
“Pollution control & waste Management

INFRA-STRUCTURE OF IR

- **IR has 16th Zonal Railways,**
- **Metro Railway, Kolkata,**
- **Six production units,**
- **67 Divisions .**
- **4000 DIESEL LOCOS.**

FOR ITS SMOOTH FUNCTIONING.

INFRA-STRUCTURE OF IR

- IR deals with the manufacturing of rolling stock components, Manufacturing /maintenance and repair of Coaches, wagons, diesel locos and electric locos.

- A huge amount of waste (Solids or liquids or gases) is generated during these operations.

Different types of EFFLUENTS GENERATED in IR premises

1 Coaches (AC & Non-AC):-

- **Acid from batteries.**
- **Effluents from phosphating plants**
- **Polymeric materials(Plastics, rubbers,)**
- **Grease, oil and alkaline(during Cleaning of Coaches)**
- **Used composite materials.(Brake blocks, FRP- components etc.)**
- **Paints, Kerosene and waste used metals.**

Different types of EFFLUENTS GENERATED in IR premises

Wagons.

- **Petrol, Diesel, Furnace oil, residue from oil tank wagons.**
- **Effluent from Bosch Tank.**
- **(Cleaning of springs), Water oil Mixed**
- **Tempering furnace.**
- **Kerosene oil mixed.**
- **Paints .**
- **Used materials.**

Different types of EFFLUENTS GENERATED in IR premises

Locos. (Sheds)

- Kerosene oil mixed.
- Effluent from Locos.
- Cleaning of locos, Water oil Mixed.
- Chemicals from coolants water.
- Paints, Grease,
- Lube oil & fuel oil (Leakage during transportation & Emmisions)
- Polymeric componets
- Acids etc.

Different types of EFFLUENTS GENERATED in IR premises

- **Hospitals**
- **Medical waste.**
- **Organic & Inorganic chemicals.**
- **DOMESTIC.**
- **Domestic effluents generated from Canteen and toilets are**
- **Organic wastages, Wash water from utensils.**
- **Food grains, Waste Vegetable oil**
- **Sewage water, Urinals, bathing water.**

These waste or effluents, when enter into the environment ,

disturbs the concentration of air , water , and land or soil,

and may be harmful for the life or

act as a potential health hazards for any living organisms.

There are four type of pollutants generated from the Rly. Workshops and Diesel Sheds.

- **Water Pollutants**
- **Air Pollutants.**
- **Solid Waste**

TYPES OF POLLUTION IN IR

- ✓ Water Pollution.
- ✓ Air Pollution.
- ✓ Noise Pollution.

WATER POLLUTION

The term Water Pollution means addition to water matter in excess, which changes the property viz

- ***Organic***
- ***Inorganic***
- ***Suspended Solid***
- ***Sediments***
- ***Radioactive Elements***

that is harmful to Human being, Animals & Aquatic life.

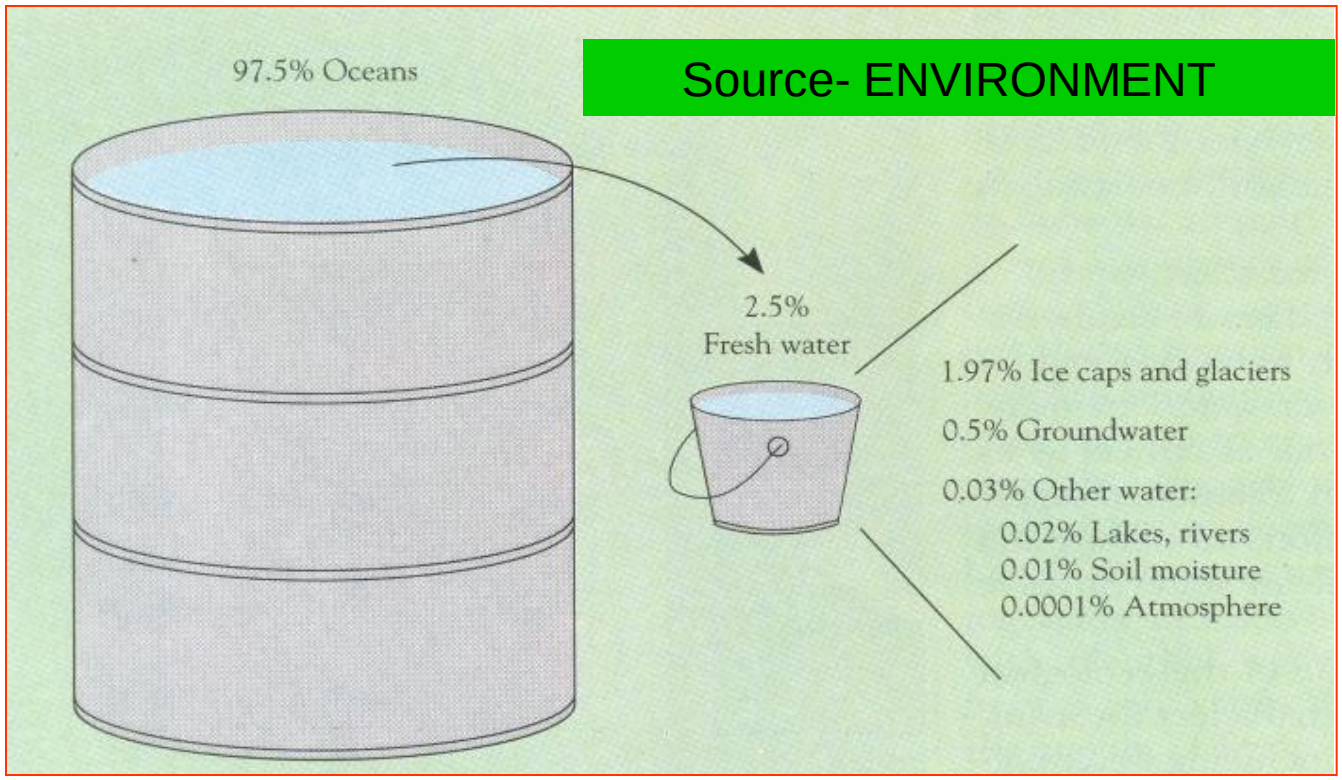
SIGNS OF WATER POLLUTION

- Bad taste of drinking water.
- Offensive odour from Lakes, Rivers & Ocean Beaches.
- Unchecked growth of Aquatic weeds in water bodies.
- Decrease in number of fish.
- Oil & Grease floating on water surface.

CLASSIFICATION

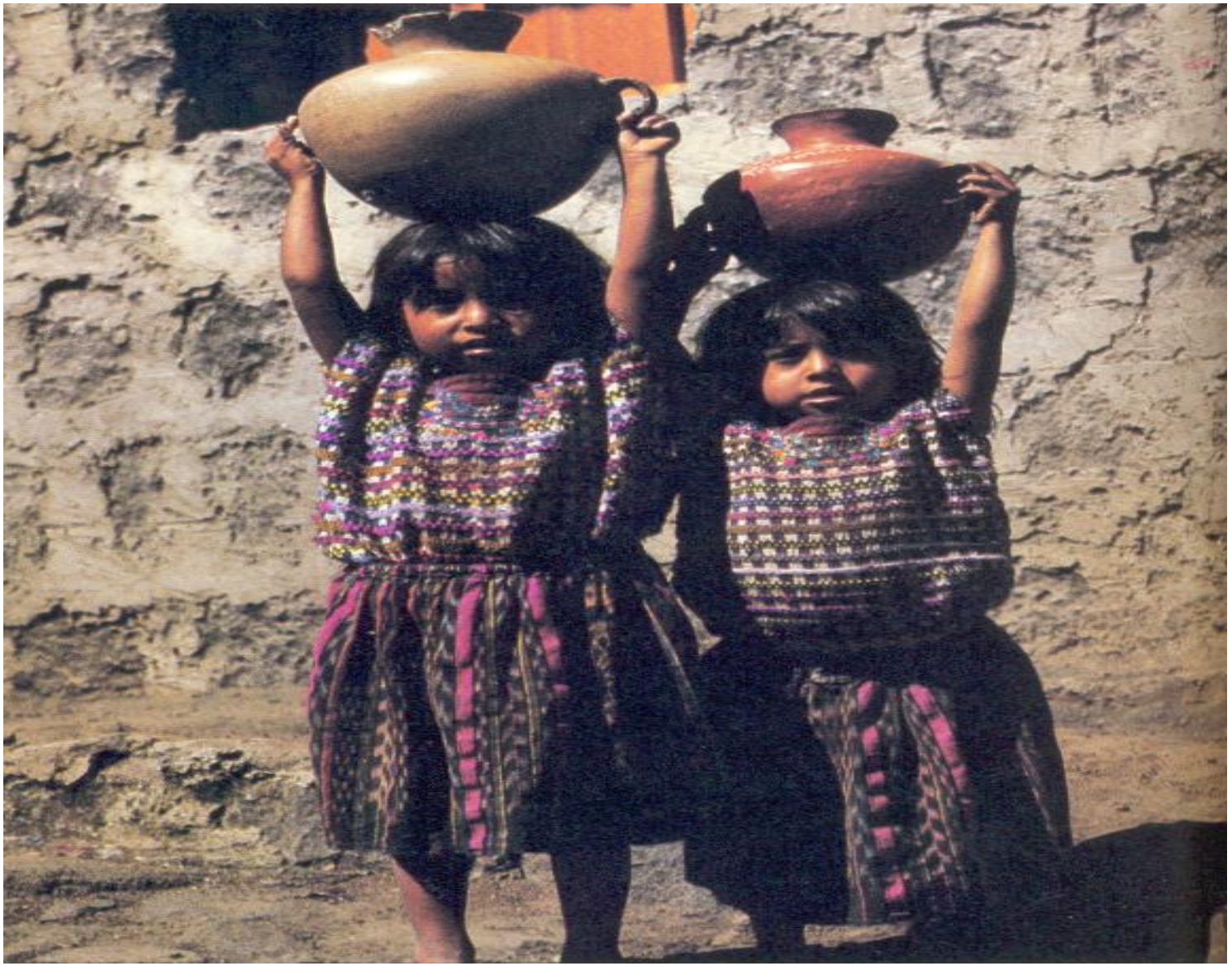
- Organic Pollutants.
- Inorganic Pollutants.
- Suspended Solids and Sediments.
- Radioactive Materials.
- Thermal Pollutants.

WATER SUPPLY AND ITS RENEWAL



Only a fraction of 1% is available for humans.Most water is salty, frozen, or inaccessible in the soil and atmosphere.

FOR FRESH WATER --------?



Railways plan to install water Recycling Plants.

- Water recycling plants (WRP) have been planned to be installed at different locations, where there is a water scarcity and heavy demand of water for domestic & non-domestic purposes.

- At New Delhi railway station consultancy contact has been awarded to TATA ENERGY RESEARCH INSTITUTE.

- Total 14th Water Recycling plant at different locations like Jabalpur,Katni, Satna, Bhopal, Itarsi, Udaipur,Jodhpur, Puri, Waltier each is proposed to Install at the amount of Rs 10.81 crores.

ETP PLANTS IN IR.

IR have installed Effluents treatments plant in all workshops Diesel & Electrical sheds & production units.

In designing the ETP plant the following factors were consider.

QUALITY OF EFFLUENTS WATER.

QUANTITY OF EFFLUENTS WATER.

TREATMENT PROCESS.

Quality & quantity of Effluent Water:-

It is essential to find out the quality & quantity of effluent water passing through different points of the shop & to design efficient and economical treatment plant.

Following parameters decide the quality of effluent water.

- ***Biological Oxygen Demand (BOD).***
- ***Chemical Oxygen Demand (COD).***
- ***Total suspended Solids (TSS).***
- ***pH.***
- ***Oil and Grease content***

Biological Oxygen Demand (B.O.D)

- **B. O. D.:-** is most widely used parameter of Organic pollution applied both for waste water and surface water.

- It is defined as amount of Oxygen required for the biological decomposition of biodegradable organic matter under aerobic condition.

- The Oxygen consumed in the process is related to the amount of decomposable organic matter.

The *Chemical Oxygen Demand* (C.O.D)

- C.O.D.: is the measure of the Oxygen required for chemical oxidation of organic matter.

- In other words, it is oxygen equivalent to the organic matter that can be oxidized by using strong chemical oxidizing agent in an acidic media.

- C O D is always higher than B O D because of more compounds can chemically be oxidized than can be biologically oxidized.

Parameters of effluent water.

- Water released from Industries must have lower B.O.D, C.O.D and Suspended Particle.
- Oil and Grease should be as low as possible.
- pH of the released water should be within recommended limit.

Types Of Treatment Process:-

Following three options are considered, namely

- Aerobic Process.
- An Aerobic Process.
- Low cost Facultative Process.

Aerobic Process

- **It is simple in operation and has lower capital cost compared to other unit process.**
- **No Chemical is used in this process.**
- **Only Aerobic Bacteria and atmospheric Oxygen are involved in this process.**
- **Organic Matter + Micro-Organism + Oxygen Increased Micro Organism + CO_2 +H_2O + Energy (Oxidised End Product)**
- **IR adopted mostly Aerobic process in workshop and an Aerobic process in diesel sheds or all the above process, as per nature of effluents generated.**

TREATMENT PROCESS ADOPTED AT LILUAH

Here we adopted Extended Aerated Activated Sludge Process which is an AEROBIC Process

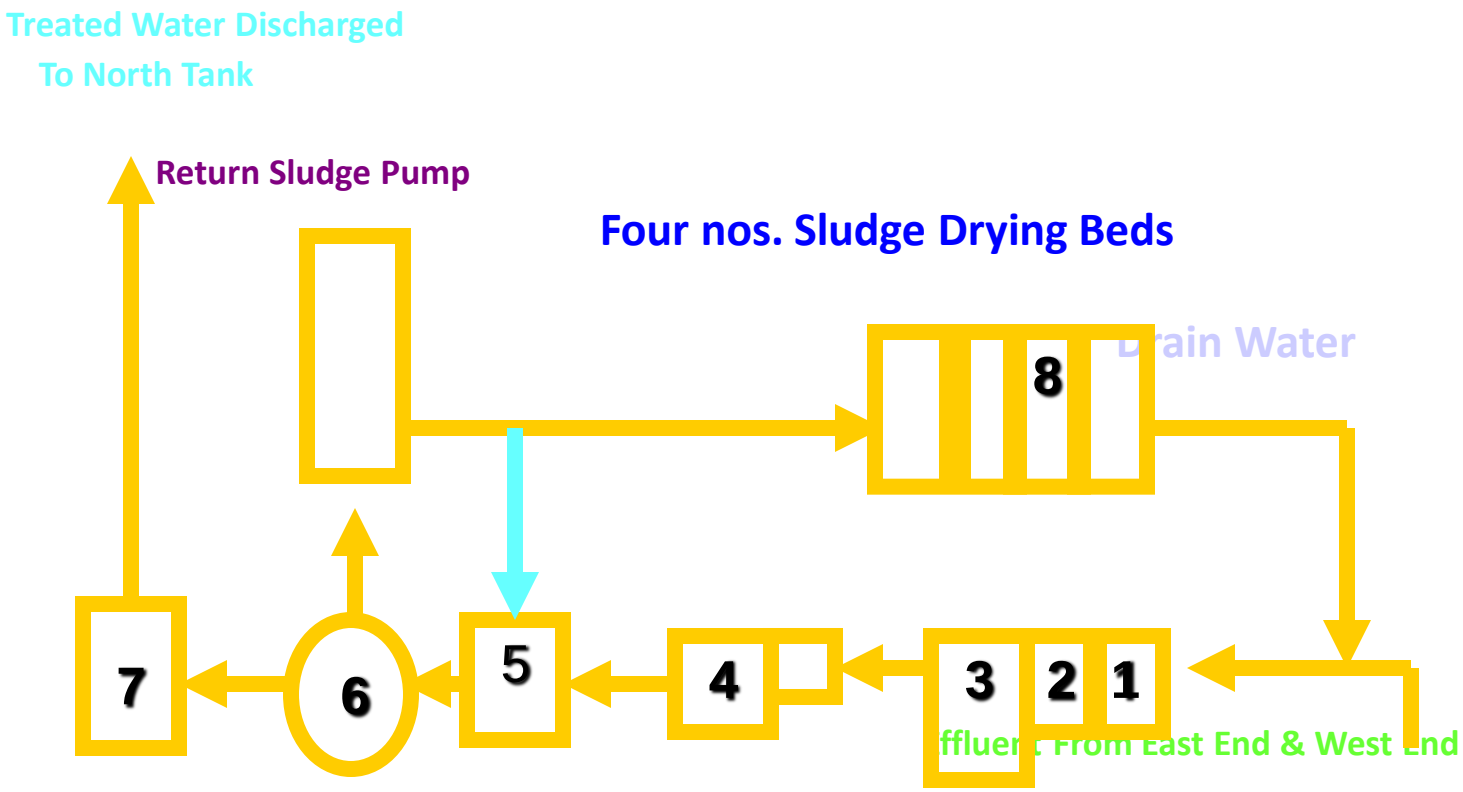
Reaction involved

Organic Matter + Micro organism + Oxygen

Increased Micro-organism

+CO_2+H_2O+Energy (Oxidised end product)

SCHEMATIC LAY OUT OF E.T.P



1 → Screen chamber. **2** → Oil Trap. **3** → Sump cum Pump house	**4** → Stilling chamber cum Oil removal Unit	**5** → Aeration Tank fitted with 2 nos. Aerator.	**6** → Clarifier fitted with Rake Mechanism	**7** → Guard Pond fitted with hay filter.

QUALITY CONTROL OF EFFLUENT TREATED WATER

- The monitoring of the ETP is very much essential to asses proper working of the Plant. For this Untreated & Treated Water Samples are analyzed regularly by ETP Laboratory.

TREATED EFFLUENT QUALITY AS PER WEST BENGAL POLLUTION CONTROL BOARD

- Total Suspended Solids (T.S.S.) → 100mg / lit. max.
- Biological Oxygen Demand (B.O.D.)→ 30 mg / lit. max.
- Chemical Oxygen Demand (C.O.D.) → 250 mg / lit. max.
- Oil & Grease (O&G) → 10 mg / lit.
- pH → 5.5 – 9.0

PHOTO GALLERY OF ETP


WELCOME



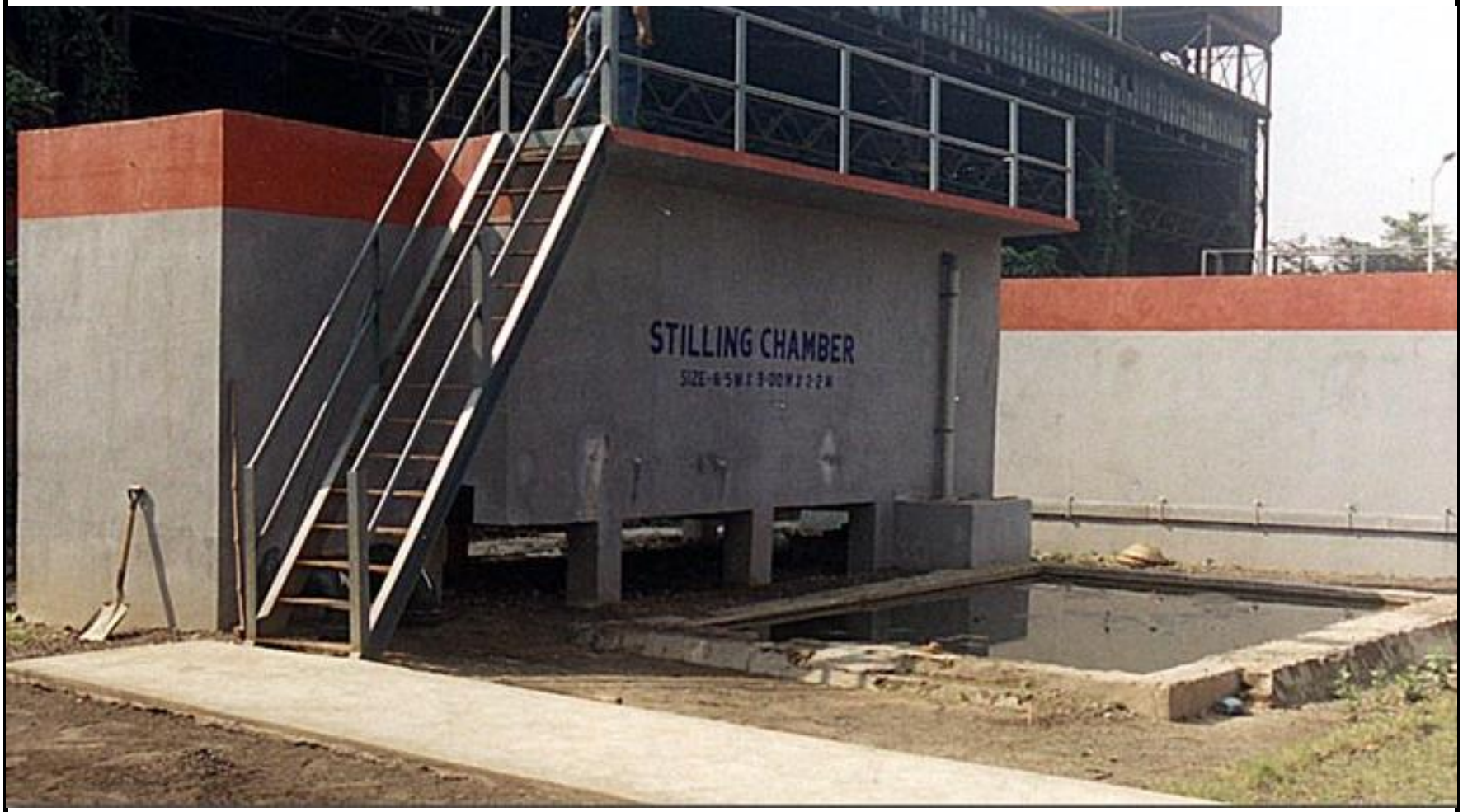








VIEW OF SUMP CUM PUMP HOUSE



STILLING CHEMBER





AERATION TANK



CLARIFIER



GUARD POND



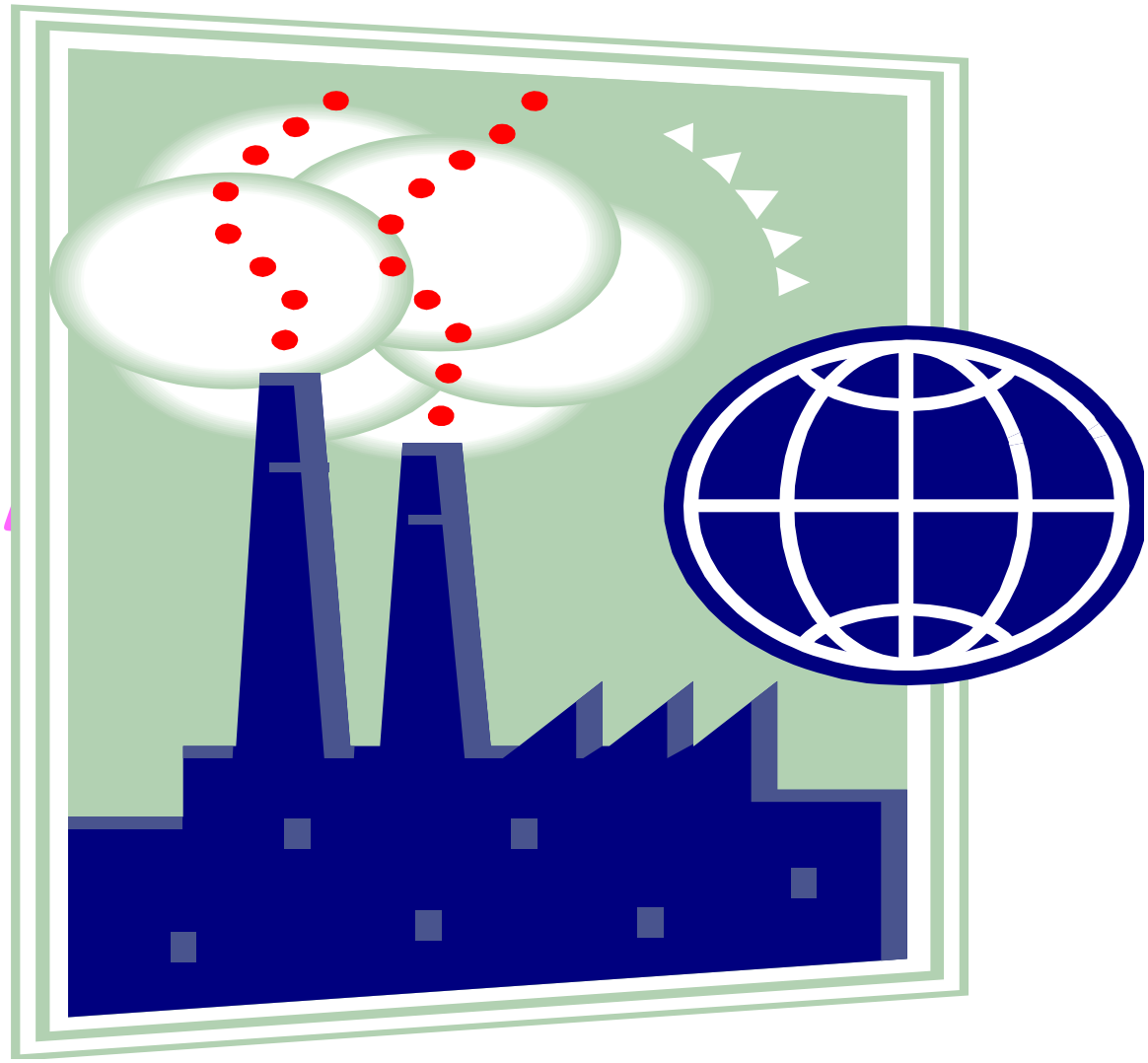
RETURN SLUDGE PUMP



SLUDGE DRYING BEDS

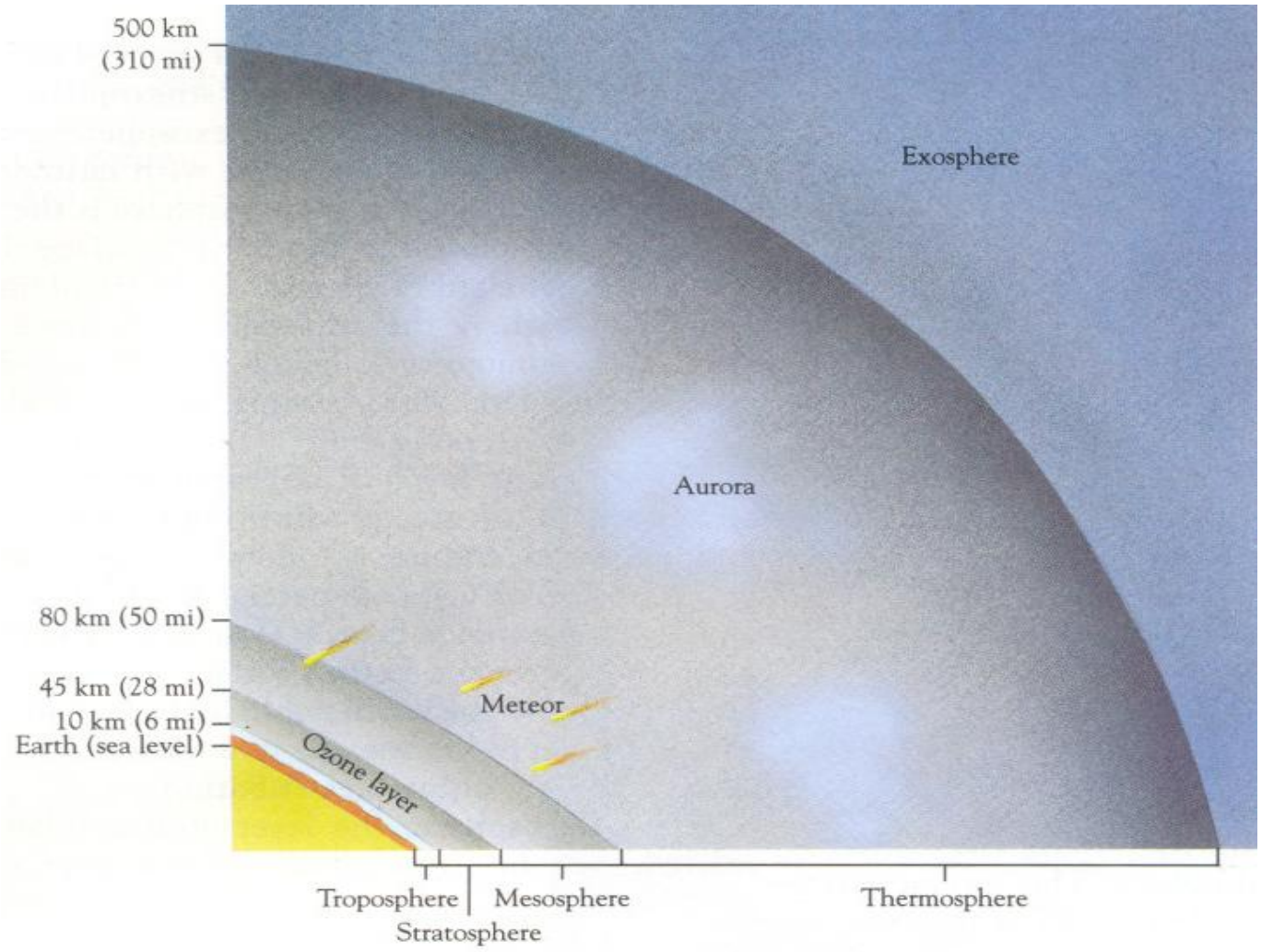


ETP LABORATORY



WHAT IS AIR POLLUTION ?

It is defined as change in Atmospheric Condition in which certain substances (Solid, Liquid or Gaseous) are present which are not naturally present or which are present in such concentration that is injurious to Human being, Plants, Animal Life or Property.



The atmosphere is composed of several layers.

The

AIR POLLUTION IN IR.

- **Air pollution caused by combustion of Fossil fuels, resulting in production of pollutants like NOX, SOx, COX CO, HC and particulates. Limits laid down for exhaust from automobiles (Euro norms are in force in national capital Region(NCR) for automobiles.**

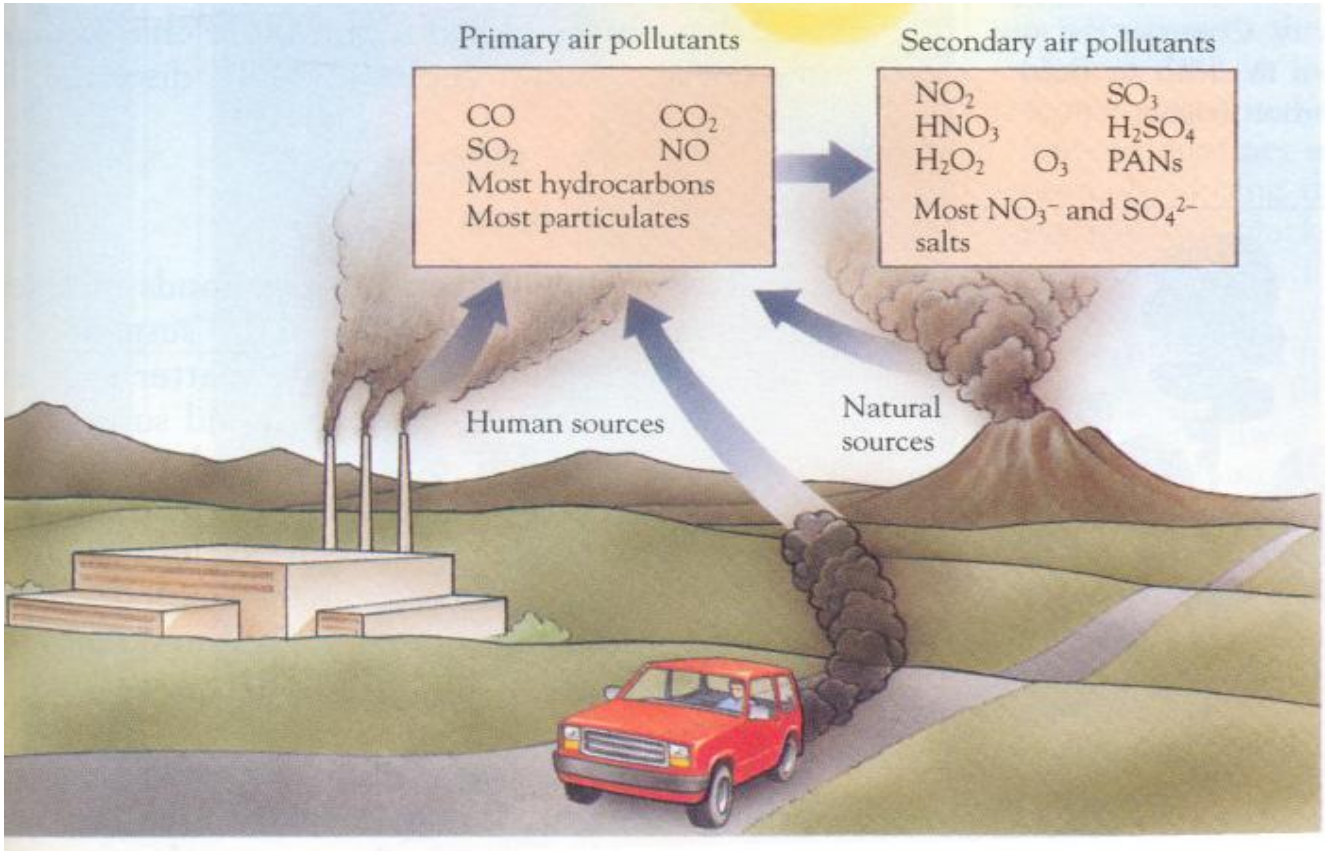
- **But No Legislation norms laid down presently for Locomotive Diesel Engines.**

- **The workshop has the foundries for the manufacturing of Aluminium and cast Iron products in furnaces which are generating gases regularly and are polluting the Environment.**

EFFECT OF AIR POLLUTION

- ***Reduction in Visibility*** – Photochemical smog.
- ***Climate is affected*** – Fog formation decreases the solar radiation by 15-20%.
- ***Weather is affected*** – Ambient temperature rises.
- *May cause irritation to Eye & Skin*.
- ***The respiratory system may be affected***.
- ***Rise in concentration of Toxic Chemicals***.
- ***Aerosols of Fertilizer*** sprays enter the food and fodde causing several dieses.
- ***Life of buildings & others may be shortened by Acid rain***

ACCORDING TO ORIGIN



ACCORDING TO STATE OF MATTER

- ✓ ***Particulate Matter*:-** Tiny divided solids or droplets (100µm down to 0.1µm and less).
- ✓ ***Gaseous Pollutants*:-** These are mainly emitted by Industries & Automobiles during burning of fossil fuel. e.g. SO_2, NO, CO.

ACCORDING TO CHEMICAL COMPOSITION

1. ***Organic Pollutants***:- Hydrocarbons, Aldehydes, Ketons and Alcohol.
2. ***Inorganic Pollutants:-***

- ✓ ***Sulphur Compounds*:-** **H_2S, H_2SO_4.**
- ✓ *Nitrogen Compounds* :- Oxides of nitrogen,NH_3.
- ✓ *Carbon Compounds*:- Oxides of Carbon, Carbonates.
- ✓ *Inorganic Particles*:- Silica, Fly Ash, Asbestos.
- ✓ *Halogen Compounds*:- HF, HCl.

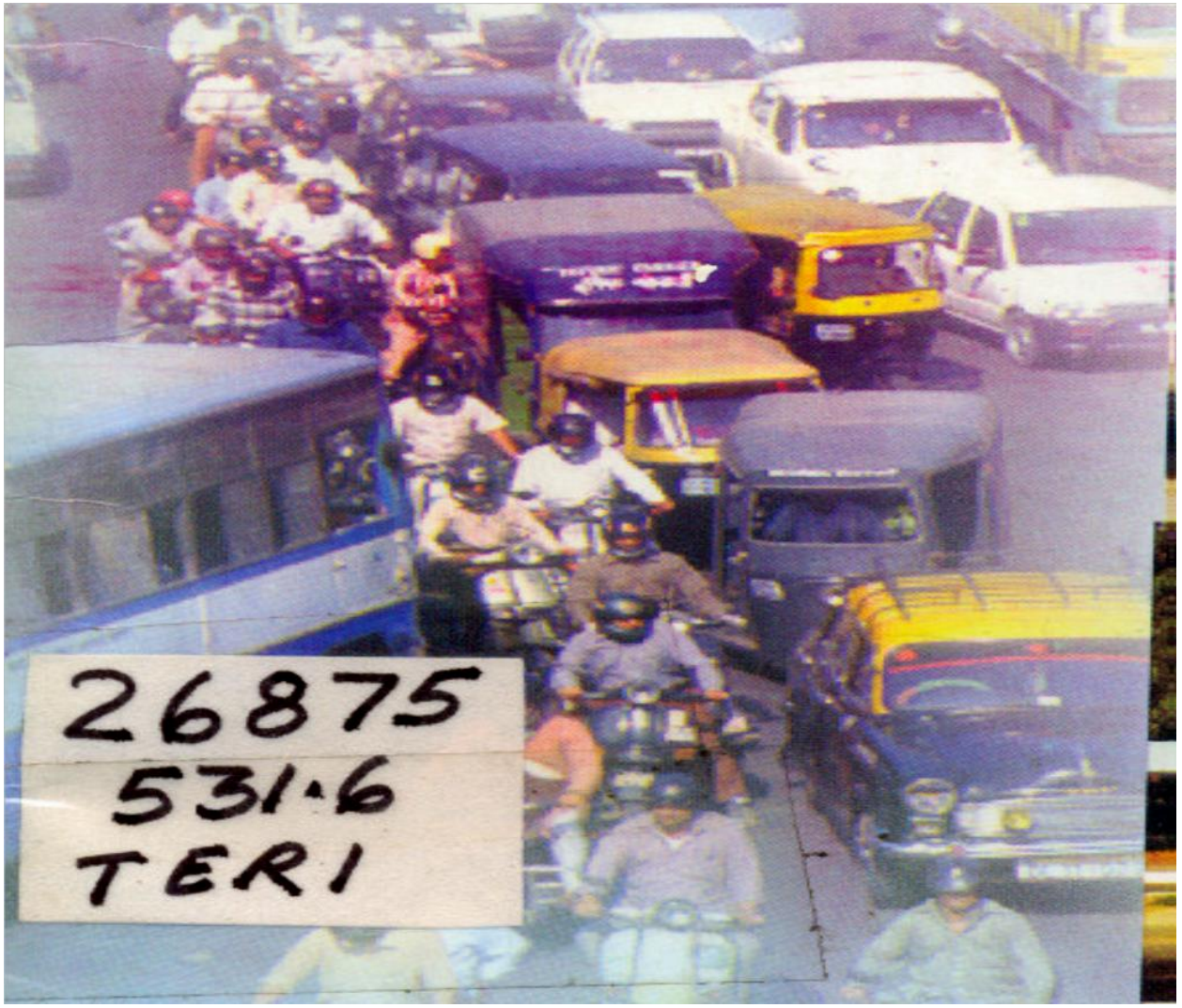
ACCORDING TO SOURCES

- ✓ **Natural Sources**:- Volcanic Ash, Gas from Forest fire wind blown dust & Pollution.
- ✓ **Anthropogenic Sources**:-
  - Industries & Burning Fuels- SO_2,NO,CO.
  - Chemical & Metallurgical Industries- Metal Oxides.
  - Iron & Steel Industries-Fumes, H_2S , SO_2,Dust.
  - Petroleum Refineries.
  - Paper Pulp Industries.
  - Agricultural & Food Processing Industries.

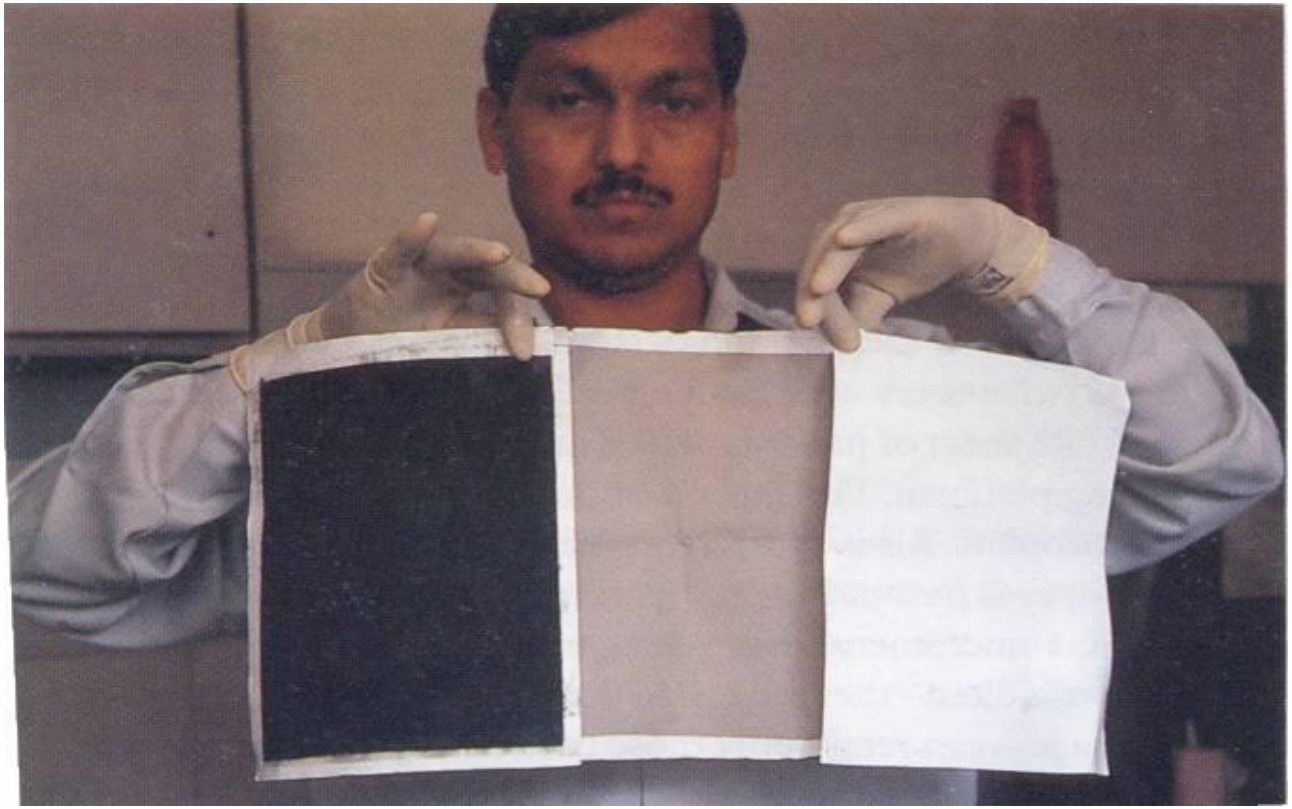
MAIN POLLUTANTS

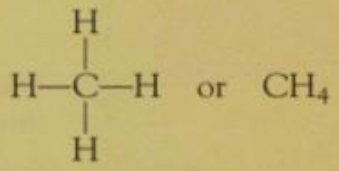
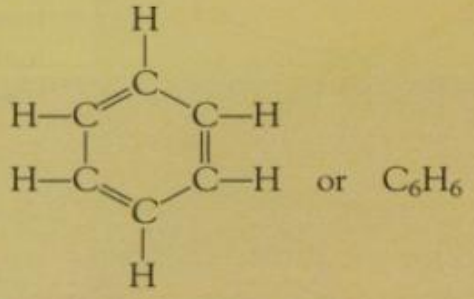
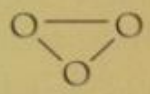
- Particulate Matter
- Oxides of Sulphur.
- Oxides of Nitrogen.
- Oxides of Carbon.
- Hydro Carbon.
- Chlorine.
- Hydrogen Sulphide.

India will become third biggest CO_2 emitter by 2015

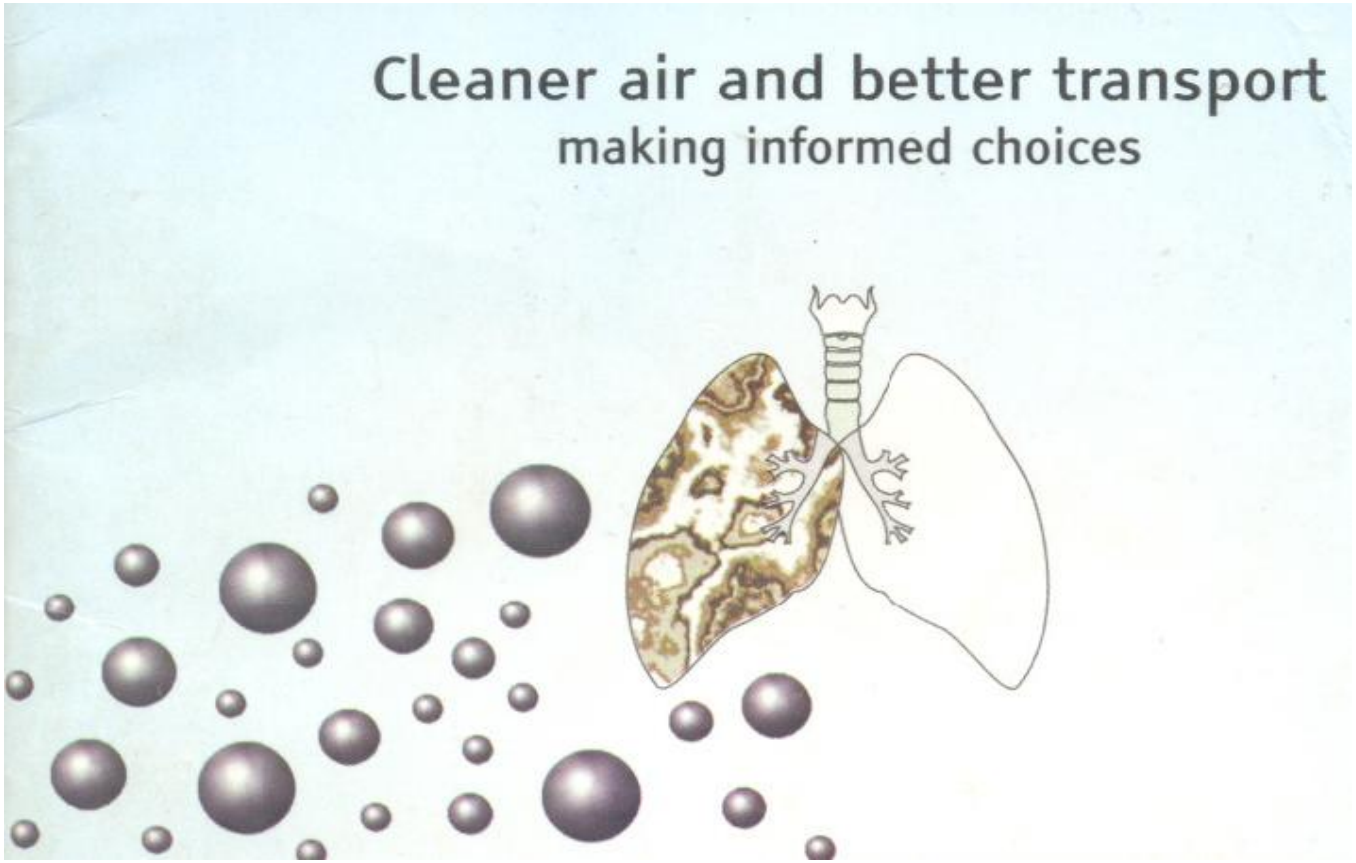


IMPACT OF AIR POLLUTION.

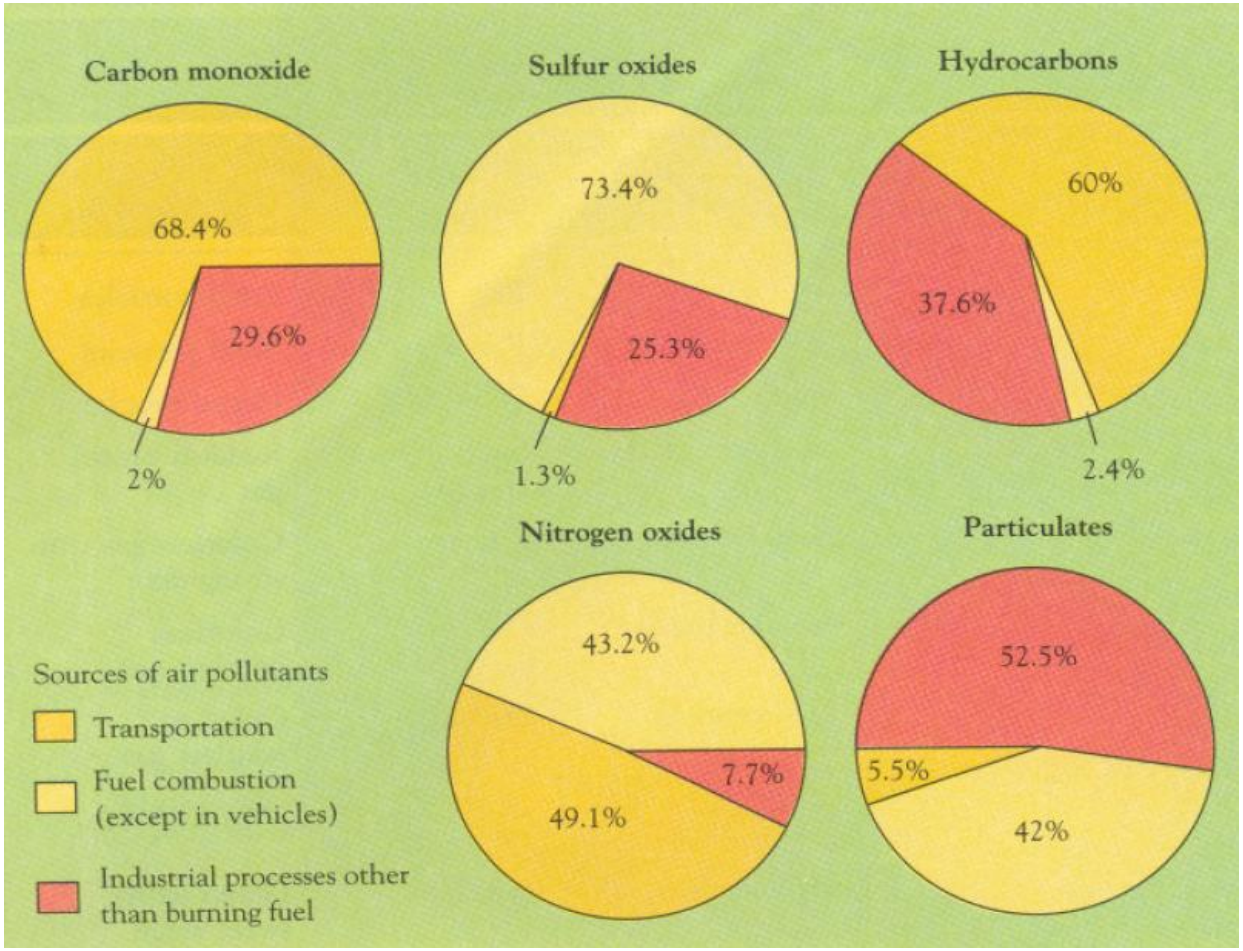


Pollutant	Composition	Class	Primary or Secondary	Characteristics
Dust	Variable	Particulates	Primary	Solid particles
Lead	Pb	Particulates	Primary	Solid particles
Sulfuric acid	H_2SO_4	Particulates	Secondary	Liquid droplets
Nitrogen dioxide	NO_2	Nitrogen oxide	Secondary (mainly)	Reddish brown gas
Sulfur dioxide	SO_2	Sulfur oxide	Primary	Colorless gas with strong odor
Carbon monoxide	CO	Carbon oxide	Primary	Colorless, odorless gas
Methane	 or CH_4	Hydrocarbon	Primary	Colorless, odorless gas
Benzene	 or C_6H_6	Hydrocarbon	Primary	Liquid with sweet smell
Ozone	 or O_3	Photochemical oxidant	Secondary	Pale blue gas with sweet smell

The respiratory system may be affected.

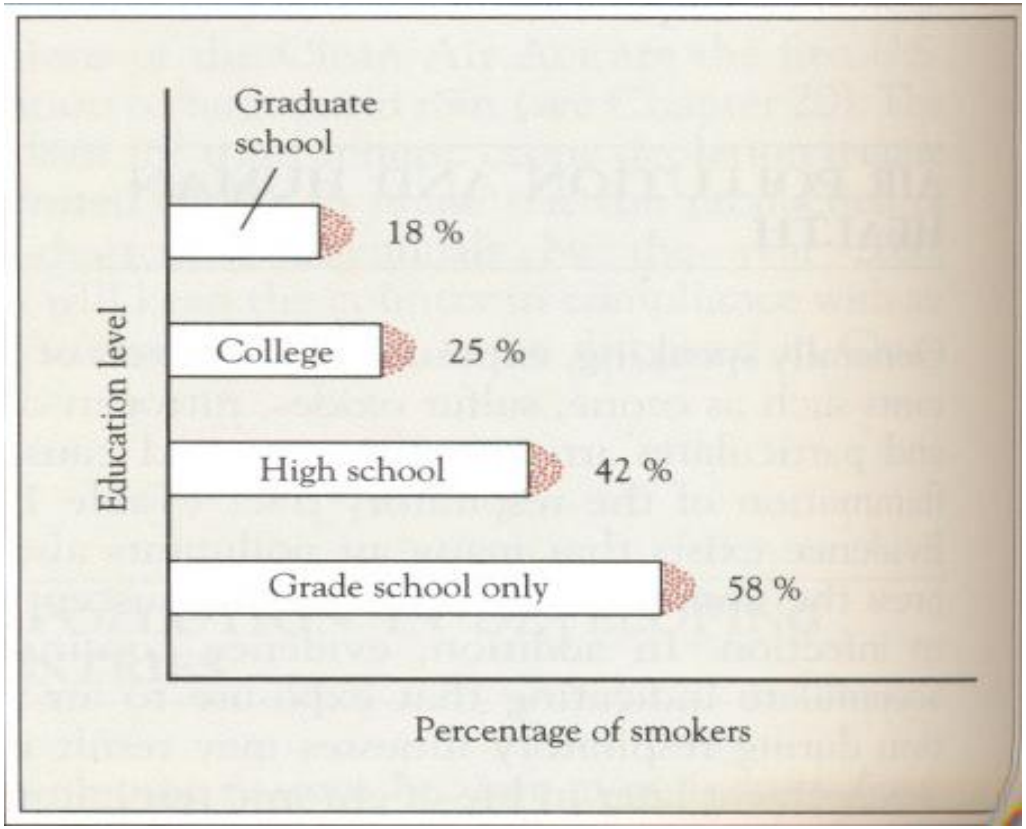


Air pollutants.



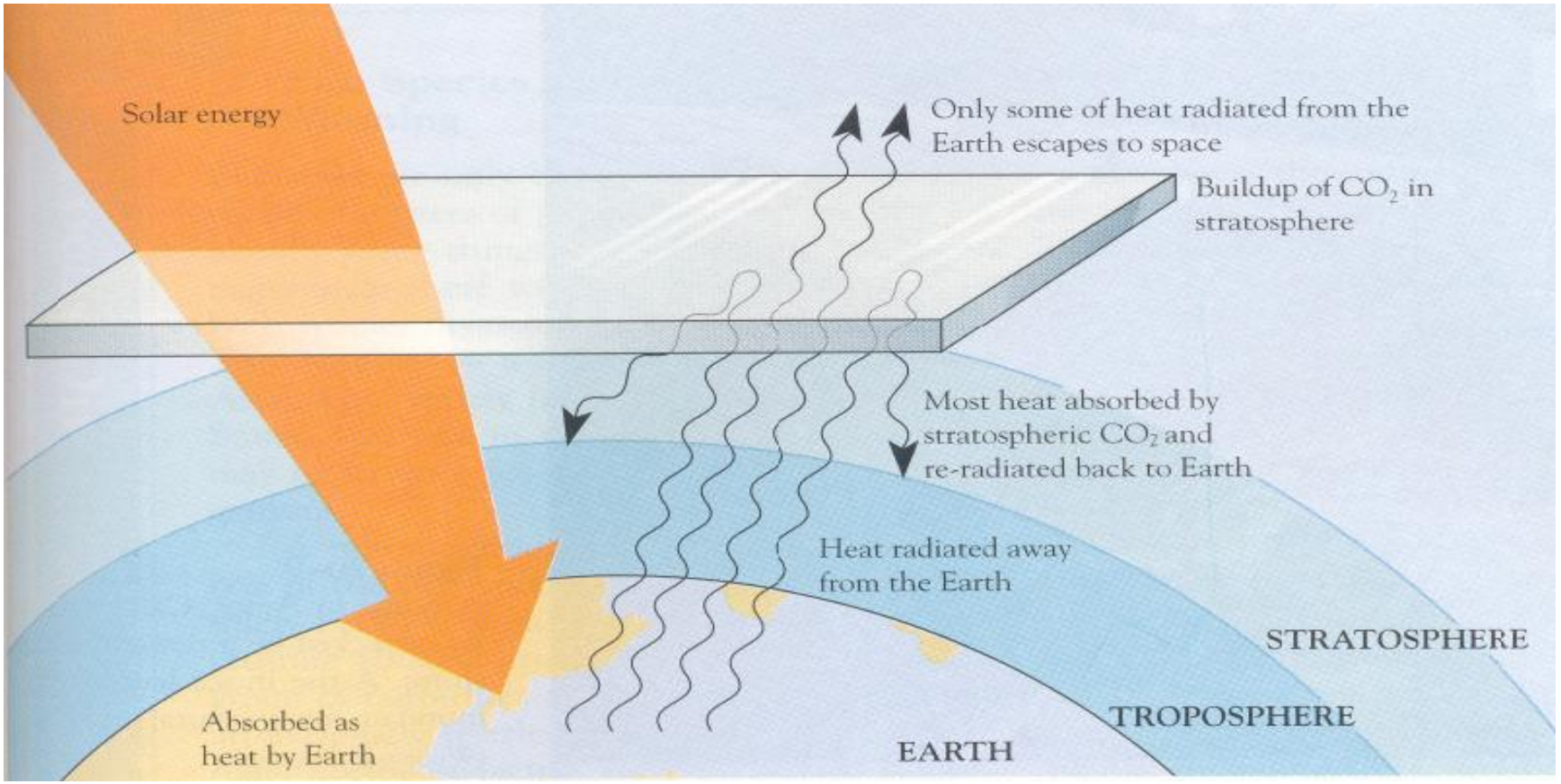
Motor vehicles and industrial fuel combustion are major contributors of pollutants.

Air pollution due to smoking..



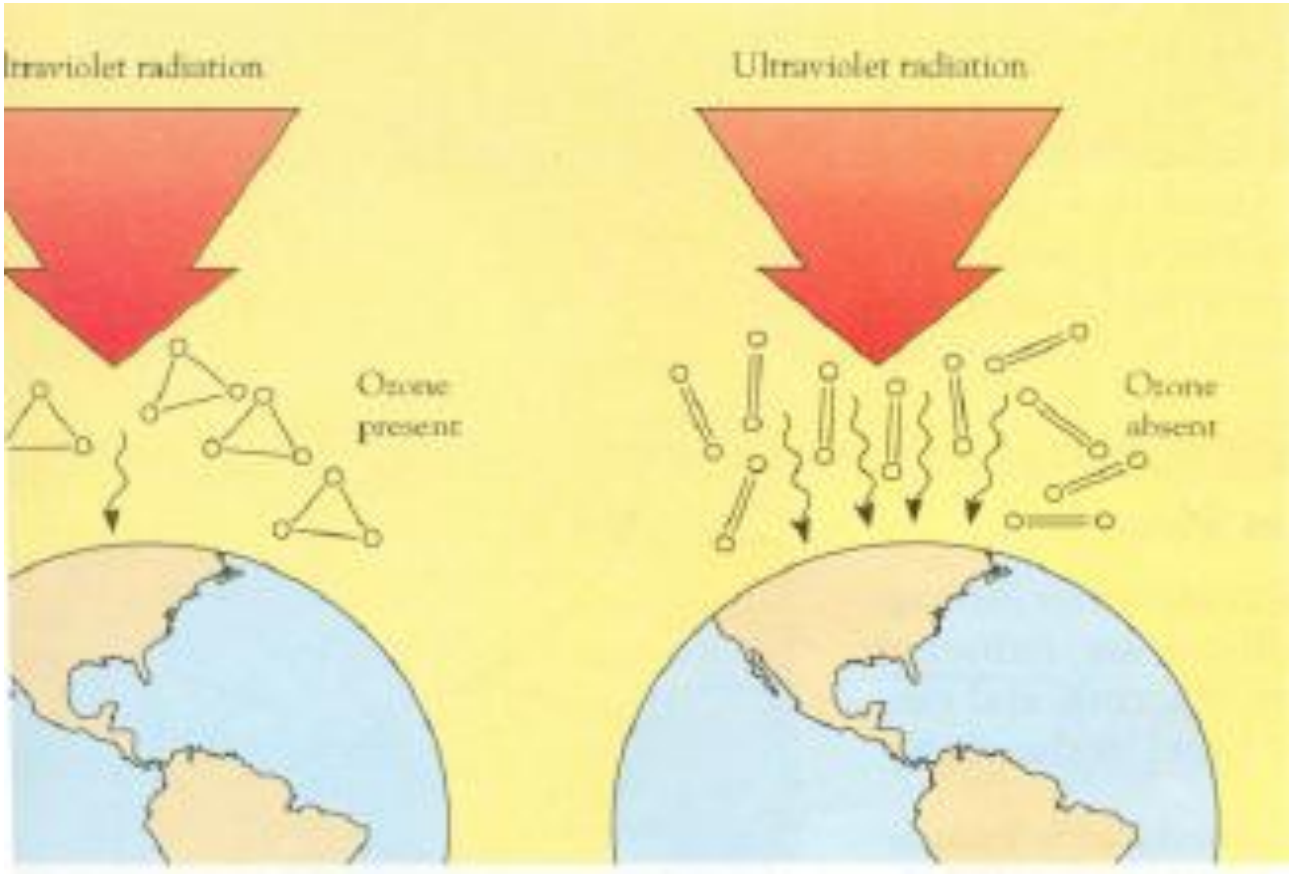
An inverse relationship exists between smoking and education level.

Air pollutants.



How CO_2 and the greenhouse effect promote global warming.

OZONE DEPLETION IN THE STRATOSPHERE



UVR-PENERTRATES THE ATMOSPHERE TO THE EARTH SURFACE,WHERE ITS PRESENCE HARMS LIVING THINGS.

NATIONAL AMBIENT AIR QUALITY STANDARD

(Published By Central Govt. in Gazette on 11th April 1994.)

Pollutant	Time Weight Average	Concentration in MicroGram/NM^3		
		A	B	C
SO_2	Annual 24 Hrs	80 120	60 80	15 30
NO_x	Annual 24 Hrs	80 120	60 80	15 30
SPM	Annual 24 Hrs	360 500	140 200	70 100
RPM	Annual 24 Hrs	120 150	60 100	50 75
Lead	Annual 24 Hrs	1.0 1.5	0.75 1.0	0.50 0.75
CO	8 Hrs 24 Hrs.	5000 10,000	2000 4000	1000 2000

A:- Industrial Area.

B:- Residential Area, Rural Area & Others.

C:- Sensitive Areas.

NOTE:- Here the annual arithmetic mean of minimum 104 measurement in an year taken twice a week 24 –hourly at uniform interval..

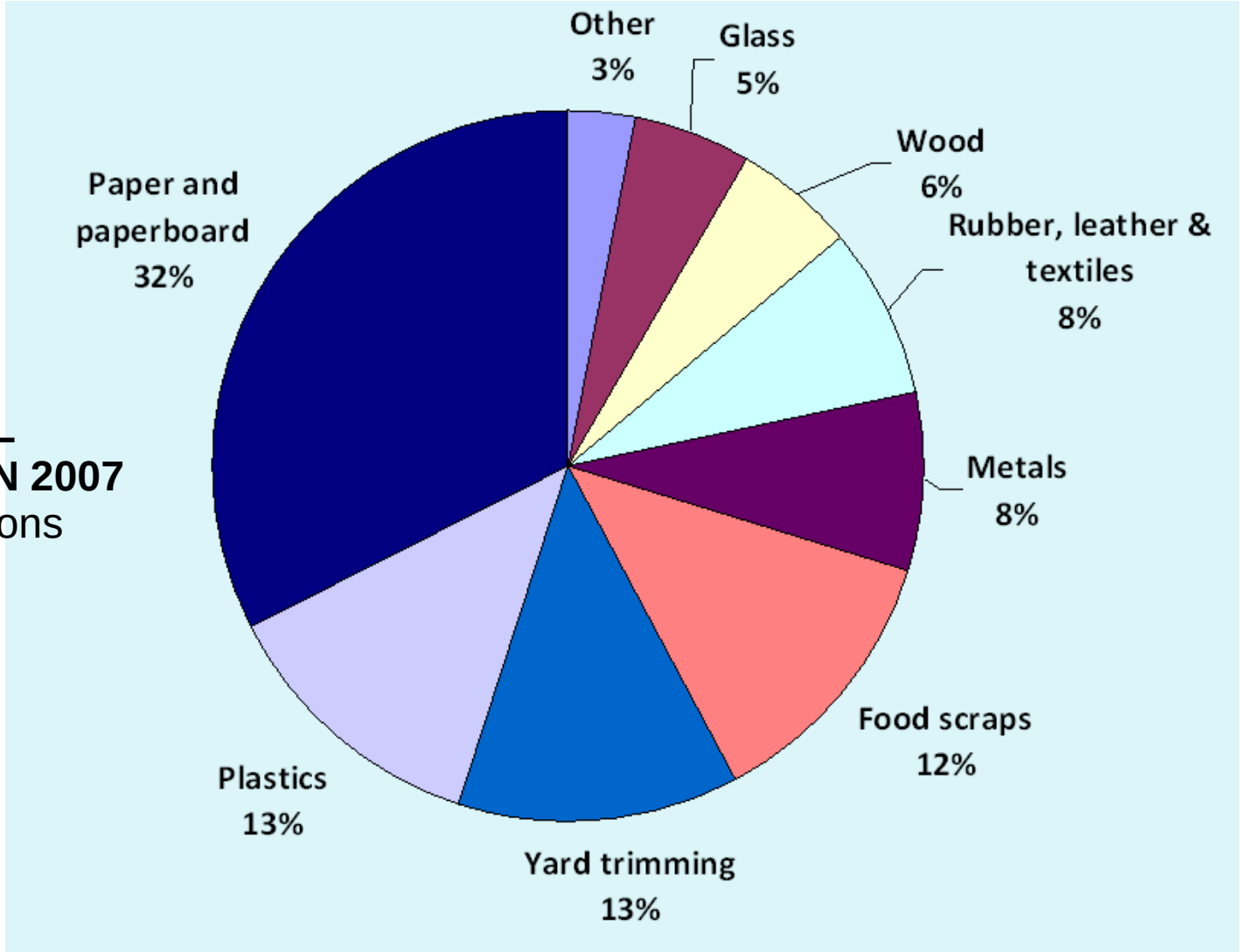
The 24-hrs/8 hrs. values should be met 98% of the time in a year

FURNACE STACK EMISSION STANDARD (as per pollution act)

❖ **Sulphur dioxide**	
Liquid fuel burning	1200 mg/NM^3.
Solid fuel burning	1200 mg/NM^3
❖ **Carbon Monoxide**	
Liquid fuel burning	175 mg/NM^3.
Solid fuel burning	250 mg/NM^3.
❖**Particulate Matter**	150 mg/NM^3.

Just what are we throwing away?

MUNICIPAL SOLID WASTE IN 2007
254.1 million tons



Solid wastes



E-waste

PROBLEMBS,RULES & ITS MANAGEMENTS

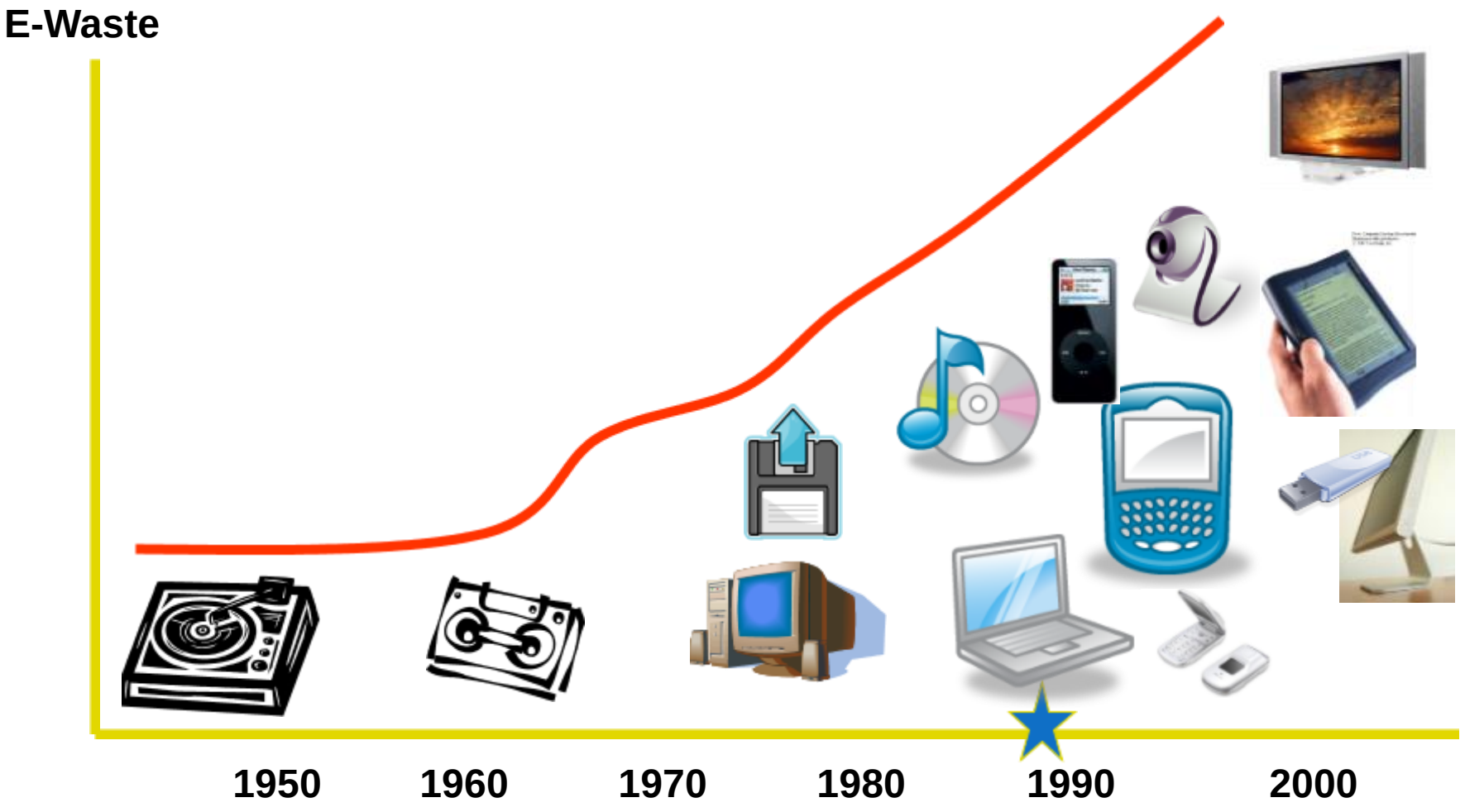
COMPUTERS ARE NOT DESIGNED FOR RECYCLING.

- 20-50 Mill T generated annually world wide.
- Every two years Computer thrown away.
- Unusable & goes straight to scrap heap.
- Valuable stuff can be extricated out of e-waste/computer.
- Down To Earth. September-2007

The E-waste crisis started about the time our present high-school students were born.



Evolution of E-Waste



Handling of hazardous waste.

- The hazardous Wastes (Management, Handling and Transboundary Movement) Rule 2008 for proper management and handling of hazardous wastes including e-waste.
- The occupier has the responsibility for safe and environmentally sound handling of such waste generated in their establishments.

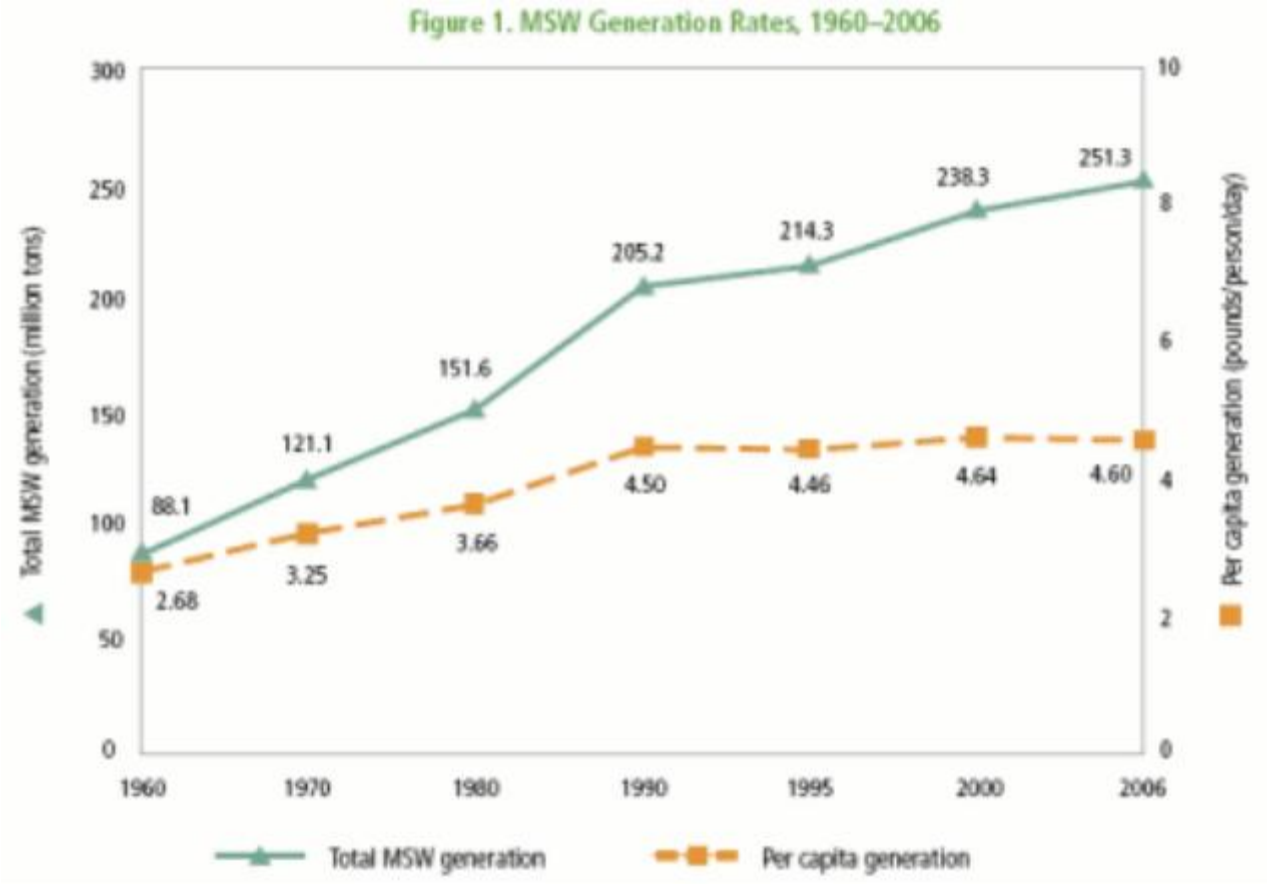
  (www.envfor.nic.in/legis/hsm.htm)
- A list of registered recyclers who are authorised to handle such wastes.

  www.cpcb.nic.in/divisionsotheadoffice/hwind/ewaste.pdf

- GOI, MR (Railway Board)

  No-2009/C&IS /oth/E-waste/29 dated 13.09.2010

Comparison of garbage production per person with entire garbage production
Both rates have risen between 1960 and 2006



What do we do with all this waste we are producing?



Burying: which takes space, special construction of lined landfills, off gassing, leaching remediation, and monitoring 30 year after the landfill is closed



Burning: Incinerators or Waste to Energy Plants reduce the volume of garbage by ~60% but they require special air quality equipment, fly ash must be treated as an hazardous material, and residue ash still has to go to the landfill. This method is more costly than landfills, but suitable for large populations with land storages.



Mining: Mining recyclable material out of our waste stream reduces the volume of garbage going to the land fill, but cost flexes with the market prices.

Do you know where your garbage ends up at?

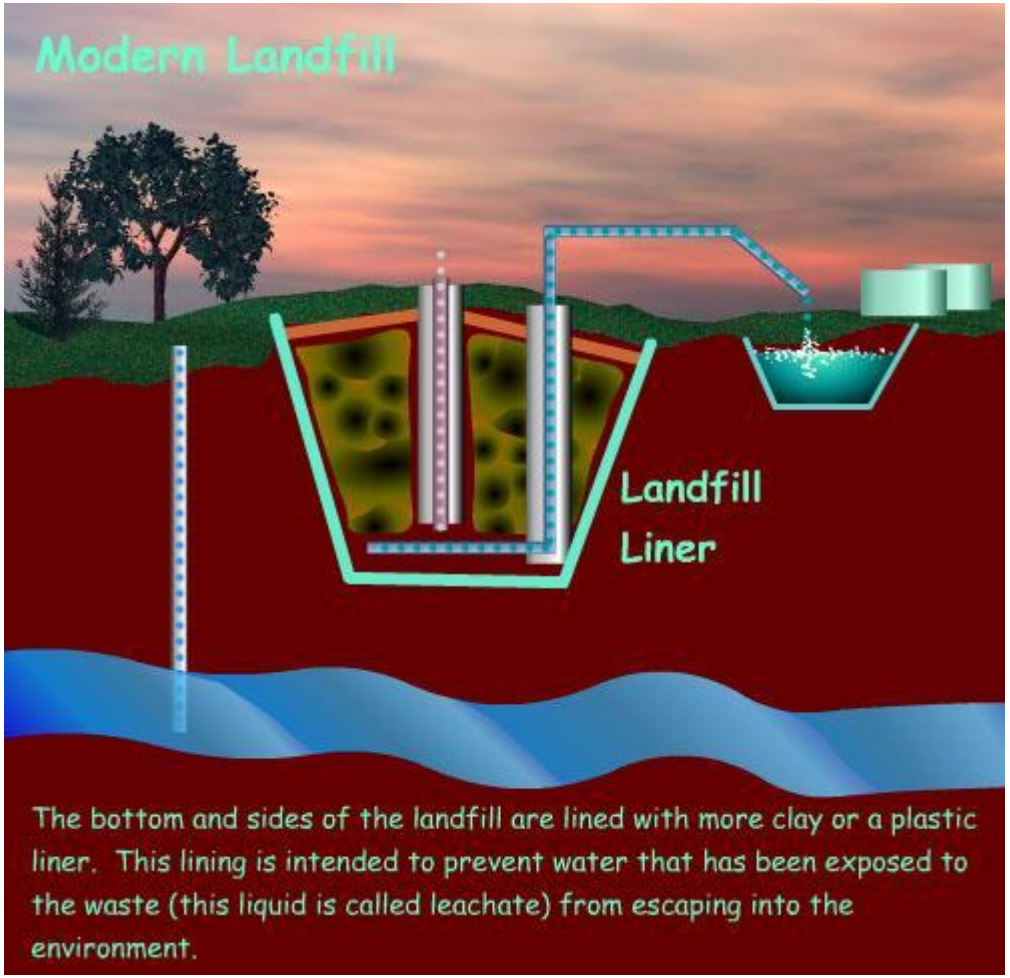
- Here is a aerial photo of the FNSB landfill.
- Compare the size of the landfill to your local school.





Landfills

- ~65% of US waste ends up in landfills
- 100% of Fairbanks waste ends up in the landfill.
- Can items decompose underground?



Burning Garbage

- The US burns 17% of its garbage in incinerators. Incinerators cost more than landfills. However in density populated area that lack land for landfills rely on incinerators to handle most of their garbage.

- Burning can reduce the volume of garbage by 60-90%. But it produces ash and creates harmful gases and particles that must be filtered out of the air.

- Many experts believe incineration can work safely, but it requires adherence to strict standards and regulations. A 1994 Supreme Court decision requires operators to test their ash and, if it's toxic, to handle it as a hazardous waste.

- Citizens are often reluctant to accept an incinerator in their own community because of concerns about safety, odors, and the conflict between recycling programs and incineration.

- Economic benefit of the waste to energy plants depends on the price of competitive energy sources.

A Duel Problem:

The issue is not just the volume of trash we are producing, but also the hazardous composition our trash.

EXAMPLE: These elements in electronic devices can become hazards if set on fire, placed in acid baths, inhaled as dust, or dumped in waterways.







- **Circuit boards** contain cadmium, lead or beryllium

- **Cathode ray tubes (CRTs)** are coated with barium and phosphor, in addition to containing 2-6 lbs of lead.

- **Batteries** are loaded with lead, mercury, and/or cadmium.

- **Components, switches, or lights** contain mercury-, beryllium- and Polychlorinated Biphenyl-containing materials.

Mercury

80
200.5
Hg

Electrical switches, batteries, barometers, thermometers, fluorescent and neon lights

Valuable Properties:

Mercury conducts electricity and expands at a constant rate in response to changes in pressure or temperature.

In its vapor state, mercury can combine with other gases to form more complex molecules that emit light when charged with electricity.



"Mad as a hatter"

Hazardous Properties:

Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus.

Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Lead

82
207.2

outlawed

Lead gasoline
Lead Paint
Lead Shot for waterfowl

Pb

Lead-acid batteries, solder, x-ray protection, paint

Valuable Properties:

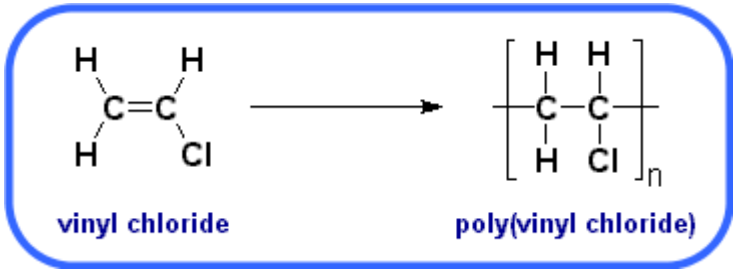
Lead is a very corrosion-resistant, dense, ductile, and malleable metal.

Hazardous Properties:

Lead can cause damage to the central and peripheral nervous systems, blood system and kidneys. Effects on the endocrine system have also been observed and its serious negative effects on children's brain development has been well documented.

The toxicity of lead comes from its ability to mimic other biologically important metals, most notably calcium, iron and zinc which act as cofactors in many enzymatic reactions and interfering with the enzyme's ability to catalyze its normal reaction(s).

PVC





Cabling, insulation of wires, and computer housings, although many computer moldings are now made with the somewhat more benign ABS plastics.

Valuable Properties:

PVC is strong, rigid, light weight, waterproof and flame-resistant. PVC also can be made into a soft and flexible plastic by mixing it with plasticizers.

Hazardous Properties: The PVC itself isn't toxic or carcinogenic, but the monomer used to make PVC, vinyl chloride, is carcinogenic and can be harmful to people who work in the factories where PVC is made. Dioxin (polychlorinated dibenzo-p-dioxins) is produced as a byproduct of vinyl chloride manufacture and from incineration of waste PVC in domestic garbage. Also the plasticizers that make PVC soft and flexible can be toxic and carcinogenic.

Hexavalent chromium

Cr^{6+}



anti-corrosion

Because chromium can go into solution and move through soil, chromium pools and blooms (the crystallized chromium left on the surface when the water evaporates) may occur some distance from the original site of contamination.

Valuable Properties: It is used as a corrosion inhibitor and in hardening and corrosion protection in metal housing.

Hazardous Properties: While other forms of chromium can be trace nutrients for animals and humans, hexavalent chromium is highly toxics even at low concentrations, and in some case carcinogenic, site specific cancer-lung and sinoeus (ATSDR 2000).

Also Hexavalent chromium is far more reactive and soluble in water than other forms of chromium, making it more mobile in the environment (Mukherjee 1998).



Beryllium

4
9.0
Be



semi-conductor chips, ignition modules, transistors, electrical insulator

Valuable Properties:

Beryllium is extremely lightweight, hard, a good electrical and thermal conductor, and non-magnetic. Due to its electrical conductivity, it is used in low-current contacts for batteries and electrical connectors

Hazardous Properties:

Handling beryllium in its solid form, such as a finished computer part that contains beryllium, is not known to cause illness. However, some people who inhale beryllium dust or fumes will develop beryllium sensitization or chronic beryllium disease (CBD).

Poisons in our trash



Have you seen this symbol? The crossed out wheeled bin symbol informs you that the product should not be disposed of along with municipal waste because it contain hazardous substances that could impact health and the environment, if not properly disposed.

The "Take-back" Discussion:

So who's responsibility is it to make sure these hazardous substance do not enter our municipal waste system?? Is a labeling enough? Should it be up to the individual to sort this out? Should the manufacture "take back" the item to insure proper disposal? Who pays for treating hazardous waste? The public, the government, retailer or the manufactures? Which method would be the best incentative to reduce hazardous materials in the design and manufacture item of items.

The Link between Solid Waste & Climate Change

- Methane (CH_4), is a greenhouse gas produced in landfills.

- Global Warming Potential of methane is 25 times greater than carbon dioxide.

- Landfills are second only to livestock industries as the greatest anthropogenic source of methane.

- The manufacture, distribution, and use of products—as well as management of the resulting waste—all result in emissions of greenhouse gases that affect the Earth's climate. Reduction and Recycling reduce production of green house gases.

The Link Between Waste Management and Greenhouse Gases

Increased GHG EMissions

Extraction

Greenhouse gases are emitted during the harvesting of trees, and the extraction and transport of raw materials.



Waste prevention and recycling delay the need to extract some raw materials, lowering greenhouse gases emitted during extraction.

Manufacturing

Manufacturing products releases greenhouse gases during processing and as energy is expended during product use.



Waste prevention means more efficient resource use, and making products from recycled materials requires less energy. Both lower greenhouse gases emitted during manufacturing.

Combustion

Burning some kinds of waste in an incinerator increases greenhouse gas emissions.



Waste prevention and recycling reduce the amount of waste sent to incinerators, lowering the greenhouse gases emitted during combustion.

Landfilling

Greenhouse gases are emitted as waste decomposes in landfills.



Waste prevention and recycling reduce the amount of waste sent to landfills, lowering the greenhouse gases emitted during decomposition.

Decreased GHG EMissions

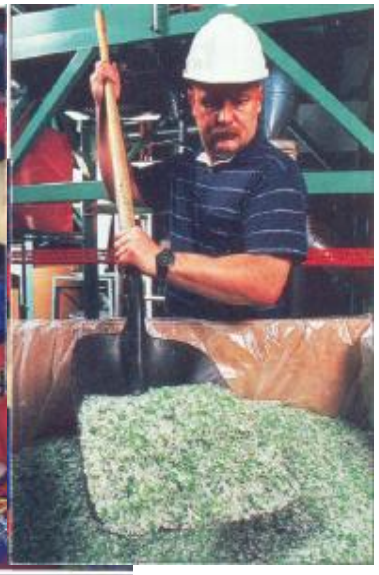
ECONOMICS OF SOLID WASTE

Whether you use a landfill, incinerator or combine it with a recycling program, managing solid waste is still costly. Waste-to-energy programs are only cost effective when fuel price are high and programs serve a large population. Pay as you throw programs are the most effective at deterring waste production. What do you pay to throw garbage away?

Economically, the best choice is to reduce the amount of material we throw away.

Recycling of solid wastes.





WELCOME TO GREEN ENERGY TECHNOLOGY



FROM THE **POLLUTING FOSSIL FUELS OF THE 20TH CENTURY**

TO THE

GREEN RENEWABLE ENERGIES OF THE 21ST CENTURY(BIO-DIESEL)

How can we reduce our waste production?

Tools to reduce waste:

The Four Rs:

Rethink

Reduce

Reuse

Recycle

RETHINK

We know that most items we purchase will be thrown away eventually, so why not design for the “end of life” of the product? Engineers and product designers need to address:

- **Packaging**: materials comprise 65% of our waste.
- **Toxic substances**: substitute with less toxic or benign materials (i.e. lead-free solder) that can be harmlessly disposed of or recycled.

Paying for a Bad Design



Photo courtesy of Recycling Council of Ontario

"Electronics were designed to be disposed of rather than recycled, therefore it is difficult and costly to separate the high-value recyclable materials and the toxic components from discarded electronics."

Rethink Example:
Building a Greener Computer

1. Engineer recycling into the design of the computer. Create components which are easily interchangeable for updating or removed for recycling.
2. Solder with lead-free material.
3. Select wire insulation that is free of PBC.
4. Use non-toxic silicon-based flame retardant instead of non-recyclable and toxic brominated fire retardants.
5. Replace chromium corrosion inhibitors with non-toxic forms.

REDUCE

As consumers, we make choices about the products we purchase and how much use we get out of them.

- Bottled water vs personal water bottles
- Single use shopping bags vs. reusable bags
- Coffee and soda “go-cups” vs. reusable insulated cups
- Food packaged in individual servings vs. buying in bulk (i.e. oatmeal, pasta)
- News papers vs. On-line news
- Paper bills and newsletters vs. email or on-line

REUSE

We can choose when to replace our belongings.

- Repair vs. replace: is it broken, or just “old”?
- Using “hand me downs” and shopping at thrift stores instead of always buying new clothing
- Taking advantage of libraries and rentals instead of buying most books and movies.
- Taking proper care of the items we do purchase, to maximize their lifetime.
- Adapting items for another use instead of discarding (e.g. dryer lint + wax = fire starters)

RECYCLE

- This term is often misused, or used too broadly. Proper definition of recycling is "the separation and collection of materials for processing and manufacturing into new products, and use of these new products to complete the cycle".
- Should be the final step, after **rethinking** product design and **reducing** waste production through wise purchasing and **reuse**.
- We are **“closing the cycle”** when we purchase items made up recycled material.
- **“Downcycling”**occurs when the new product is of mixed materials and can not be recycle again (i.e. carpeting and boards made of a mixture plastic bottles and sawdust).

Boom and Bust of Recycling

The success of a recycling program is tied to market forces, transportation cost, and proximity to manufacturers.







Items made of a single material are costly to recycle

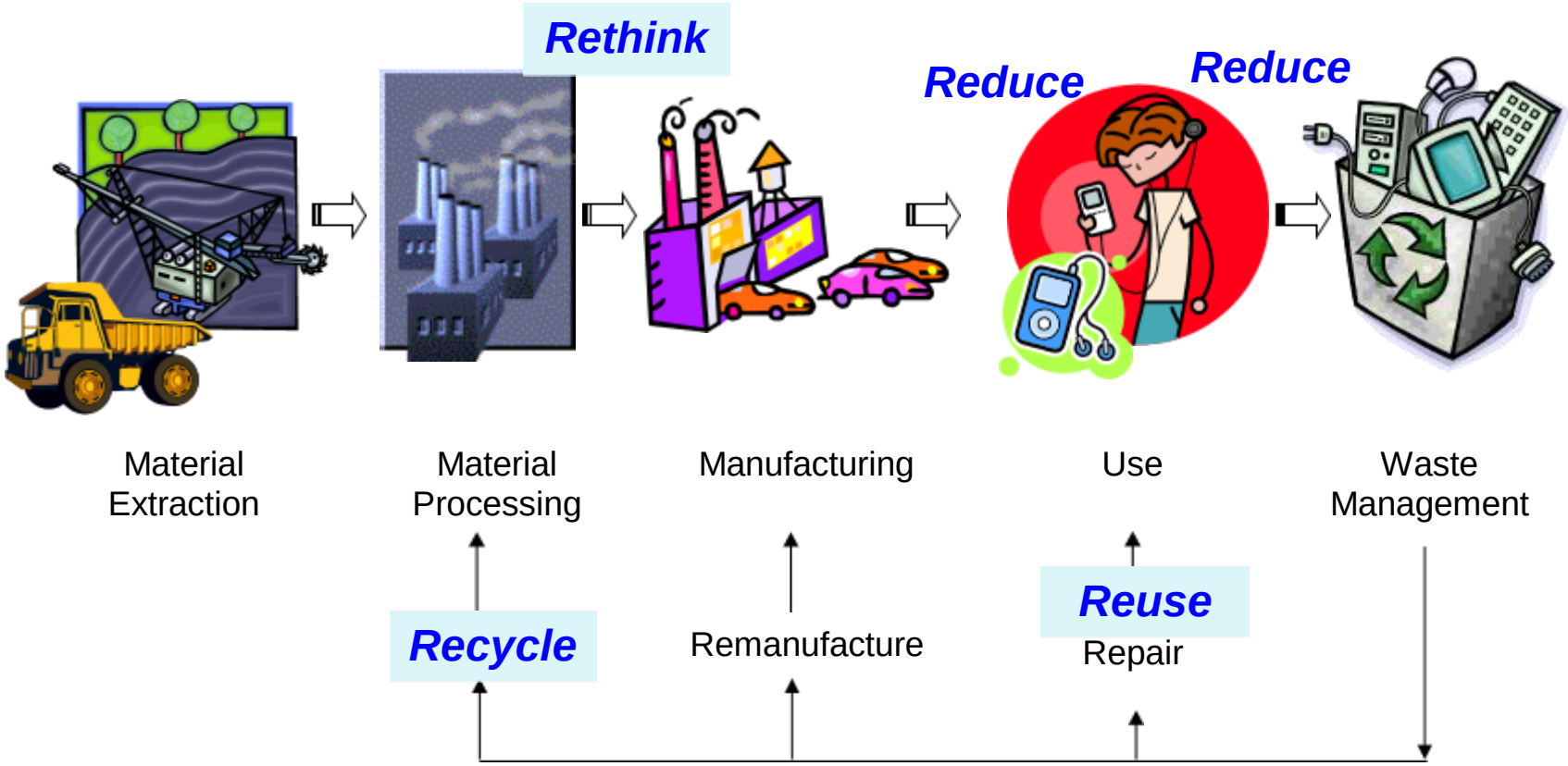


Items made of many materials have higher labor cost to recycle

Should you pay for recycling?

The more complex an item the more labor is needed to separate materials. If the labor is more costly than the recovered material than recycling is expensive. However one should also include the environmental cost of mining raw material versus recycling raw metal.

The 4 Rs Illustrated: Product Lifecycle



Suggested by OTA, "Green Products by Design: Choices for a Cleaner Environment," 1992.

What can you do?

- Learn what you can keep out of the garbage.
- Recycle naturally, that is COMPOST in your own back yard
- Consume wisely. Plus you can study to become a green engineer or designer



There is no “away”

- **There is no way to get rid of *all* our garbage.** The best solution is to make less, then find the most appropriate way -- reuse, recycle, burn, or landfill -- to manage what's left.

- **Where does *your* trash go?** Find out, if you don't know. What would your family do if your trash wasn't picked up every week?

You as an individual

You have purchasing power:

- Will you select more “greenly” designed items?
- Will you buy less and reuse more?

You can choose a greener lifestyle:

- Will you take advantage of existing recycling programs in your community?
- Will you pass along your usable goods to thrift stores, online pages like Craig’s list, Freecycle?

Steps taken by IR

TO OVERCOME POLLUTION

Green Initiatives taken by Indian Railways..

- Development of Emission test car.
- Uses of alternative source of energy like BD & CNG
- Process to develop electronic fuel injector.
- Closure of foundry.
- Implementation of ZDTS.
- Out source the cleaning activity such as OBHS.etc
- Contact with authorized recyclers.
- To improve levels of upkeep and cleanliness/waste managements.



Development of ETC for Diesel locomotives.

M/S HORIBA Ltd., JAPAN

&

CAR MANUFACTURED AT

ICF,CHENNAI.



On Board Analysis System

The mass emission measurements system provided on the coach is capable to measure:-

•Oxides of Nitrogen.

•Particulate matter total hydrocarbons

•Methane hydrocarbon.

•Smoke opacity.

•Carbon monoxide and carbon dioxide.

the ES gives data in ppm or Vol %. It also gives a A/F ratio . Software is used to calculate it into g/kwh.

BIO-DIESEL in IR

- **To reduce the pollution created by the burning of HSD oil in locomotives and vehicles a big plan has been charted out to manufacture Bio-diesel from Jatropha seed.**

- **Jatropha plantation is also under taken at mass level.**

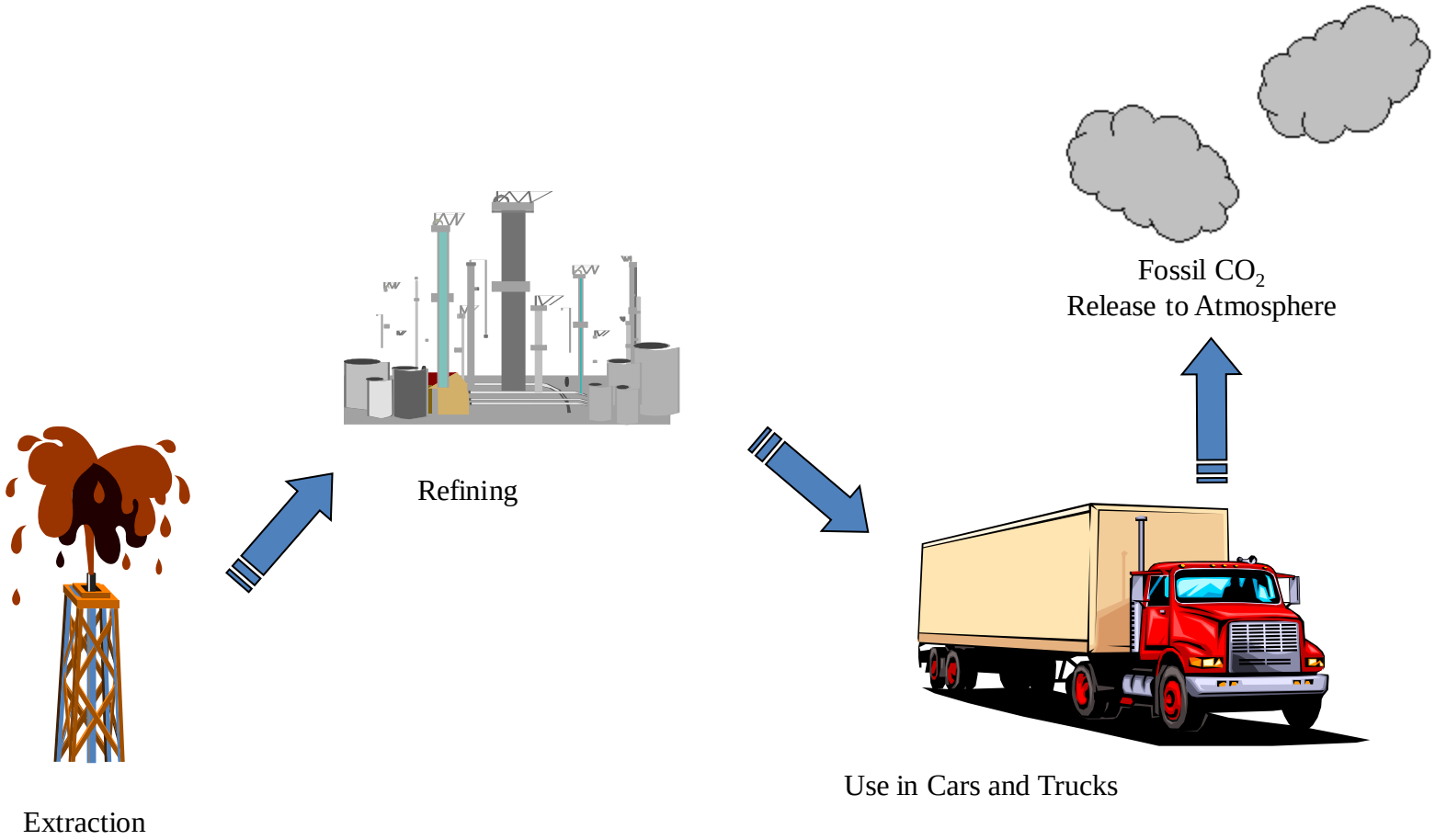
* Set up IROAF

ENVIRONMENTALCONCERNS

Emission	Reduction (%)
CO	**67**
Hydrocarbon	**30**
Particulate Matter	**68**
SOOT	**50**
Polycyclic aromatic hydrocarbons(PAH)	**85**
CO_2	**100**
NO_X	**+/-2--6**
SO_2	**80-100**

PETRO-DIESEL CO_2 CYCLE

13 pounds of fossil CO_2 released per gallon burned



BIODIESEL CO_2 CYCLE No fossil CO_2 Released



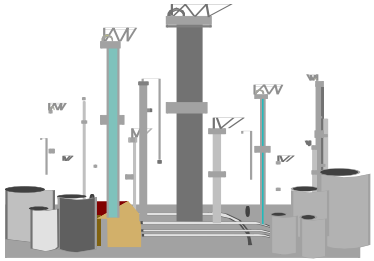
Renewable CO_2



Oil Crops



Use in Cars and Trucks



Biodiesel Production

Indian Railways runs Shatabdi on biodiesel blend



- Shatabdi run from Delhi to Amritsar on 31st December 2002.
- Fuel used – 5% blend of bio diesel
- Parameters monitored-
  - Filters
  - SFC
  - Fuel Injection Equipment

Results

- No loss of hp, acceleration or any other problem observed during run.
- No unusual deposits observed on fuel filters.

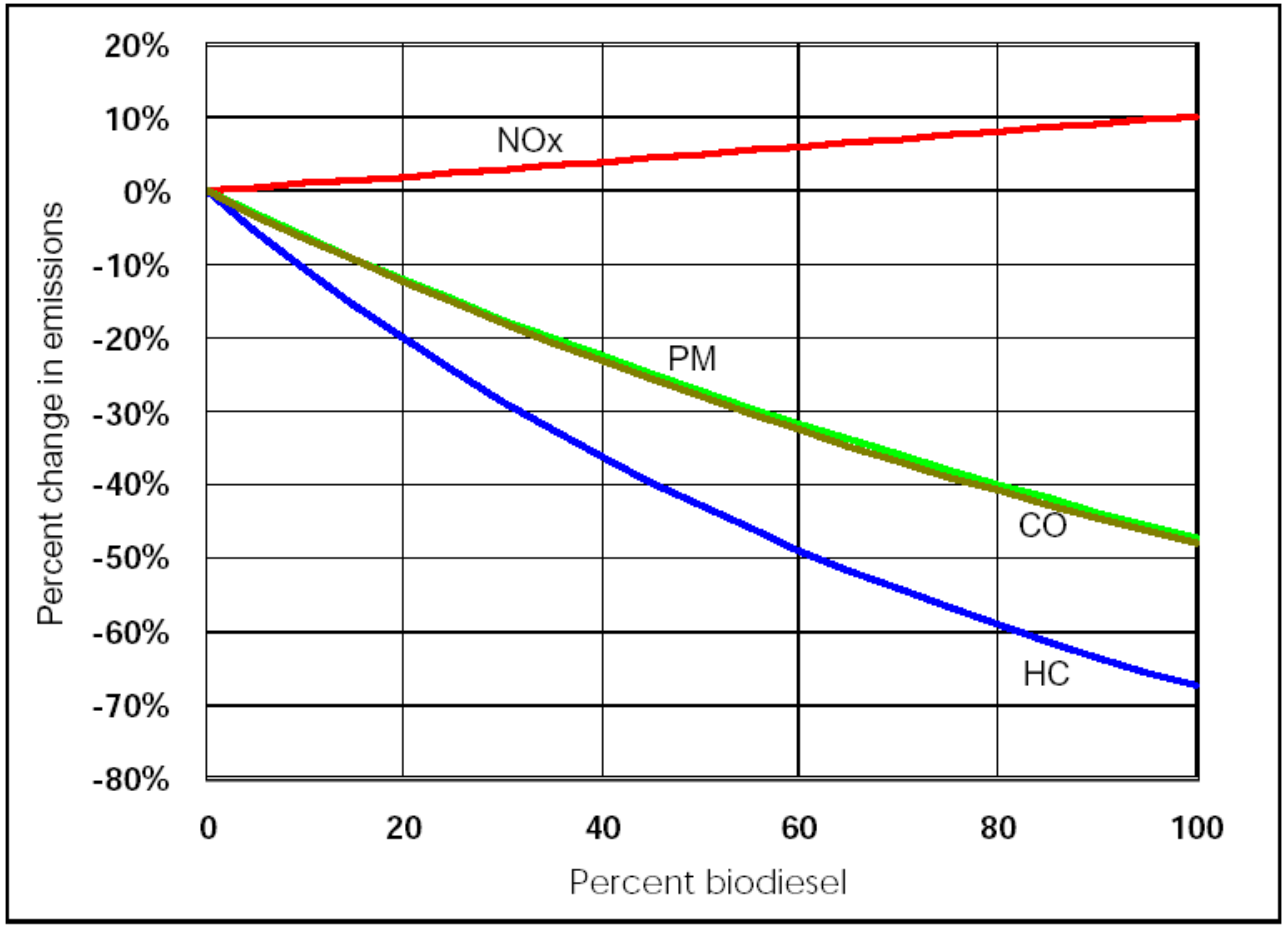

LOCO WORKS
POWERED BY BIODIESEL - S.R.Y
4 5 2004

Advantages of Biodiesel PM,HC,CO reduction

EPA analysis:

- data from many studies
- engine models through 1997

- NO_x
  - No change for B5
  - 2% up for B20
  - 10% up for B100
- PM
  - 5% down for B5
  - 12% down for B20
  - 48% down for B100



Analysis from EPA420-P-02-001, October 2002

Jatropha Plantation













BIO-DIESEL in IR

- **For the manufacturing of Bio-diesel, several esterification plants have already been set up at different location like Diesel Shed Kharagpur, Sakurbasti near New Delhi, TKD-Diesel shed, Loco workshop Perambur, S.Railway.**

- **IRIMEE , for the training of Manufacturing method.**

- **RDSO/LKO has already plan to set up one esterification plant based on Heterogeneous Catalyst as well as to set up testing facilities at the cost of more than ten crores.**

BIO-DIESEL in IR

- **Some trains & Road vehicle are alredy run on blended Bio-diesel in IR.**

- **Supported of Bio-diesel.**

Improving levels of upkeep

- Weeding out of old records.
- Removal /repair of broken furniture etc.
- Removal & disposal of garbage/scraps
- Regular housekeeping.
- Regular dusting,sweeping and washing of the premises.
- Provision of proper dustbin of different colours & sizes

Improving levels of upkeep

- Regular clealing/painting of machinery and plant.
- Display Boards should be properly maintained.
- Proper barricading of rish prone areas.
- safety ,productivity and motivation related poster on the shopfloor.
- Securing hanging wires and open defective junction boxes etc

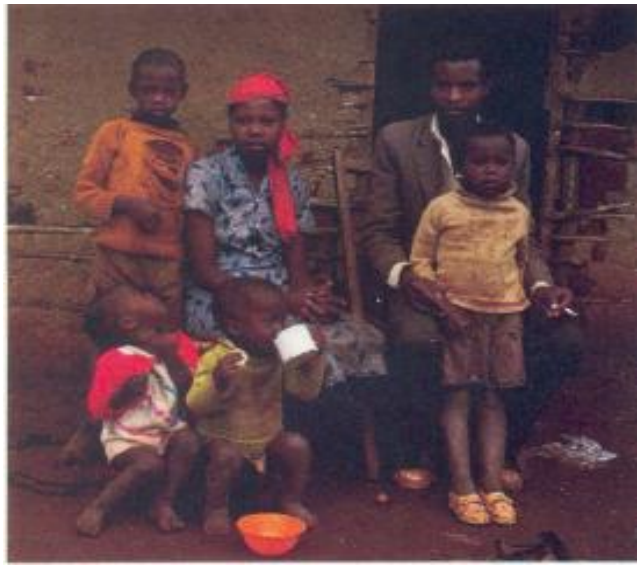
Improving levels of upkeep

- Restoring heritage condition and providing heritage interpretation.
- Beautification of premises
- Maintaining Green space/parks
- Maintaining proper wall painted signages/interpretation, room numbers and notices Boards.

Conclusion:-

- IR is now fully aware that it is socially, legally and politically unacceptable to pollute the IR premises & its surroundings.
- The different measures like installation of STP,ETP.
- Recycling of waste,(WATER & SOLIDS).
- Uses of non polluting items .
- Auction of used oils, batteries, sludges to authorized reclaimers have been adopted at different placesses based on the nature of pollutants.
- Over all IR is effectively taking care in controlling the environmental pollution responsible for its Industrial effluent.

TOMORROW'S WORLD





TOMORROW'S WORLD



FOLLOW THE TIME WATCH.

WISHING INDIAN RAILWAYS A GREENER FUTURE



THANK YOU