain or rough surface, two wheels of each side rests on the land in the angle of 72 because of which the weight of the wheelchair and rider does not fall on the wheels directly. This ensures the free movement of the wheelchair.

When this wheelchair climbs up the staircase it uses only each wheel of the rear side which rest on the step of the staircase. The other four wheels, as well as castor wheels are non- functional.

The wheels which rest on the step are at the angle of 90 to the seat of the chair due to which the entire weight of the wheelchair and rider falls on these wheels. Moreover, these wheels are locked to the vertical side of the step. As a result those wheels get obstructed and cannot move. When the driver pulls the wheelchair upstairs, the next parallel wheels climb the next step. This process continues during climbing of the entire staircase. This process continues during entire climbing.

When this wheelchair alights the staircase, the wheels which rest on the step are at the $90^0$ of the seat due to which the entire weight of the wheelchair and the rider falls on these wheels. As a result, these wheels get locked and cannot move. Due to the gravitational force and weight of the rider as well as weight of the wheelchair, the next wheel on the front side falls down on the next step. This procedure continues further. To control the downward movement of the wheelchair, a provision of mechanical disc brake is made on the main axle.

When this wheelchair runs on the land, plain or rough, two bottom wheels on each side, rests on the ground. The angle between these two wheels is 72 . Due to this castor angle, the weight of the rider and the wheelchair is distributed among these two wheels. This ensures the free movement of the wheelchair on the plain or rough surface.

## Applications

- Physically challenged persons to climb the stairs at any place.
- Old persons to climb the stairs at any place.
- Laborers at construction sites and porters at railway stations.
- Public places, railway stations and airports, schools, hospitals, shopping malls, gardens and rough roads.

# 10

# Low Cost Grinder

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## Introduction

Low cost grinder is an essential machine in a country whereas rice is a stable food. The rice grinder presented here uses hydro power in place of electric power, petrol or diesel. It is difficult to have an electrically-operated grinder/mill in village or remote areas because of its high cost of installation, maintenance storage and non-availability of electricity and this model is also produced electricity during working hours.

## Scientific Principle Involved

Friction plays an important role in separating rice or grains from their respective seeds and mechanical energy of hydro power is converted into electrical energy.

## Materials Required

Wooden frames, iron plane sheet, wooden cylinder, two wooden pulleys, two ball bearing, a dynamo etc.

## Construction and Working

This model mainly consists of a hollow and a solid wooden cylinders. Both the cylinder kept in vertical position and lower

solid cylinder join an axil at centre. The ends of the axil are fixed with two pulleys lower and upper. Few iron blades are fixed to the lower pulley as a water turbine. Two ball bearings are also fixed to the axil for smooth movement of the lower cylinder. On the other hand, the lower cylinder is kept fixed. The contact layer between upper and lower cylinders have a groove mark for crushing and husking the rice or grains. A dynamo is fixed with the upper part of the exhibit and connected to the upper pulley with a belt (Fig.10.1).

When turbine is joined to the moving water or water fall over it lower cylinder moves, crushing or husking the grain or rice. During this period electricity is also produced.

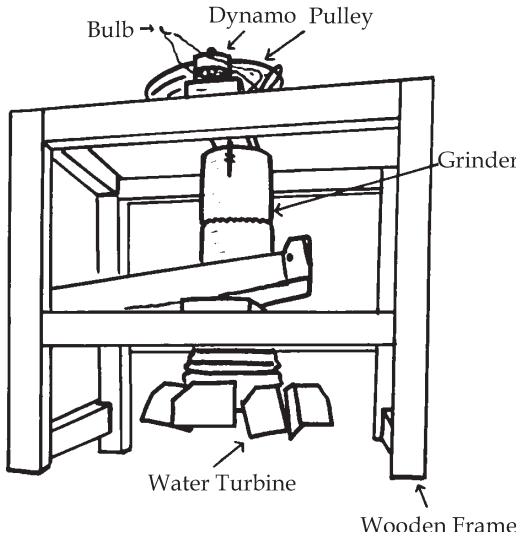


**Fig. 10.1: A Low Cost Grinder**

## APPLICATION

It can be used on a small scale and also on medium scale. It can husk paddy at the rate of 100 to 150 kg per hour. It is pollution-free because no fuel like petrol or diesel are used. The outer layer of rice containing vitamin 'B' is not washed in this grinder. This vitamin helps to protect against diseases like angular stomatitis and beri-beri. The cost of installation is very low.

# 11

# HYDROPONICS

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## INTRODUCTION

Hydroponics is the science of soilless cultivation of plants. It is about enriching water with the very same nutrient salts as found in nature. It is about creating and maintaining a 'Nutrient Solution' that is perfectly balanced for plants. Since soil is not required for growing plants, it can be practiced anywhere on earth and even in space.

Hydroponics was practiced in the older civilisations (hanging garden of Babylon, floating gardens of the Aztecs etc.) but later on lost its popularity. In moden times a lot of interest is generated in this field of science and researches are being carried out worldwide.

The future food scenario of the world is alarmingly bleak. With increasing population and depleting per capita cultivable land, it is impossible to feed the entire population with conventional cultivation alone.

Hydroponics provides an alternative to achieve food security for all.

## Rationale Behind the Exhibit

The project is a modest attempt to create awareness about the looming challenges of food crisis and need for alternative means to conventional methods of farming. For easy understanding of the working of hydroponic systems, the model displays both the passive and active systems of hydroponics culture.

## Scientific Principles Involved

In the conventional system of cultivation, soil provides four needs to the plant: supply of water, supply of essential nutrients, supply of Oxygen, support for the plant root system.

In hydroponics, soil-free mediums are used for sowing seeds and providing support to the plant. The plant roots are moistened with the nutrient solution containing the essential elements. The subsequent mineral intake by plants is the same as in soil culture.

There are 16 elements which are considered to be essential for growth of higher plants as shown in Table 1. Three of these elements–Carbon, Hydrogen and Oxygen — are called structural elements. The remaining 13 elements are classified as macronutrients (required in large quantities) and micronutrients (required in small quantities).

Plants possess the ability to extract Carbon — Hydrogen and Oxygen from the atmosphere in the presence of macro nutrients and micronutrients to create food. Light provides the energy to make this possible.

**Table 1: Essential elements for higher plants**

| *Structural elements* | *Macronutrients* | *Micronutrients* |
|---|---|---|
| Carbon | Nitrogen | Boron |
| Hydrogen | Phosphorus | Chlorine |
| Oxygen | Potassium | Copper |
| | Calcium | Iron |
| | Magnesium | Manganese |
| | Sulfur | Molybdenum |
| | | Zinc |

In hydroponics all the essential elements are supplied to the plants by dissolving fertiliser salts in water to make the

nutrient solution. There is no physiological difference between plants grown hydroponically and those grown in soil.

## Materials Construction and Working

Two rectangular polypropylene trays – one as the nutrient reservoir for the passive system and the other one as the support tray for the active flood and drain system. A thermocol plate as the container for the soil-free growth medium (coco peat) in the passive system. Absorbent wicks (used in kerosene stoves) for the passive system. A 5 litre jerry can as the nutrient reservoir for the active system. A length of flexible plastic pipe (about 3 metres) as a conduit for the nutrient solution in the active system. Coco peat, sponge gourd and synthetic sponge (packing sponge) as the growing media. Nutrient solution enriched with the essential elements (obtained from ICAR, Shillong). Wheat grains, Pea Seeds, Rectangular 4  4 feet plywood board to support the entire model.

In a passive capillary system or a wide system (Fig. 11.1), the reservoir (polypropylene tray) is filled with nutrient solution. Holes are made in the bottom of the growing tray (thermocol plate) and the wicks are fitted. The tray is then positioned above the reservoir such that the wicks are well inside the nutrient solution. A thin layer of coco peat and the system is ready. The nutrient solution rises up by capillary action through the wicks and moistens the growing medium which in turn moistens the roots of the plants. Thus the plants get a constant supply of essential nutrients to grow. The solution in the reservoir is to be replenished and required.

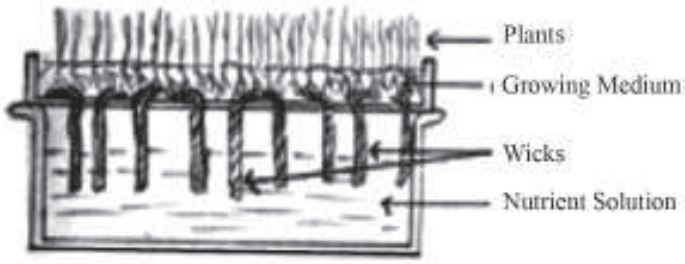


**Fig. 11.1: Passive Capilary or Wiek System**

In an active flood and drain system (Fig. 11.2), a flexible tube connection is made between the bottom of the support tray (rectangular polypropylene tray) and the base of the nutrient reservoir (jerry can). Germinating pea seedlings are placed in three different types of growth media: (i) inside the hollow of a dry sponge gourd, (ii) along the holes made in a piece of synthetic sponge, and (iii) in a small tray of coco peat. All the three media are then put inside the support tray. When the nutrient reservoir is raised above the level of the support tray, nutrient solution flood the tray by gravity and supplies nutrients to the plant roots. When the reservoir is lowered below the level of the tray, the nutrient solution from the tray is drained letting the roots get exposed to atmospheric oxygen.

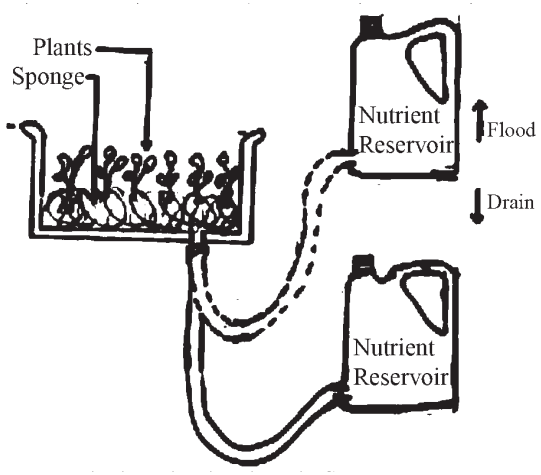


**Fig. 11.2: Active Flood and Drain System**

## APPLICATIONS

Hydroponics systems can be established almost anywhere – in villages, towns and even in the middle of a crowded city, because plants grown hydroponically are in a controlled environment, with no soil, we need not worry about soil borne diseases or pests.

Hydroponic growth requires only one twentieth of the water used to irrigate a farm growing the same number of plants, yet yields are higher, because there is a continuous flow of nutrients to the plant, the plant can concentrate its energy on producing

fruit rather than roots. Hydroponic lights and a $CO_2$ rich atmosphere within the building could also increase food production by stimulating photosynthesis and lengthening the daylight hours available to the plants.

The exhibit is only an attempt to highlight the feasibility of a simplified hydroponic system with reference to underdeveloped countries like India with ever increasing population. In real practice the main problem will be the easy availability of the nutrient solution. The most effective way of making the nutrient solution easily available to the public would be through a system of recycling treated water enriched with the essential plant nutrients. We can have two parallel systems of water supply – one for consumption and the other for gardening (as done in most big cities). The supply water for gardening will have all the essential nutrients in a basic ratio for most practical purposes. Any extra requirement of nutrients for specific plants can be taken care of commercially available fertiliser salts. This system will be something like India's highly successful iodized salt programme. With this simplified hydroponics system it is possible for every household to grow its own vegetables at home.

12

# Use of Graphene – the Wonder Material

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## Introduction

Graphene is one of the strongest, lightest and most conducting material known to humankind. It is 97.3 per cent transparent but looks really cool under powerful microscopes.

It is a worthy Nobel, for the simple reason that graphene may be one of the most promising and versatile material ever discovered. It could hold the key to everything from super small computers to high-capacity batteries.

Graphene's properties are attractive to material scientists and electrical engineers for many reasons, of which is the fact that it might be possible to make circuits that are smaller and faster than the made by using silicon.

## What is Graphene

Graphene is a single layer of carbon packed in hexagonal (honeycomb) lattice, with a carbon-carbon distance of 0.142 nm. It is the first truly two-dimensional crystalline material and it is representative of a whole class of 2D materials including for example single layers of Boron-Nitride (BN) and Molybdenum-disulphide ($MoS_2$), which have both been produced after 2004.

Graphene is stronger and stiffer than diamond, yet can be stretched by a quarter of its length, like rubber. Its surface area is the largest known for its weight.

Geim and his colleague Konstantin Novoselov first produced graphene in 2004 by repeatedly peeling away graphite strips with adhesive tape to isolate a single atomic plane. They analysed its strength, transparency and conductive properties.

It was well known that graphite consists of hexagonal carbon sheets that are stacked one on the top of other but it was believed that a single such sheet could not be produced in isolated form. It, therefore, came as a surprise to the physicist community when in 2004, Konstantine Novoselov, Andre Geim and their collaborators showed that such a single layer could be isolated and that it is stable. The single layer of carbon is what we call 'Graphene'.

It is interesting to consider that everyone who has used an ordinary pencil has probably produced graphene-like structures without knowing it. A pencil contained graphite and when it is moved on a piece of paper, the graphite is cleaved into thin layers that end up on the paper and make up the text or drawing that we are trying to produce. A small fraction of these thin layers contains only a few layers or even a single layer of graphite, i.e., graphene. The thin layers of graphite can be extracted from a graphite crystal with Scotch tape and then these layers can be transferred to a silicon substrate.

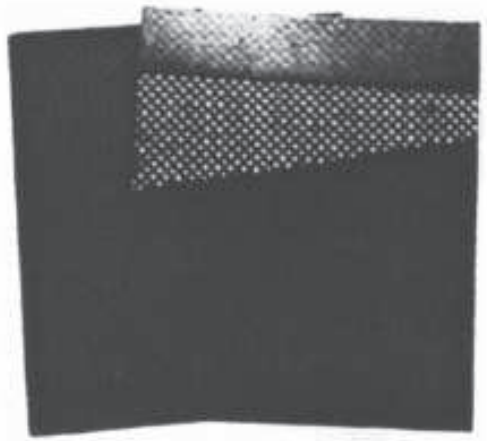

**Fig. 12.1: Graphite Sheet**

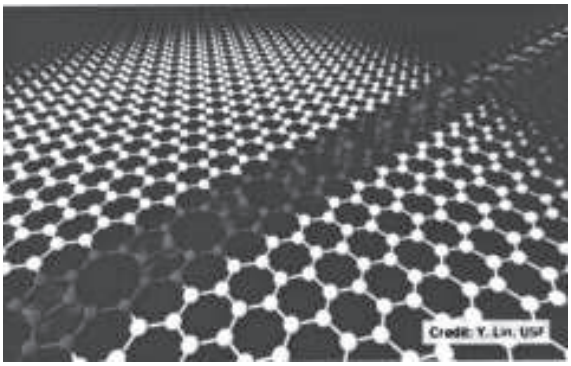


**Fig. 12.2: 2D Graphene Sheet**

**Fig. 12.3: Graphene**

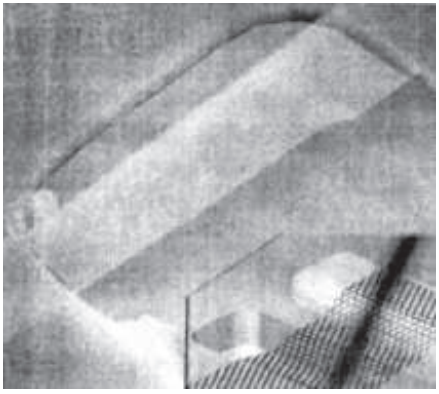

**Fig. 12.4: Pounding of Graphene Sheet**

Graphene can also be doped by adsorbing, for example, water or ammonia on its surface. The electrical conductivity for doped graphene is potentially quite high at room temperature. It may even be higher than that of copper. It may be used for lightening resister.

## Use of Graphene

The graphene can be used as: super-small transistors, computer microchips, super dense data storage, energy storage, optical devices — solar cells, flexible touchscreens and electrical wires.

## Graphene in Biodiversity Conservation

Geographical Information System (GIS) technology helps in spatial mapping, census of animals and plants, natural hazards in an ecological system. It includes the use of Indian Remote Sensing Satellites (IRS), various computers in the earth stations, laser beams, sensors etc. Instruments for different works are spoiled within a short period and need maintenance. New IRS needs to be sent to space at a particular interval. But the use of graphene for computer microchip, dense data storage device, energy storage device gives them a long life and durability. This, in turn, gives continuous service for biodiversity conservation issues.

The general fencing with electrical connection results in the elephant death in elephant sanctuaries like in Chandaka of Bhubaneswar, Bandipur Sanctary of Karnatak etc., but fencing with graphene sheet may help in preventing such incidents. Use of light graphene panels may indicate the movements of the elephants through sensors.

Graphene will challenge against the raid of elephant on the crops and villagers. Three male and one female elephant will be installed with Collar Radio made of graphene. By the use of radiometry techniques we can assess their movement, spatial mapping, position etc.

Energy storage device made of graphene gives continuous energy to laser to provide the information in the dense forests. This is facilitated by the signal receiving antenna in different places in jungle. Elephant in day-time and owl in night-time installed with graphene microchips or sensors may give the 24-hour information through GIS system.

## Materials Required

Hexagonal wire net pasted with thermocol beads to represent graphene Sheet, a motor, drawing board, solar panel models,

satellite model, laser torch, house model with copper rod, pencil, paper, cellotape, model of forest and animal toys.

## Description

Wire net having hexagonal mesh and thermo-coal beads at each joint representing carbon atoms represents single-layered graphene which is prepared from the graphite crystal. This can be shown with the help of a pencil, paper and cellotape. Solar panels are kept in the space and also on the earth station producing electricity, where graphene plates can be used as the stronger plate than the traditional fragile Indium Tin Oxide (ITO). The electricity produced in the space can be sent with the help of laser beams which is to be received by the antenna. It is transported through the wire made of graphene sheets. Continuous light beams from the space can be received by the earth station solar panels to produce electricity irrespective of the weather. It can be used as thunder resistant plates on the temples and apartments instead of the copper ones. This model demonstrates different ways in which graphene can be used in forest laser lighting, sensor arrangements and receiving antenna systems. It is wonder regarding biodiversity conservation and assessments.

## Applications

It has potential applications in electronic devices, flexible electronic and gas sensors. It can contribute to an even more accurate resistance standard in meterology in satellites and aircrafts.

13

# MODERN AQUATIC BIODIVERSITY

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**TEACHER**
Chitaranjan Jena

## INTRODUCTION

For all living organisms, air is one of the most essential substance. When we think about aquatic animals, we think good quality of water which they require for sustenance. Now-a-days a polluted aquatic medium is being created due to human activities, hazardous to aquatic life. By making proper balance in aquatic environment, there is a possibility of better chances of survival of aquatic animals.

## AIM

To give a suitable medium for better living to aquatic animals which are at the edge of extinction to conserve and sustain the pond biodiversity.

## OBJECTIVES

The objectives of this project are: to protect the natural pond bio-diversity; to recycle the harmful waste products and convert them into good manure for providing fresh water for aquatic animals; to make a better living medium for fish and prawn; to increase soil fertility; to prevent extinction of aquatic animal; to increase the production of fish; to fulfil the need of drinking

water; to reduce the manpower in fish cultivation; to use new devices for easy fishing and cleaning of non-diffusible substance and to make artificial rain for molting of prawn.

## Purpose of Project

This project aims at: to reduce nitrogenous waste product (Ammonia); to maintain the pH of water; to recycle waste product into useful product for aquatic animal; to clean polluted water; to increase soil fertility; to remove non-diffusible substance through new device; and to catch fish easily through a new device.

## Description

Presently the quality of aquatic medium (pond) is gradually decreasing. Due to this, survival of the aquatic animals has become difficult and some aquatic animals are at the edge of extinction. The IUCN (International Union for Conservation of Nature and Natural Resources) gives attention towards extinct species, endangered species, vulnerable species, rare species and insufficiently known species.

Our aim is to provide a good medium for aquatic animal and make new device for easy cultivation.

## Materials Required

Aeration motion, plastic pipe and plastic tap, net, rope, plastic boat, water tank, plastic bucket, water pumps, wheels, nitrifying bacteria (nitriosomonas, nitrococcus, nitrobactor and nitrogloea), oyster lime, oyster shell and charcoal, sand and gravels, funnel, bleaching powder and alum.

## Working of Newly Designed Pond

The pond must be square in shape. Four poles are placed on four corners. These poles may be wooden or of concrete. Each pole contains three wheels namely A, B and C respectively (Fig. 13.1). In this system the first wheel C touches the ground while the second wheel B and third wheel A are kept 15 cm above the water surface. A thread is also passed around the wheels.

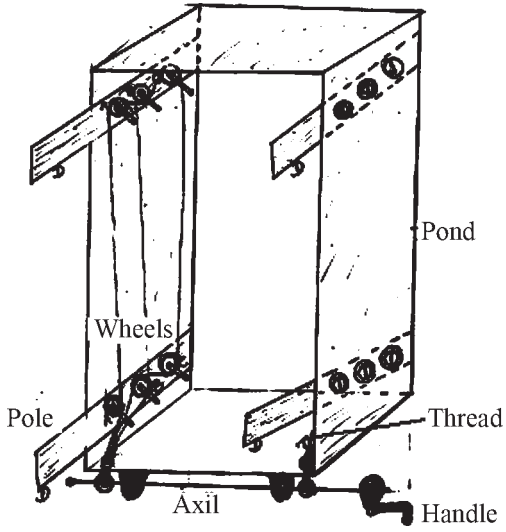


**Fig. 13.1: Pond Biodiversity**

Two wheels are fixed on an axil present outside the pond. One is on the left side and another is on the right side. This axil is fixed with two ball-bearing sockets. A handle is fixed on this axil which is easy to rotate.

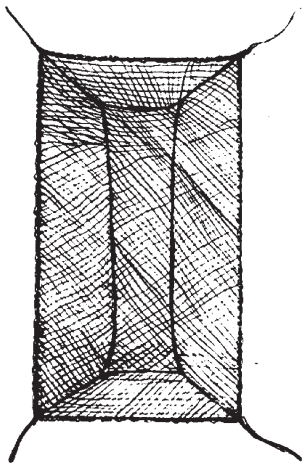

**Fig. 13.2: Net to Collect Weeds**

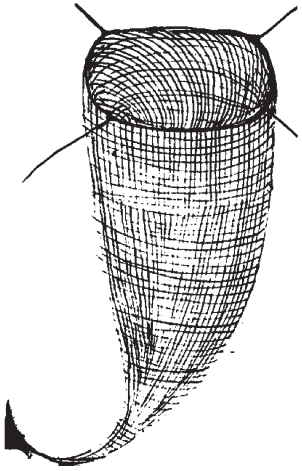

**Fig. 13.3: Net to Collect Fishes**

In this pond, two types of net are used. First net is used for collecting floating weeds and second net is used for catching fish. On right side at lower corner first net is fixed in thread of second wheel (B). The right upper corner of first net is fixed with the thread of third wheel (A). Just like this the left side of first net is fixed with the second and third wheel of the thread. Both the side threads are fastened with outside wheel. With this system one can collect all weeds which floats on the upper surface of water (Fig. 13.2). In this manner using of first (C) and third (A) wheel, can also catch all the fishes from the pond with the help of net shown in Fig. 13.3.

In this exhibit, the polluted water is filtered through bio-filter. In this filter we have used four layers for filtration. First layer is sand, second is charcoal, third is snail and the fourth one is of gravel.

The nitrifying bacteria are placed in fourth layer for conversion of ammonia into nitrite and nitrate. The polluted pond water is taken in bio-filter and after filtration the filtrated water is again poured into the pond. Fig. 13.4 shows a schematic block diagram of this exhibit.

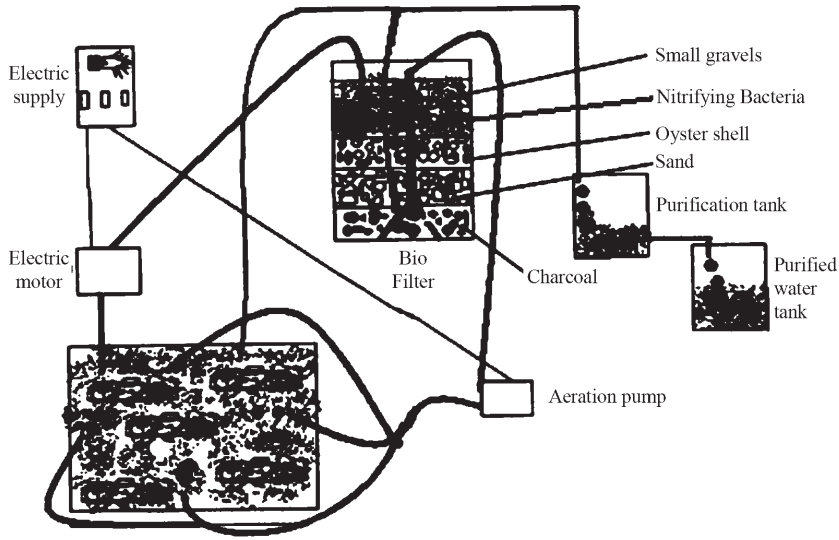


**Fig. 13.4: A Schematic Diagram of Aquatic Pond**

For prawn molting, we have further used a system of having artificial rains. It is done through five balls. The filtered water enters into a small tube like pipe which fits into ball. Aeration is used to maintain the pH of water.

## Chemical Reactions Taking Place

The chemical formula of ammonia is $NH_3$, Components are N and H. It is present in aquatic medium in the form of $NH^+_4$ ion. It is highly toxic substance which is easily soluble in water.

$$\underset{\text{Dinitrogen}}{N \equiv N} + \xrightarrow[2H^+, 4ATP]{\text{Nitrogenase} + 2e^-} HN = NH \xrightarrow[2H^+, 4ATP]{+2e^-} NH_2 = NH_2 \xrightarrow[2H^+, 4ATP]{+2e^-} \underset{\text{Ammonia}}{2NH_3}$$

Each step of reduction requires a pair of electron ($+2e^-$), a pair of proton ($2H^+$) and 4ATP molecules. Conversion of each molecule of Nitrogen ($N_2$) into ammonia ($2NH_3$) requires $6e^-$, $6H^+$ and 12 ATP molecules.

$$N_2 + 6H + 6e^- \rightarrow 2NH_3$$

Aeration of ammonia gives ammonium hydroxide which is a weak base:

$$NH_3 + H_2O \rightarrow NH_4\ OH$$

It is toxic. Bacteria introduced in the medium convert the ammonia in nitric oxide and then to nitrate. Thus, the pH of the medium becomes basic. Limestone and oysterlime are used inside pond for maintaining the pH of water.

### Use of Aeration Pump

Excess amount of Oxygen is dissolved into medium which has following functions. It reduces deficit of Oxygen concentration in water. The free ammonia, which is release from nitrogenous waste product of aquatic animal, dissolves in water to produce Ammonium Hydroxide. It is a highly toxic substance and may create great hazard for aquatic animals. Bacteria are used to convert nitrate oxygen which is required for the process.

The nitrate and nitrite produced increase soil fertility. The nitrate and nitrite can be used by phytoplanktone. Then aquatic animal can eat phytoplanketon which increase the growth of

aquatic animals (fish). Aeration also enhances the activity of nitrifying bacteria.

Oysterlime reduces acidity of water and which is harmful for micro-organisms of aquatic medium.

### Use of Nitrifying Bacteria (Nitrosomans, Nitrococcus, Nitrobactor)

The ammonia is converted into nitrite in oxidation process by nitrosomonas/nitrococcus i.e.,

$$NH_3 \xrightarrow[\text{Nitrosomonas/Nitrococcus}]{\text{oxidation}} NO_2^-$$

Nitrite converts into nitrate by nitrobactor.

$$NO_2^- + O_2 \rightarrow NO_3^-$$

### Use of Gravels, Oyster shell, Sand, Charcoal

These substances remain in bio-filter at different layers and filter non-diffusible substances. Oysterlime in pond maintains the pH of aquatic medium. After filtration the free ammonia, non-diffusible substance of water are drawn into aquatic medium.

## Conclusion

We may conclude from this project that high ammonia and oxygen deficit create great hazard for aquatic medium. This method can be used to increase the production of aquatic animals such as fish and prawn which fullfil our proteineous food requirement. We can recycle the waste products for reuse. This process is indeed environment-friendly.

# 14

# A Device for Water Lifting

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## Introduction

Water is life as every living-being need water for their existence. Water is also required in every field like agriculture, industry, power generation etc., To meet the requirement of water we depend on natural sources of water through river, pond etc., and also adopt different ways to use groundwater through digging well/bore well. The question here is how to obtain the river or pond or well water for our use. The usual method is by using electric/diesel pump, drawing water from well using rope and vessel, hand pump etc. In these methods the expenditure and loss of physical strength are involved. To overcome the problem of lifting water, we have designed a low-cost device which neither require electricity nor physical strength.

## Rationale Behind the Exhibit

We made this project (Fig.14.1) to solve the water lifting problem using a very low cost, simple and maintenance-free model which does not require electricity. It is suitable for all categories of people and can be used anywhere. This device is appreciated for lifting water in our everyday life.

## Scientific Principle Involved

In this device, the scientific principle adopted is based on circular motion, principle of pump, cohesive force and principle of generator.

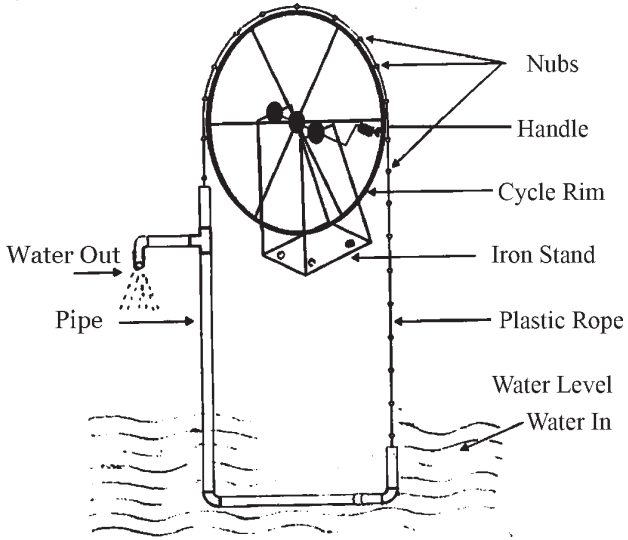


**Fig. 14.1: A Water Lifting System**

## Materials Required

Iron stand, cycle rim, nub, plastic rope, PVC pipe, two water tanks, DC generator, four bearings, turbine, pulley, belt etc.

## Construction and Working

A wheel is fitted with the iron stand. The nubs are tied with the plastic rope around one feet distance from one nub to another and build in a circular form over the wheel and the pipe (Fig.14.1). One end of the pipe is inside the water level. When we rotate the wheel, the rope also rotate through the pipe which causes the air of the pipe to come out by the nub and on the other hand, the water comes automatically upward in the pipe. Now the lifted water can be collected in a reserve tank. We can use the reserve water in different ways as per requirement.

# 15

# HIGH EFFICIENT HYDRO-ELECTRIC GENERATOR

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Rama Chandra Sahu

## INTRODUCTION

The increase in energy requirement, increase in fuel cost, depletion of fuel reserves and dependence of foreign resources, make it necessary to develop the efficiency of traditional generators being operated by the current water of dams. Since our country is having a large number of dams in different rivers, it is important to develop the mechanism of the traditional generators and to produce a huge amount of electricity to meet the basic necessity of the people.

## SCIENTIFIC PRINCIPLE INVOLVED

It is known that a dynamo or a generator produces electricity either the field magnet rotates around the armature or the armature rotates in the magnetic field. Due to rate of change in magnetic lines of forces, electricity is induced in the armature. In Hydro-electric power plants, the turbine of the generator rotates due to kinetic energy of water current emerging horizontally from the dam.

In this type of generator, the same kinetic energy of the water is utilised to rotate both armature and field magnet of the

generator opposite in direction to produce approximately two-times electrical energy that of the traditional one.

## Materials Required

One dynamo, one wooden frame, two turbines, LED bulbs and hardware materials.

## Construction and Working

The whole model is made up of wooden battens and tin foils. Two turbines are made in tin foils and both of them are fitted with armature and field magnet separately. The design of the blades are so made that when water passes through them, one will rotate in clockwise direction and other one will rotate in anti-clockwise direction. Now this system is set at the centre of a wooden frame and allow it to work through ball and socket system. When the door of the dam is opened, water rushes at a very high speed (horizontally) and hammers the upper turbine of the generator which is fitted with armature.

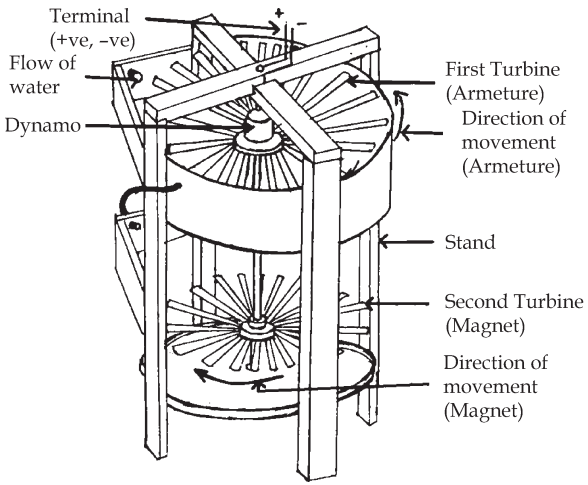


**Fig. 15.1: An Efficient Generator**

This turbine now rotates in anti-clockwise direction. Again this water after rotating the turbine fall vertically downward due to force of gravity of earth and rotates the second turbine already fitted with field magnet. Now the field magnet rotates in

clock-wise direction. Hence more electricity is generated from the same generator in comparison with that of the traditional one. Electricity thus generated can be collected through bush-commutator system.

## Application

It is a dynamic model with new indigenous technology run on running water. It could be successfully used for generating electricity. It does not pollute air. It can be very economical and efficient.

# 16

# COMMUNITY ASTHMA DETECTOR

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**TEACHER**
Samarjit Mohapatra

## INTRODUCTION

India accounts for one-third of the world's 115 millions asthma patients. The prevalence of pollen allergy, dust and mite allergy in an already polluted environment and the growing pressure of urban living are fueling the spurt of respiratory disease like asthma in India. Asthma has a serious repercussion on the country's economy. One in three asthmatic children, misses school everyday. One in every four adults, skips work in India. The total lost is about 15,000 working days in a year.

It is estimated that there may be an additional 100 million people with asthma by 2025. Environmental pollution and poor awareness are some of the main reasons. Our project aims at the early detection of asthma susceptible/prone people.

## OBJECTIVES

(i) The lungs efficiency of a community is to be measured easily.
(ii) Asthma susceptible/prone people is to be detected at the earlier stage in a particular area and the position of asthma may be monitored through internet.

## Scientific Principle Involved

Spirometry (the measuring of breath) technique is adopted to construct the project. Spirometry is the most common Pulmonary Function Test (PFT). This helps in measuring the lung function, specifically the measurement of volume and speed of air inhaled and exhaled.

## Materials Required

Funnel, rubber tube, motorised fan, digimeter, box, close circuit camera and computer with internet.

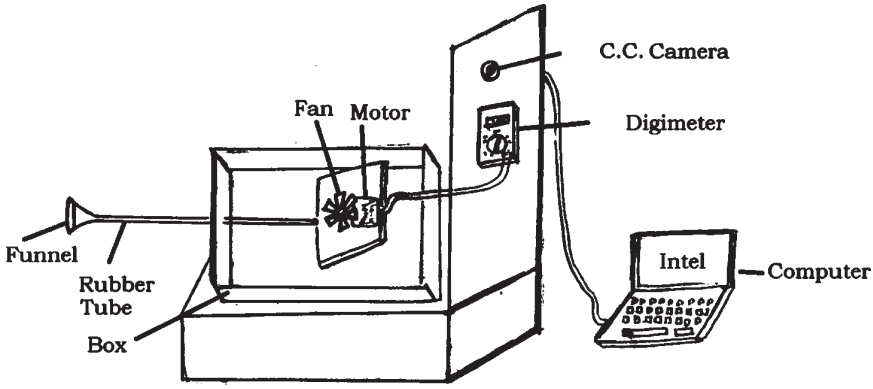


**Fig.16.1: Block Diagram of Asthma Detector**

## Construction and Working

The funnel is connected to the rubber tube and the tube is placed before the fan which is fixed on the surface of the box (Fig. 16.1). The Digimeter is connected to the motorised fan and placed on the wall of the Asthma detector. A close circuit camera is placed above the Digimeter which is connected with computer linked to a web server. When air is blown into the pipe, the fan rotates according to the force of the exhaled air. As a result, the armature connected to the fan rotates that produces the current. The voltage of the current is measured with a digimeter, which is connected to the fan motor. To delineate the perception about asthma susceptibility, a reprehensive sample of 70 students and 90 adults has been examined to fix the range of lung efficiency.

## Results and Discussion

The lung capacity of the investigated people is examined with the help of Community Asthma Detector and is represented in the Table 1.

**Table 1: Mean Value of Digital Readings of Examined Persons in Community Asthma Detector**

| *Sl.No.* | *Age groups (in Years)* | *Mean Digital readings in mV* | | | *Total* |
|---|---|---|---|---|---|
| | | *Above 1500* | *1000-1500* | *Below 1000* | |
| 1. | 12-18 (Students) | 55 | 8 | 7 | 70 |
| 2. | 20-40 | 27 | 14 | 9 | 50 |
| 3. | 41-60 | 12 | 10 | 18 | 40 |

Persons with reading more than 1500 mV are considered healthy and 1000 mV - 1500 mV are treated as weak in the lung efficacy. The digital reading showing below 1000 mV are the persons with asthma susceptibility.

## Applications

In a very short time lung efficiency of a large number of people can be measured and people having asthma susceptibly can be detected. This information is transferred to a computer with loaded online into the web server. A doctor needs to log into a web site to access his patient information. Using close circuit camera, photographs of the examined people can be taken and transferred online through computer. Thus, monitoring of asthma through Internet would be possible. Government can easily get the data of asthma susceptible people in a particular area and take necessary action towards control. People can also aware themselves easily about asthma.

# 17

# SOLOR AC — SOLAR CHIMNEY

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Bhushan Kumar
Bant Kaur

## INTRODUCTION

This exhibit can help us to meet the challenge of scarcity of electricity and on global warming by reducing the use of electricity.

## MATERIALS USED

### For Solar AC

Wood, water pipes, brick stone, storage box and black paint.

### For Solar Chimney

Teflon (hard polythene sheet), black polythene sheet, nails, cotton threads, black paint, turbine, dynamo and galvanometer.

## CONSTRUCTION

### For Solar AC

A small house of wood is made, a black painted chimney is connected inside from the roof of the house. An underground one meter deep hole is dug out away from the house. The hole is connected with a water pipe to house floor and hole. Hole is provided with brick stones and water.

### For Solar Chimney

A black coloured sheet is put on the ground. A polythene sheet is attached from centre with a water pipe. The water pipe under the polythene sheet is provided with some inlets. Turbines are placed in these inlets. The polythene sheet is spread over the black sheet and is kept above the ground level with the help of nails. The polythene sheet is tied to the nails with the help of cotton thread. The structure appears like an inverted umbrella. Turbines are connected to the galvanometer through a dynamo. Thus, we can generate electricity from solar energy which is a non-conventional source.

## WORKING

### For Solar AC

During day time the sunlight falls on chimney, the temperature of chimney rises. We know that hot air rises up. As a result of a very high temperature inside the chimney, the air inside the chimney comes out into atmosphere and a suction is created behind. In order to overcome this suction, naturally the hot air inside the building rises up towards chimney. In this way, hot air from inside the building is exhausted. As the pipe is connected with a brick box containing water to overcome the suction created in building, the air comes from the brick box in the building through the inlet pipe. When air flows over water, it carries moisture along with. It makes the room cool. Thus natural AC is made without any use of electricity.

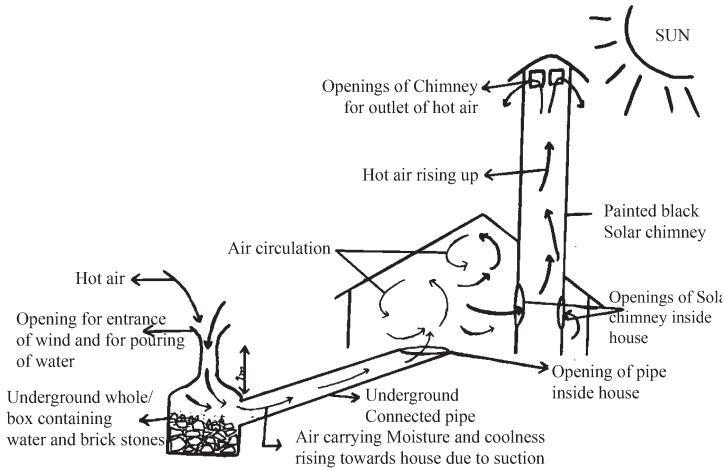


**Fig. 17.1: Solar AC**

**For Solar Chimney**

In this system when sun light falls from the collector area, the heat is collected over that surface due to green house effect. The temperature of air below the collector area rises. Chimney is painted black so that it can trap more heat. Some turbines which are placed at the inlet chamber of chimney will start rotating as the air inside chimney on becoming hot arises, the air in collector area rises towards chimney. Hot air in the collector rises and comes in atmosphere through chimney rotating the turbine that can produce electricity. The suction creation in collector area is being replaced by air from outside and suction in chimney is replaced by air from collector area.

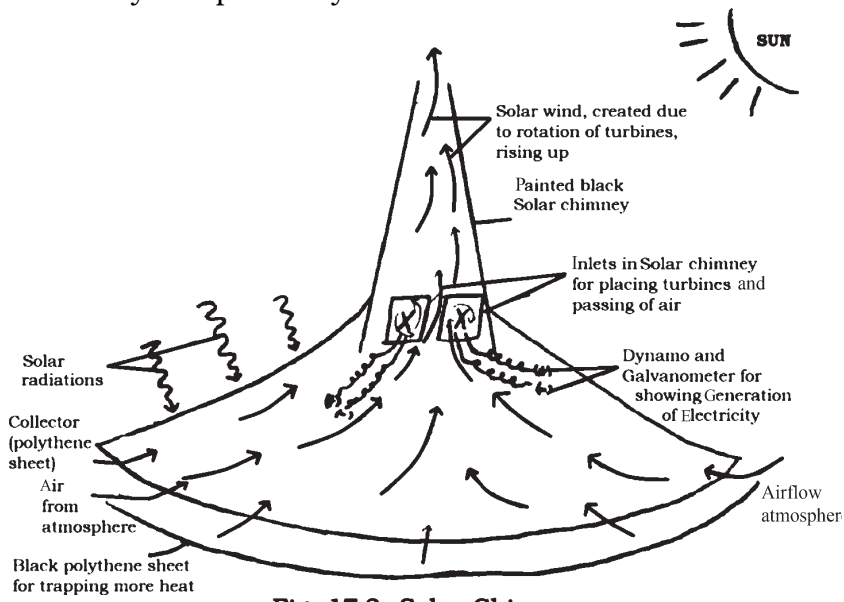


**Fig. 17.2: Solar Chimney**

## ADVANTAGES

It saves electricity, economic in use and efficient. It can reduce global warming. It can utilise the heat energy trapped in desert area. It uses a non-conventional source of energy.

# 18

# TABLE FOR HANDICAPS

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## INTRODUCTION

Many people all over the world are unable to perform work with their hands because they are handicapped from their arms or even from legs or both, due to injury in some accidents or by birth. They can't fulfil their desire to read the books because they are unable to turn over the pages of a book. This model can help them to read the books.

## SCIENTIFIC PRINCIPLE INVOLVED

In this model the principle of levers and pulleys are used. An electromagnet to pick up the page of a book is provided with irons pins to work on the basis of laws of electromagnetic induction.

## MATERIALS USED

Iron angle of 1.25 inch and 12 feet in length; Iron angle of 1 inch and 12 feet in length; Plyboard 10 mm  2 feet  3 feet; Two paddles; Shoulder levers 10 mm  10 mm  3 feet; square iron rod; An electromagnet to pick up the pages. Switch used

for electromagnet and A string used to turn over the pages with feet using paddles or with shoulders using shoulder lever.

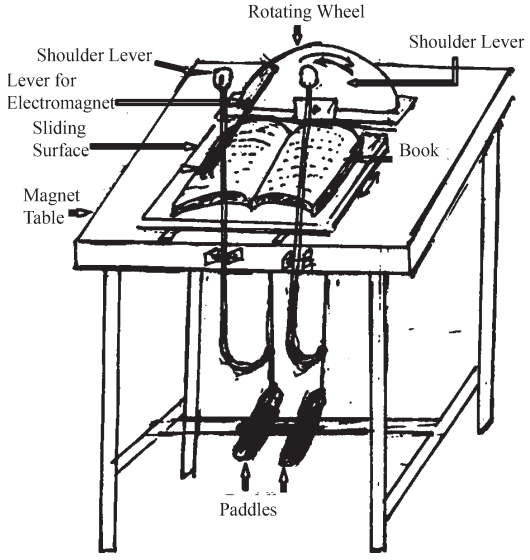


**Fig. 18.1: A Table for Handicaps**

## CONSTRUCTION AND WORKING

The design of table provide paddles and shoulder levers. Angles of iron are used to make the table frame and plywood is used to make the table floor. A rotating wheel is made from wood which carry the rotating lever fitted with an electromagnet (Fig. 18.1). A switch is used to activate and deactivate the electromagnet. The iron pins are used at the edges of pages of the book. These are attracted by electromagnet and turn over the paddles. A slide is used near the book for adjustment of book.

A person who is handicapped from arms and her/his hands are not in working position but legs and feet can use two paddles left and right to turn over the pages in left or right sides. She/he presses the paddles with feet and press the switch fixed in levers. The pins fixed in pages are attracted by magnet and pages can be turned over with the help of paddles one at a time, after the page is turned over the magnet is deactivated and release the page.

A person whose arms and legs are not working, can do the same function with his shoulders using shoulder levers.

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# Oil Production from Carbon Dioxide Using Microalgae

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## Introduction

Presently, scientists are trying to find out alternate fuel resource whose deposits are be renewable, eco-friendly and abundant in nature. This project uses carbon-dioxide and microalgae for this purpose.

## Working

The working principle behind this project is the metabolism of the glucose, produced by the photosynthesising microalgae, into lipids or oils. Microalgae are the fastest photosynthesising organisms. The glucose they produce-enters the glycolysis process forming pyruvic acid which then produces acetyl CoA which, in turn, converted into lipids or oils. Higher the lipid concentration better is the oil production.

*Botryococcus braunii, Chlorella, Dunaliella tertiolecta, Gracilaria, Pleurochrysis carterae and Sargassum* are the best known species of microalgae that produce oil. Scientists have experimented in extracting oil from microalgae by a 3-step process:

### Step 1: Cultivation of Microalgae

Microalgae were kept in a 20 L box type vessel containing 2 L of medium on which floats the microalgal cells. The medium consisted of: NaCl-58.8 g, $MgCl_2$. $6H_2O$-1.5 g, $KNO_3$-1.0 g, $MgSO_4.7H_2O$-0.5 g, KCl-0. 2 g, $CaCl_2.H_2O$-0.2 g, $NaHCO_3$-43 g, $KH_2PO_4$-40.8 g, $K_2HPO_4$-0.495 g, $FeCl_3$ solution-1.0 mL. The carbon-dioxide content in the aerating gas was maintained at 0.25 vvm. It's initial pH was 8.0. This entire setup was kept either in a bio-photo chamber or under incandescent bulbs.

Here, the microalgae were allowed to multiply, absorb carbon-dioxide and increase their lipid concentration.

### Step 2: Extraction of the Oil

This was done using a stainless steel autoclave of 100mL capacity with mechanical mixing. The autoclave was charged with algal cells (20 g), following which nitrogen was introduced to urge the residual air and its pressure was elevated to 3MPa in order to prevent water present from vaporising because water favours this process. The temperature of the heated autoclave was maintained constant at $300^0$C for a 5-6 minute period, following which it was allowed to cool using an electric fan.

Here the high temperature and pressure allowed the algae to react with water and break down. Not only did the native oil get released but proteins and carbohydrates also decomposed and added to the fuel yield.

### Step 3: Separation of the Oil

The autoclave was opened. The reaction mixture consisted of a tar-like mixture, floating on a water phase. This reaction mixture was extracted with dichloromethane in order to separate out the oil fraction. The dichloromethane was evaporated at 35 C under reduced pressure yielding a dark brown viscous material (oil). The aqueous phase resulting after the dichloromethane extraction was washed with water and filtered in order to remove the insoluble dichloromethane.

## The Oil Produced

A heavy oil yield of 35.6 per cent was obtained. This heavy oil consisted of carbon (73 per cent), hydrogen (9 per cent), oxygen (13 per cent) and nitrogen (5 per cent). The heating volume of the heavy oil is 34.7 KJ/g and has a viscosity of 860 cps. This

oil will be serving as a bio-diesel fuel. On the contrary, the leftover algae can be given as a feed for animals as well. The oil can be further used to create other products of the fossil fuels as well.

Microalgae can be easily treated because of their relatively small size. Algae can grow in salt water, fresh water or even contaminated water, at sea or in ponds and land not suitable for food production. Algae should grow even better when fed extra carbon-dioxide and organic matter like sewage. Cost for harvesting and transporting the oil is relatively low. It is capable of producing more that 30 times the amount of oil (per year per unit area of land) when compared to oil seed crops. Upto 120 tons of oil per hectare per year can be produced from algae. Moreover it will provide energy security to the oil-bearing nations and also control global warming and eutrophication. However, there are two disadvantages of this idea. First, high irradiation intensity of 10000 Lux is required for the culture of microalgae. Second, due to the presence of nitrogen in the oil, flue gas treatment is required to prevent the formation of oxides of nitrogen.

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# Raw Polythene Utilisation Plant

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## Introduction

In the present age, there is a great threat of soil as well as air pollution caused by polythene. The disposal of plastic is a great threat to mankind. It has affected living as well as non-living things. To solve this problem and to save our environment from various harmful effect of polythene, this exhibit has been prepared.

## Scientific Principle Involved

This model is based on the following principles:

(i) Prevention of soil and air pollution caused by polythene.
(ii) Utilisation of raw polythene by converting it into useful products like tiles, carbonic acid ($H_2CO_2$) and fuel.

## Material Used

Thermocol, charts, cotton, stand, pipe and cardboard.

## Construction and Working

The plant (Fig. 20.1) consists of four furnaces of different sizes. The first furnace is larger and has two inlets, one for sand and

another for polythene. It has two outlets, one for smoke and another for molten material formed during the process. A heater is fitted which works on the principle of biogas at the base of the furnace. A mixer is placed at the upper end of the tumbler.

This first furnace is connected to the second furnace. The second furnace has one inlet and one outlet. A small quantity of cotton is kept inside this furnace. It provides a continuous supply of water from the bottle kept on the stand. Second, third and fourth furnaces are connected with each other, respectively, and a smokeless chamber is fitted at the top of the fourth one.

Polythene and sand are drawn into the first furnace through the respective inlets in the ratio 5:1 (Ratio is 5:2 for making hard tiles). The apparatus is made airtight. The heat is supplied and at 400 K, the polythene start to melt. The mixer mixes the polythene and sand. Thus, a soften material is formed. This soften material is collected in the tray outside. On cooling, it forms hard tiles, which are used in the paving of footpaths etc.

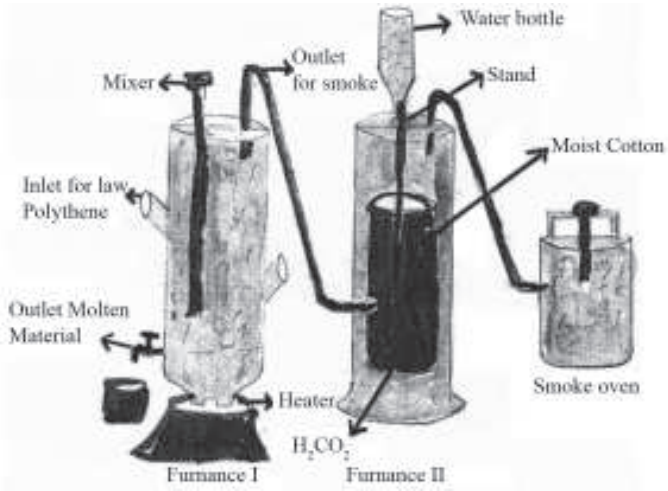


**Fig. 20.1: Raw Polythene Utilisation Plant**

The smoke produced during the process comes into the second furnace. The carbon monoxide (CO) get converted to carbon dioxide ($CO_2$) which forms carbonic acid or soda water ($H_2CO_2$) after reacting with water. This can be used in the laboratory. However, hydrogen and other components of this smoke are combustible and can be stored in the third furnace

from where it is supplied to the fourth furnace and used as fuel. The heater, which is kept beneath the first furnace, is placed under the smoke oven, which provides heat energy by burning the fuel.

## Application

The model is prepared at a very low cost. It can be implemented successfully in rural areas. It controls air and soil pollution. It is eco-friendly and multiple useful products (such as tiles, carbonic acid and fuel) are obtained from a harmful product like polythene.

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# Anti Storm Car

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## Introduction

We have often seen that during the heavy storm or strong winds, the vehicles parked on the road get severe damages and sometimes blown off. This causes breaking of windshields and other damages with possible loss of life. This exhibit ponders about this problem and suggests a solution.

## Scientific Principle Involved

This exhibit is based on vacuum. Vacuum means a space where there is no air. This causes a very low pressure inside a chamber where vacuum is created, whereas the atmospheric pressure is very high. If vacuum is created inside, then it is very difficult to overcome the pressure of outside, i.e., atmospheric pressure.

## Materials Required

Vacuum pump, hydrolic cylindrical arm, motor, battery, gears and a toy car.

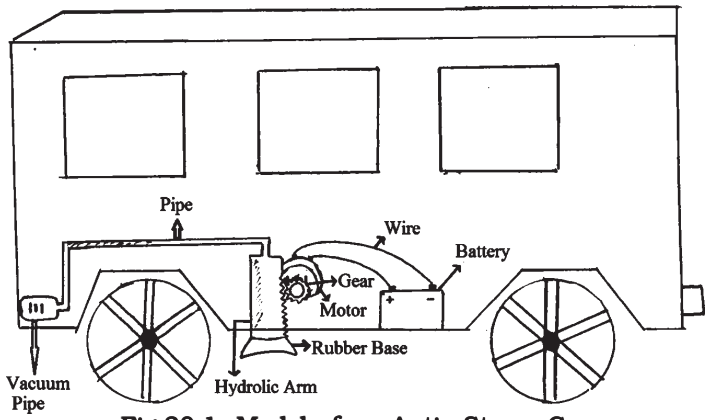


**Fig.20.1: Model of an Antic Storm Car**

## How it Works

A gear is attached to the motor and this gear is also attached to a hydrolic arm (Fig. 20.1). As motor moves, the gear attached to the motor also makes the hydrolic arm to move downwards. The base of hydrolic arm is made of strong rubber to make it air-tight. When this arm touches the ground, the motor will stop and vacuum pump starts working. As the air is removed from the space between the arm and road surface, the strong atmospheric pressure will keep the arm stuck with the road, due to this, the car will not move even during strong winds.

## Advantages

As the name suggests, it will help cars and other vehicles to resist the strong winds. It can be used in cranes, earth-movers and other veicles used to lift heavy weight. Using this technology, the vehicles will not lose balance while lifting heavy matter. This technology is very simple and based on basic principles of physics. This technique is very cheap and do not require complicated circuitry. This technology can be useful in the coastal areas of our country like Andhra Pradesh, Tamil Nadu, Kerala etc., and in countries like USA, Japan, Canada, Australia where storms and heavy strong winds frequently occur.

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# हाईड्रोलिक रेम वाटर पम्प

**विद्यार्थी**
सुभाष प्रजापत
सेठ सम्पतरामजी दूगड़ उच्च माध्यमिक विद्यालय
सरदारशहर, राजस्थान

**अध्यापक**
बजरंग लाल सोनी

## प्रस्तावना

हाईड्रोलिक रेम वाटर पम्प कई देशों में पहाड़ी क्षेत्रों में उपयोग में लाये जा रहे हैं। इस पम्प की सहायता से बिना किसी प्रकार की बाहरी ऊर्जा के जल के स्तर को ऊपर उठाया जा सकता है। बहते जल को, जो छोटी पहाड़ी से होकर बहता है, वो चाहे झरने अथवा नदी के रूप में हो अथवा छोटा नाला हो, पास की ऊँची पहाड़ी पर बनी कॉलोनी के घरों अथवा खेतों में सिंचाई आदि के काम में लाया जा सकता है। कम ऊँचाई पर बहते रहने वाले जल को ऊँचाई पर पहुँचाने हेतु यन्त्र में विद्युत, डीजल, सौर ऊर्जा और पवन ऊर्जा आदि की आवश्यकता नहीं पड़ती। इस प्रकार से यह बिना शुल्क के 24 घंटे जल देते रहने की क्षमता रखता है।

## प्रदर्श निर्माण के पीछे बौद्धिक उद्देश्य

इस प्रदर्श को बनाने का उद्देश्य यह है कि जब इस प्रकार का पम्प पहाड़ी क्षेत्रों में काम आ सकता है तो इस पम्प की संरचना व कार्यप्रणाली में कुछ परिवर्तन कर इस पम्प को इस प्रकार का बनाया जाए कि इसका उपयोग घरों में भी हो सके और व्यर्थ बहने वाले जल की मात्रा कम से कम करते हुए इस जल का उपयोग अन्य घरेलू कार्यों अथवा बागवानी में किया जा सके।

## सिद्धान्त

यह पम्प निम्न सिद्धान्तों पर कार्य करता है: वाटर हमर सिद्धान्त, वायु दाब सिद्धान्त, बहते द्रव की गतिज एवं स्थितिज ऊर्जा का सिद्धान्त, बल परिवर्तन का सिद्धान्त।

## वाटर हमर सिद्धान्त

जब बहते जल को अचानक रोका जाता है तो उसकी गतिज ऊर्जा स्थितिज ऊर्जा में परिवर्तित हो जाती है जिससे शॉक वेव उत्पन्न होती है। इस शॅक वेव के कारण रोके जाने वाले जल में एक बल का निर्माण होता है। यह बल अगले द्रव की मात्रा को आगे धक्का देता है। इस सिद्धांत को वाटर हमर सिद्धान्त कहते हैं। यह बल पम्प में व्यर्थ जल चेम्बर में उत्पन्न होता है और इसके वाल्व पर दबाव डालता है जिससे जल पम्प में चढ़ता है। यही प्रक्रिया बार-बार होने से इस पम्प के दूसरे पात्र में जल के अतिरिक्त वायु के लिए खुली जगह होती है। जब एयर चेम्बर में जल भरने लगता है तो वायु संपीड़ित होती है। इस संपीड़न से वायु का दाब बढ़ जाता है यह दाब इस चेम्बर के जल की सतह पर पड़ता है अत: जल जहाँ स्थान मिले वहाँ से निकलने का प्रयास करता है। यह वायु दाब में वृद्धि के कारण होता है।

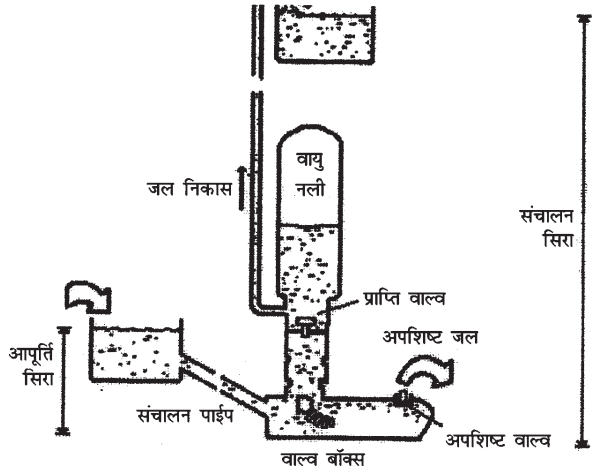
एयर चेम्बर में पहले से और अधिक जल ऊपर चढ़ता है जो वायु को बढ़ाने तथा जल को बाहर निकाल कर उठाने का कार्य करता है।

## सामग्री

अलग-अलग व्यास के दो धातु के पाईप, रबड़ पाईप, धातु का बेलनाकार पात्र, दो वाल्व, लकड़ी व प्लाई के टुकड़े, ऐल्युमिनियम व लोहे की चादर, जल पात्र, जल को नापने के उपकरण, रंग रोगन, कील, नट-बोल्ट आदि।

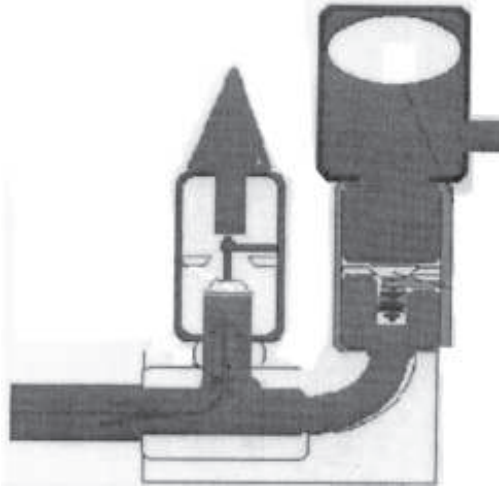
## कार्यप्रणाली एवं संरचना

एक आयताकार प्लेटफॉर्म पर धातु से बने चेम्बर पर बेलनाकार पात्र व्यवस्थित किया गया है (चित्र-22.1)। इस बेलनाकार पात्र में केवल ऊपर की ओर खुलने वाला वाल्व लगाया गया है। यह वाल्व झरने से आने वाले ऊँचे स्तर के जल को तथा वाटर हमर से धक्का लगने वाले जल को इस पात्र (सिलेण्डर) में जाने देता है परन्तु सिलेण्डर में गए हुए जल को वापस नीचे नहीं आने देता।




**चित्र 22.1: पम्प की संरचना**

इस सिलेण्डर का सम्बन्ध वेस्ट वाल्व से किया जाता है। वेस्ट वाल्व भी धातु का एक सिलेण्डरनुमा पात्र होता है जिसमें स्प्रिंग के दाब से केवल ऊपर खुलने वाला वाल्व व्यवस्थित किया गया है जो जल के बहाव को एक झटके से रोकता है (चित्र-22.2)। यह दाब वाल्व पर लगी स्प्रिंग के दाब से व्यवस्थित होता है। यह दाब आने वाले जल के पाईप के व्यास तथा पाईप के ऊपरी सिरे की ऊँचाई के नाप पर आधारित होता है।



**चित्र 22.2: पम्प की कार्य प्रणाली**

बेलनाकार पात्र में वाटर हमर से अन्दर गया हुआ जल निकास द्वार द्वारा अतिरिक्त ऊँचाई तक पहुँचाया जाता है। यह अतिरिक्त ऊँचाई भी वाटर हमर के बल तथा निर्गत पाईप के व्यास पर निर्भर करती है।

वाटर हमर चेम्बर में जब ऊँचाई से जल आता है तो इसका वाल्व प्रथम अवस्था में जल को बाहर निकलने देता है परन्तु बहते जल की गतिज ऊर्जा से अचानक वाल्व ऊपर खिसक कर बाहर निकलने वाले जल के रास्ते को बन्द कर देता है जिससे बहते जल की धारा अचानक रुक जाती है जल के बाहर निकलने तथा रास्ते के बन्द होने में कुछ समय लगता है। यह समय इस वाल्व के रेम (छड़) तथा इस रेम पर लगने वाले भार के दाब पर निर्भर करता है। यदि इस रेम की लंबाई और इस बाहर से लगने वाले दाब में परिवर्तन किया जाए तो इसमें कुछ सुधार सम्भव है। इसी दृष्टि से रेम पम्प में कुछ परिवर्तन किए गए हैं।

इन्हीं सभी पहलुओं का अध्ययन किया गया है तथा निम्न प्रकार से आंकड़े प्राप्त कर विश्लेषण के आधार पर परिणाम तैयार किया गया है।

जैसा कि हम जानते है यह हाईड्रोलिक रेम पम्प स्वनिर्मित ऊर्जा के द्वारा कार्य करता है और यह विशिष्ट स्थानों के लिए ही उपयोगी है। इसमें दो मुख्य कमियाँ हैं:

(i) व्यर्थ जल की अधिक मात्रा।
(ii) ऊपर उठाए जाने वाले जल की मात्रा का कम होना। इन दोनों कमियों के कारण इसका उपयोग मैदानी भागों में सिंचाई के लिए अथवा घरों में सामान्य वाटर सप्लाई के लिए नहीं किया जाता है।

इस प्रदर्श के निर्माण के पीछे उद्देश्य यह है कि वाटर हमर चेम्बर की बनावट और वाल्व के डिज़ाइन में ऐसा सुधार किया जाए जिससे ये कमियाँ दूर हो सकें। इसी उद्देश्य से हाईड्रोलिक रेम पम्प के वाटर हमर चेम्बर के डिज़ाइन में परिवर्तन किया गया है।

सर्वप्रथम व्यर्थ जल वाल्व की छड़ की नाप में परिवर्तन किया गया, जिसके आंकड़े निम्नानुसार हैं। पम्प में प्रवेश किये जाने वाले जल का स्तर-6'', पम्प से जाने वाले पाईप की नाप-1'', पम्प से चढ़ाए जाने वाले पाईप की नाप-1/4'', पम्प से चढ़ाए जाने वाले जल की उंचाई, ये सभी नाप स्थिर रखी गई हैं। दिया गया समय-15 मिनट। छड़ पर दिया गया भार-50 ग्राम।

| *क्र.स.* | *रेम का नाप* | *व्यर्थ जल की मात्रा (लीटर)* | *ऊपर चढ़ने वाले जल की मात्रा (मि.ली.)* |
|---|---|---|---|
| 1. | 4' | 1.5 | 750 |
| 2. | 3.5' | 2 | 700 |
| 3. | 3' | 1 | 800 |
| 4. | 2.5' | 1.75 | 1.25 |
| 5. | 2' | 1.75 | 1.00 |

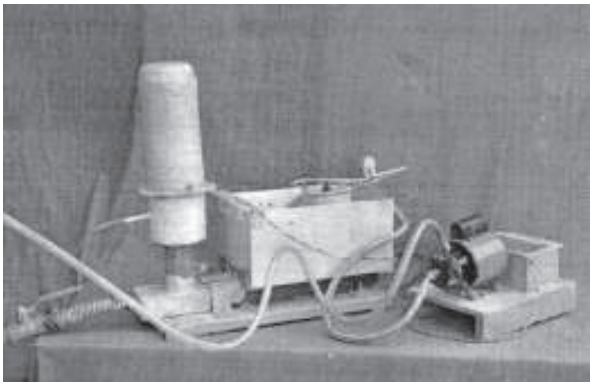
**परिणाम**

यदि व्यर्थ जल टैंक के हमर की छड़ की नाप 2.5'' रखा जाता है तो व्यर्थ जल का 1.75 लीटर तथा ऊपर चढ़ने वाले जल की मात्रा 1.25 लीटर रहती है। वेस्ट वाल्व की छड़ (रेम) की नाप 2.5'' रखते हुए इस पर रखे जाने वाले दाब में परिवर्तन करके देखने से प्राप्त आँकड़े निम्नलिखित हैं:

| *क्र.स.* | *रेम का नाप* | *व्यर्थ जल की मात्रा (लीटर)* | *ऊपर चढ़ने वाले जल की मात्रा (मि.ली.)* |
|---|---|---|---|
| 1. | 4' | 1.5 | 750 |
| 2. | 3.5' | 2 | 700 |
| 3. | 3' | 1 | 800 |
| 4. | 2.5' | 1.75 | 1.25 |
| 5. | 2' | 1.75 | 1.00 |

प्रस्तुत आंकड़ों से यह ज्ञात होता है कि भार में परिवर्तन करने की अपेक्षा यदि स्प्रिंग की दाब को परिवर्तन करते हुए समायोजित किया जाए तो व्यर्थ जल की मात्रा और ऊपर चढ़ाए जाने वाले जल की मात्रा समान रहती है।

इस हाईड्रोलिक रेम पम्प में वेस्ट टैंक के हमर वाल्व के रेम का नाप 2.5'' तथा दाब परिवर्तन स्प्रिंग से एडजेस्ट करने पर अधिकतम ऊँचाई तक जल की अधिकतम मात्रा प्राप्त होती है तथा व्यर्थ जल की मात्रा न्यूनतम रहती है। इस व्यर्थ जल का उपयोग हम घरेलू कार्यों अथवा गृह वाटिका में कर सकते हैं।



**चित्र 22.3: रेम पम्प**

## उपयोग

*हाईड्रोलिक रेम पम्प के मुख्य तथ्य*

यह एक साधारण सरल बनावट का पम्प है जिसमें किसी प्रकार की पेंचीदगी नहीं अत: रखरखाव में कोई दिक्कत नहीं होती। कम ऊँचाई पर जल चढ़ाने में इस पम्प में अतिरिक्त ऊर्जा का उपयोग नहीं करना पड़ता। इसलिए यह व्यय शून्य है। बनावट सरल होने से लोहे के काम करने वाले किसी भी दक्ष कारीगर से इसे बनवाया जा सकता है। प्लास्टिक पाईप और दो साधारण वाल्व का उपयोग करके, बिना वैल्डिंग व विशेष औजारों के इसे बनाया जा सकता है।

## कमियाँ

यह विशिष्ट स्थानों के लिए ही उपयोगी है फिर भी इसमें कुछ कमी है।

यह केवल बहते जल की दशा में ही कार्य कर सकता है अत: इसमें प्रवेश करने वाले जल का स्तर ऊपर होना चाहिए। साधारण मैदानी भागों में बने घरों अथवा खेतों के लिए इसका उपयोग उचित नहीं रहता। इस पम्प में भेजे जाने वाले जल का 10 प्रतिशत से 20 प्रतिशत भाग ही ऊपर चढ़ पाता है। इस पम्प में भेजे जाने वाले जल का अधिकांश भाग व्यर्थ चला जाता है। पहाड़ी क्षेत्रों अथवा झरने या नदी-नालों में तो इसका कोई प्रभाव नहीं पड़ता क्योंकि, उनमें तो जल बहती अवस्था में ही होता है, परन्तु मैदानी भागों में बने घरों अथवा खेतों में यह सम्भव नहीं है कि हम 20 लीटर जल में से केवल 1 से 2 लीटर जल तो ऊपर चढ़ाएँ

और शेष जल को व्यर्थ बहने दें। इन कमियों को दूर करने के लिए अथवा इस पम्प में सुधार करके यदि 10 प्रतिशत से 20 प्रतिशत जल से अधिक जल ऊपर चढ़ाया जा सके तथा व्यर्थ बहने वाले जल की मात्रा को कम किया जा सके तो इसका उपयोग मैदानी भागों में बने घरों या खेतों में भी किया जा सकता है। इसी दृष्टिकोण को सामने रखते हुए सुधार के लिए सर्वप्रथम इस यंत्र की कार्यप्रणाली को समझ कर इसमें परिवर्तन करने की कोशिश की गई है।

23

# जैव कीटनाशक

**विद्यार्थी**
स्वाति अग्रवाल
राजकीय बालिका उच्चतर माध्यमिक विद्यालय
सरूपगंज, राजस्थान

**अध्यापक**
वी. साधना

## प्रदर्श के निमार्ण के पीछे बौद्धिक उद्देश्य व वैज्ञानिक सिद्धान्त

वर्तमान समय में कृषि क्षेत्र में फसल को कीटों से केबचाने के लिए रासायनिक खाद व कीटनाशक का अंधाधुंध उपयोग किया जाने लगा है जिसमें फसल को तो कीटों से बचा लिया जाता है किन्तु रासायनिक पदार्थों के अवशेष फसल व सब्जियों पर रह जाते हैं। ये शरीर पर घातक प्रभाव डालते हैं। तेजी से फैल रही केन्सर, ट्यूमर व अन्य जानलेवा बीमारियों का संक्रमण इसी का परिणाम है। इस प्रदर्श के द्वारा सुगमता से उपलब्ध जैविक सामग्री का उपयोग कर जैविक कीटनाशक बनाया गया है जिसमें पर्यावरण की हानि को न्यूनतम कर कीटों का अधिकतम नियंत्रण किया जा सकता है। जैव कीटनाशक के अवशेष मानव के शरीर को कोई घातक नुकसान नहीं पहुँचाते।

## उद्देश्य

ग्रामीण क्षेत्र में कृषि व बागवानी हेतु न्यूनतम व्यय से स्थानीय स्तर पर जैव कीटनाशक तैयार करना।

## सिद्धान्त

आसवन की विधि से विभिन्न पादप सामग्रियों से जैव कीटनाशक कार्बनिक रसायन का आसव प्राप्त करना।

## प्रयुक्त सामग्री

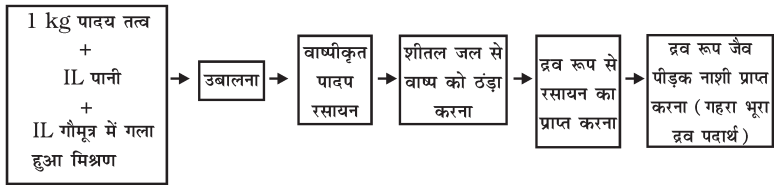
पादप सामग्रीः नीम की पत्ती, गाजरघास, (1 किग्रा.), धतूरे का फल, (1 किग्रा.) (बीज सहित), गौमूत्र (10 लीटर), ½ किग्रा. ग्वारपाठा का जैल, ½ किग्रा. लाल मिर्च, 200 ग्रा. तम्बाकू, 500 ग्रा. निम्बोली।

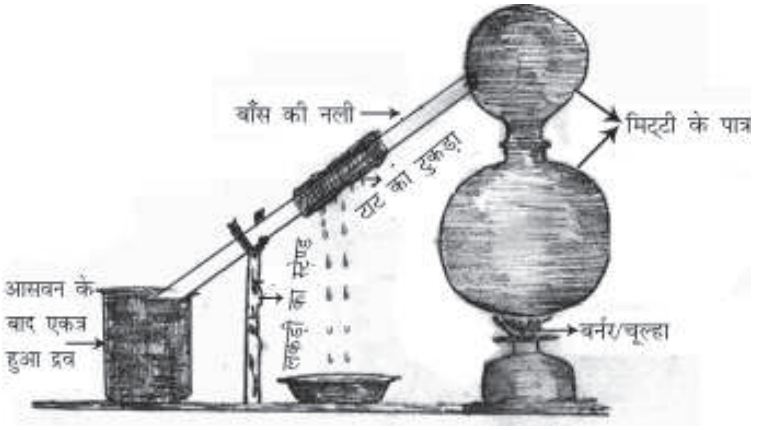
**अन्य सामग्रीः** जल, मिट्टी के दो पात्र, टाट-पट्टी का टुकड़ा, बाँस की नली, लकड़ी की खूंटी/स्टैन्ड, लकड़ी का गुटका अदि।

## प्रयोग हेतु विधि

इस प्रदर्श (चित्र 1) को साधारण आसवन विधि से तैयार किया गया है। इसमें नीम की पत्ती, निम्बोली, धतूरा फल एवं बीज, गाजरघास, ग्वारपाठा जैल, लाल मिर्च, तम्बाकू घोल, गौमूत्र का आनुपातिक मिश्रण व जल की आनुपातिक मात्रा को मिलाकर लुगदी बनाते हैं और इतना उबालते हैं कि पादप पदार्थ का निष्कर्ष धीरे-धीरे वाष्पीकृत होने लगे और द्रव बांस की नलिका से होते हुए पात्र में वहाँ पहुँचे जहाँ इसे एकत्र किया जा सके। प्राप्त द्रव का रंग गहरे भूरे रंग का होता है। यह कीट नियंत्रण में काफी प्रभावी सिद्ध हुआ है। इस प्रक्रिया में कच्ची पादप सामग्री से लगभग 50 से 60 प्रतिशत आसवित कार्बनिक रसायन प्राप्त हो जाता है। इस मात्रा को बढ़ाने के लिए पादप तत्वों की लुगदी को पेट्रोलियम ईथर या ऐलकोहल के साथ 40°C से 60°C ताप पर उबालकर प्राप्त किया जा सकता है। प्रयोग में शेष रहे अपशिष्ट पदार्थ से जैविक खाद बनाई जा सकती है एवं इसे सुखाकर मिट्टी में मिलाने पर दीमक से भी छुटकारा पाया जा सकता है।

**क्रियान्विति के पद**






**चित्र 23.1: प्रदर्श का रेखाचित्र**

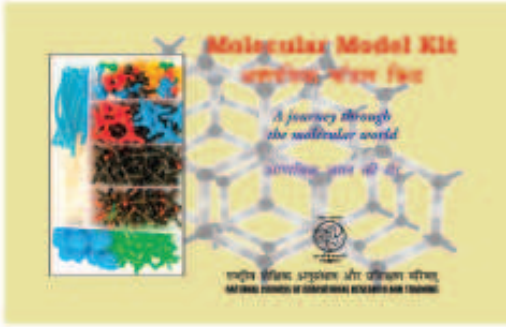
## उपयोग की विधि

उपरोक्त विधि से प्राप्त हुए 50 मिली. जैविक कीटनाशक रसायन से 1 लीटर जल और 1 प्रतिशत साबुन के घोल को मिला कर तैयार किए गए मिश्रण का छिड़काव कर सकते हैं। इस मिश्रण की 200 लीटर मात्रा से लगभग 1 एकड़ जमीन पर छिड़काव संभव है।

## उपयोगिता

फसल को नष्ट करने वाले कीटों को नियंत्रित करना और मितव्ययी होना इसकी विशेषता है। इससे मानव स्वास्थ्य पर कोई प्रतिकूल प्रभाव नहीं पड़ता।


**NCERT**
**School Kits**




**Molecular Model Kit**
आणविक मॉडल किट

*I do believe firmly that the only right approach to the world problems and to our national problems is the approach of science, that is to say, of the spirit of science and method of science...*

**–Jawaharlal Nehru**

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING