SRI VIDYA COLLEGE OF ENGINEERING & TECHNOLOGY
VIRUDHUNAGAR
DEPARTMENT OF CIVIL ENGINEERING

QUESTION WITH ANSWERS

DEPT:CIVIL–IV **SEM:VII**
SUB.CODE/NAME:EN6501/Municipal Solid Waste Management.

UNIT2-On-site Storage & Processing.

PART-A (2marks)

1.Write about On-site handling methods.

On-site handling methods

On-site handling methods and principles involve public attitude and individual belief, and ultimately affect the public health. It is an activity associated with the handling of solid waste until it is placed in the containers used for its storage before collection.

2.What is the Importance of on-site handling of solid waste?

Importance of on-site handling of solid waste:

- reduce volume of waste generated
- alter physical form
- recover usable materials

3.List out the On- site handling methods

On- site handling methods:

- sorting
- shredding
- grinding
- composting

4.Write about On- Site Storage method.

On- Site Storage

The first phase to manage solid waste is at home level. It requires temporary storage of refuse on the premises. The individual householder or businessman has responsibility for onsite storage of solid waste. For individual homes, industries, and other commercial centers, proper on-site storage of solid waste is the beginning of disposal, because simple dumps are sources of nuisance, flies, smells and other hazard.

5.Write about Storage containers

Storage containers

Garbage and refuse generated in kitchens and other work areas should be collected and stored in properly designed and constructed water-proof garbage cans (waste bins). The censor receptacles can be constructed from galvanized iron sheet or plastic materials. They should have tightly fitting covers.

6.List out the Storage containers size in MSWM.

container size for:-

- ash: up to 80 to 128 liters
- mixed refuse: should not exceed 120 to 128 liters
- rubbish up to 200 liters
- kitchen waste is 40 liters
- garbage is 48 to 80 liters

7.What are the Collection process involved in MSWM.

Collection process

Involves five different phases.

Phase 1 - House to dustbin

Phase 2 - Dustbin to truck

Phase 3 - Truck from house to house

Phase 4 - Truck to transfer station

Phase 5 - Truck to disposal

8.What are the types of collection services?

There are four types of collection services:

I. **Curb (curb side):** The home owner is responsible for placing and returning the empty container. Never entirely satisfactory.

II. **Set-out (block collection):** Owner is responsible for returning the container. The full containers are brought or set at the collection site by the crew. Bins are not left out on the street for long periods.

III. **Backyard carrying service (door to door collection**):

Collection crews that go along with the collection vehicle are responsible for bringing out stored solid waste from the dwelling units. It is the only satisfactory system in which the householder does not get involved.

IV. **Alleys**: a narrow street or path between buildings in at own. That is difficult to get the container and also to the vehicle that will collect the waste.

9.What are the Method of loading the solid waste on the vehicle?

Method of loading the solid waste on the vehicle:

a. directly lifting and carrying of container.

b. rolling of loaded containers on their rims.

c. use of small lifts for rolling the containers to the collection vehicle.

d. use of large containers into which wastes from small containers are emptied.

10.What are the Routing system of collection?

Routing system of collection

1. Micro-routing is:

- the routing of a vehicle within its assigned collection zone.
- concerned with how to route a truck through a series of one or two way streets so that the total distance traveled is minimized.
- very difficult to design and execute.

2. Macro-routing is:

- large scale routing to the disposal site and the establishment of the individual route boundaries.

11.Write the Modes of operation in solid waste collection?

1. Hauled container system- The containers used for the storage of wastes are hauled to the disposal site, emptied and returned.

2. Stationary container system - The containers used for the storage of waste remain at the point of generation except for occasional short trips to the collection vehicles.

12. What is called Resource recovery?

Resource recovery is a partial solid waste disposal and reclamation process. It can be expected to achieve about 60% reductions in future landfill volume requirements. Resource recovery must recognize what is worth recovering and the environmental benefits.

13. List out the levels of recycling.

a) primary recycling—*when the original waste material is made back into the same material* (newspaper newsprint paper)

b) secondary recycling—*when the original waste material is made into some other product* (newspaper cardboard)

c) tertiary recycling—*breaking material down to components that composed the original product*; often through depolymerization

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QUESTION WITH ANSWERS

DEPT:CIVIL–IV **SEM:VII**

SUB.CODE/NAME:CE2039/MunicipalSolid Waste Management.

UNIT2-On-site Storage & Processing

Part B-16 marks.

1.Explain the On-Site Handling, Storage and Processing of Solid Waste.

Introduction

Aesthetics, land use, health, water pollution, air pollution, and economic considerations make proper solid waste storage,collection and disposal of solid wastes (municipal andindividual) functions that must be taken seriously.Indiscriminate dumping of solid waste and failure of thecollection system in a populated community would soon cause many health problems. Odors, flies, rats, roaches, crickets,wandering dogs and cats, and fires would dispel anyremaining doubts of the importance of proper solid wastestorage, collection and disposal.

On-Site Handling, Storage and Processing of Solid Waste.

A. On-Site Handling

On-site handling methods and principles involve publicattitude and individual belief, and ultimately affects the publichealth. It is an activity associated with the handling of solidwaste until it is placed in the containers used for its storage before collection. This may take place at any time before,during or after storage.

Importance of on-site handling of solid waste:

- reduce volume of waste generated
- alter physical form
- recover usable materials

On- site handling methods:

- sorting
- shredding
- grinding
- composting

Factors that should be considered in evaluation of on siteprocessing include capabilities, reliability, environmentaleffects, ease of operation, etc.

B. On- Site Storage

The first phase to manage solid waste is at home level. Itrequires temporary storage of refuse on the premises. Theindividual householder or businessman has responsibility foronsite storage of solid waste.

For individual homes, industries, and other commercial centers, proper on-site storage of solid waste is the beginning of disposal, because unkept or simple dumps are sources of nuisance, flies, smells and other hazards. There are four factors that should be considered in the onsite storage of solid waste. These are the type of container to be used, the location where the containers are to be kept, public health, and the collection method and time.

1. Storage containers

Garbage and refuse generated in kitchens and other work areas should be collected and

stored in properly designed and constructed water-proof garbage cans (waste bins). The cans or receptacles can be constructed from galvanized iron sheet or plastic materials. They should have tightly fitting covers.

They must be of such size that, when full, they can be lifted easily by one man. They should be located in a cool place on platforms at least 30 centimeters above ground level. After putting in garbage, they should be kept covered. The bins must be emptied at least daily and maintained in clean conditions. A typical example of garbage can, constructed from galvanized iron sheet, dimensions: diameter 45 cm and height 75 cm, is shown in figure 1 below. An adequate number of suitable containers should be provided with proper platforms with receptacles stand. The number may depend on the amount, type and establishments where the need arises. Suitable containers should be watertight,rust-resistant, with tight-fitting covers, fire-resistant,adequate in size, light in weight, with side handles and washable.

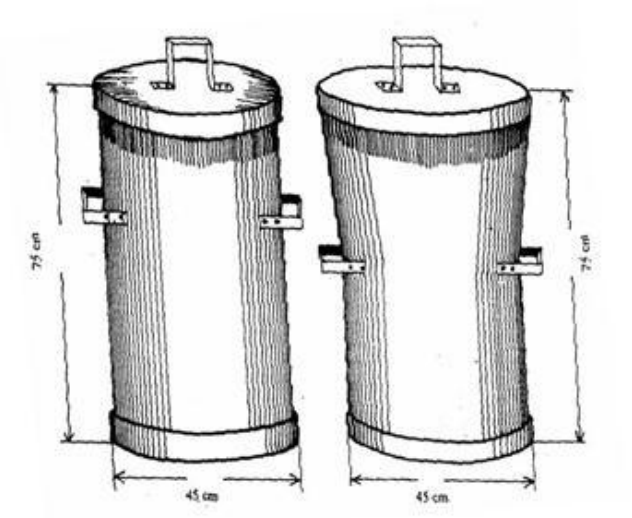


Figure 1. Typical Garbage Can with Tightly Fitting Cover
Source: Gabre-Emanuel Teka (1997): Solid Waste Disposal From Food

2. Container Size (capacity)

Consideration should be given for the size of the loaded container that must be hauled to the collection vehicle or to the disposal site.

Therefore, container size for:-

- ash: up to 80 to 128 liters
- mixed refuse: should not exceed 120 to 128 liters
- rubbish up to 200 liters
- kitchen waste is 40 liters
- garbage is 48 to 80 liters

Plastic liners for cans and wrapping for garbage reduce the need for cleaning of cans and bulk containers, and keep down odors, rat and fly breeding.

Galvanized metal is preferable for garbage storage because it is resistant to corrosion. Plastic cans are light in weight but are easily gnawed by rats. Bulk containers are recommended where large volumes of refuse are generated, such as at hotels, restaurants, apartment houses, and shopping centers. A concrete platform provided with a drain to an approved sewer with a water faucet at the site facilitates cleaning.

On- site processing

Importance of on-site processing:

- reduces volume of waste generated
- alters physical form

- recovers usable materials
Factors that should be considered in evaluating on-site processing are capabilities, reliability, environmental effects, ease of operation, etc.

2.Write about Collection of Solid Waste in MSWM.

This is the removal of refuse from collection points to final disposal site. It is the most expensive as compared with other operation and management procedures, because it demands special vehicles, experienced people to manage, more manpower, hand tools, and more funds for fuel, salary, maintenance, gathering or picking up of solid waste from the various sources, taking the collected wastes to the location where it is emptied, and unloading of the collection vehicle.

Collection cost has been estimated to represent about 50% of the total cost of collection when a sanitary landfill is used as means of disposal, and 60% when incineration is used.

Home collection of solid waste generally is done by a private collector or a local government-owned and financed operation.

Private collectors usually charge a fee to each individual homeowner, or a government contract will pay the fees. The government contract enables solid waste collection in a uniform, sanitary manner. Without such a contract, some individuals may be reluctant to pay the collector for the service and the refuse may go uncollected.

1. Collection process Involves
five different phases. Phase 1 -
House to dustbin Phase 2 -
Dustbin to truck
Phase 3 - Truck from house to house
Phase 4 - Truck to transfer station
Phase 5 - Truck to disposal

2. Collection services

People must understand that a good refuse-collection service requires citizen cooperation in the provision and use of proper receptacles in order to keep the community clean and essentially free of rats, flies, and other vermin.
There are four types of collection services:
I. **Curb (curb side):** The home owner is responsible for placing and returning the empty container. Never entirely satisfactory.
II. **Set-out (block collection):** Owner is responsible for returning the container. The full containers are brought or set at the collection site by the crew. Bins are not left out
on the street for long periods.
III. **Backyard carrying service (door to door collection**):
Collection crews that go along with the collection vehicle are responsible for bringing out stored solid waste from the dwelling units. It is the only satisfactory system in which the householder does not get involved.
IV. **Alleys**: a narrow street or path between buildings in a town. That is difficult to get the container and also to the vehicle that will collect the waste.

Method of loading the solid waste on the vehicle:

a. directly lifting and carrying of container.
b. rolling of loaded containers on their rims.
c. use of small lifts for rolling the containers to the collection vehicle.
d. use of large containers into which wastes from small containers are emptied.

3. Write about Planning of Solid Waste Collection Program.

Routing system of collection

1. Micro-routing is:

- the routing of a vehicle within its assigned collection zone.
- concerned with how to route a truck through a series of one or two way streets so that the total distance traveled is minimized.
- very difficult to design and execute.

2. Macro-routing is:

- large scale routing to the disposal site and the establishment of the individual route boundaries.

Modes of operation in solid waste collection

1. Hauled container system- The containers used for the storage of wastes are hauled to the disposal site, emptied and returned.

2. Stationary container system - The containers used for the storage of waste remain at the point of generation except for occasional short trips to the collection vehicles.

Unit operations

1. **Pick-up** - refers to the time spent driving to the next container after an empty container has been deposited.
2. **Haul** - represents the time required to reach the disposal site starting after a container whose contents are to be emptied has been loaded on the truck plus the time spent after leaving the disposal site until the truck arrives at the location where the empty container is to be deposited.
3. **At-site-** refers to the time spent at the disposal site and includes the time spent waiting to unload as well as the time spent in loading.
4. **Off-site** - includes the time spent on activities that are non-productive from the point of view of the overall collection system.

3. Frequency of solid waste collection

The frequency of collection depends on the quantity of solid waste, time of year, socioeconomic status of the area served, and municipal or contractor responsibility. In business districts, refuse, including garbage from hotels and restaurants, should be collected daily except on Sundays. In residential areas, twice-a-week for refuse collection during warm months of the year and once a week at other times should be the maximum permissible interval. Slum areas usually require at least twice-a-week collection. The receptacle should be either emptied directly into the garbage truck or carted away and replaced with a clean container.

Refuse transferred from can tocan will cause spilling, which results in pollution of the ground and attraction of flies. If other than curb pickup is provided, the cost of collection will be high. Some property owners are willing to pay for this extra service. Bulky wastes should be collected every 3 months.

Garbage - should be collected at least two times weekly in residential sections in summer and winter. However, most commercial establishments should be accorded daily collection service throughout the year.

Rubbish - is generally collected weekly in residential areas and daily in business sections.

Mixed refuse - should be collected twice daily from most commercial concerns. The

provision of frequent collection services is important in the prevention of fly breeding in garbage, because irregular collections can contribute to the nuisances and hazards which result under poor storage conditions and in chances the amount greater than the expected requirement from households.

4.What role played Collection equipment in MSWM.

Mechanical collection systems have been developed to reduce collection cost. The system requires use of a special container, truck container pick-up equipment, and replacement of the container. From an economic point of view, such equipment are most unlikely to be applied in Ethiopian situation.

Collection equipment that simplifies the collection of refuse and practically eliminates cause for legitimate complaint isavailable. The tight-body open truck with a canvas or metal cover has been replaced in most instances by the automatic loading truck with packer to compact refuse dumped in the truck during collection, except for the collection of bulky items.
Compaction-type bodies have twice the capacity of open trucks and a convenient loading height. Low-level closed-body trailers to eliminate the strain of lifting cans are also available. The number and size of the collection vehicles and the number of pickups in residential and business areas for communities of different population will vary with location, affluence, and other factors. The average refuse truck holds
6,000 to 8,000 kilograms.The solid waste collection vehicle should be covered and able to compact the refuse collected. It may load from the rear, side, or top. The storage areas in these vehicles should be kept relatively clean and water-tight.

5.Write about Organization of solid waste collection program.
Many cities and towns require homeowners to use certain types of receptacles. Collectors usually pick up at the curb in front of the dwelling. In some neighborhoods the collectors pick up the receptacles in the backyard, as the people who live there consider receptacles too bulky to handle and unsightly in front of their dwellings. Haul distance to the disposal facility must be taken into consideration in making a cost analysis. In some highly urbanized areas it is economical to reduce haul distance by providing large, specially designed trailers at transfer stations. In suburban and rural areas, container stations can be established at central locations. These stations may include a stationary compactor for ordinary refuse and a bin for tires and bulky items. Separate bins for paper, glass, and aluminum may also be provided.
Labor requirements for the collection of solid waste depend on both the type of service provided and the collection system used:

1. For hauled container system: one person, two for safety, and a driver to drive the vehicle load and unload containers and empty the container at the disposal site.
2. For stationary container system the labor requirement for mechanically loaded ones are essentially the same with hauled container system. Occasionally, a driver and two helpers are used. For manually loaded systems, the number of collectors may vary from one to three, depending on the type of service and the type of collection equipment, Curb collection needs less persons than backyard collection, which may require a multiperson crew.

6.Write about MSW Transfer and Transport.
Transfer stations are used to collect the refuse at a central location and to reload the wastes into a vehicle where the cost per kilogram-kilometer ton-mile will be less for the movement of the ultimate waste to the disposal site. Transfer stations are employed when

the disposal site is situated at significant distance from the point of collection.

A transfer station can reduce the cost of transporting refuse by reducing manpower requirement and total kilometers. When a collection vehicle goes directly to the disposal site, the entire crew, driver plus laborers, are idle. For a transfer vehicle, only one driver is needed. As the distance from the centers of solid waste generation increases, the cost of direct haul to a site increases. Ideally, the transfer station should be located at the center of the collection service area. A transfer station may include stationary compactors, recycling bins, material recovery facility, transfer containers
and trailers, transfer packer trailers, or mobile equipment.

A transfer station should be located and designed with drainage of paved areas and adequate water hydrants for maintenance of cleanliness and fire control and other concerns like land scaling, weight scales, traffic, odor, dust, litter, and noise control. Transporting vehicles could be a modern packer truck (trailer), motor-tricycles, animal carts (appropriate for developing countries), hand carts and tractors.

Transfer and transport station should provide welfare facilities for workers (lockers, toilets, showers); small stores for brooms, shovels, cleaning materials, lubricants, parking facilities for hand trucks, sweepers, refuse collectors, and office and telephone for the district inspector.

7.Resource Recovery and Processing of MSWM.

Resource recovery is a partial solid waste disposal and reclamation process. It can be expected to achieve about 60% reductions in future landfill volume requirements. Resource recovery must recognize what is worth recovering and the environmental benefits.

Resource recovery and processing is a complex, economical and technical system with social and political implications, all of which require critical analysis and evaluation before a commitment is made. They demand capital cost, operating cost, market value of reclaimed materials and material quality, potential minimum reliable energy sales, assured quantity of solid wastes, continued need for a sanitary landfill for the disposal of excess and remaining unwanted materials and incinerator residue, a site location close to the center of the generators of solid wastes.

Products That Can Be Recycled

1. Plastic

Plastic is not a natural material. It is synthesized from petrochemicals to create a long, complicated chain of atoms called polymers. Bacteria and fungi that would usually live on the decaying waste of natural food, fauna, and flora cannot digest these recovery polymers.

Instead, toxic cadmium and lead compounds used as binders can leach out of plastics and ooze into groundwater and surface water in unlined or failed landfills. Unfortunately, plastic is one of the most common non-biodegradable wastes deposited in landfills. There are a number of plastic items that create great decomposition problems. Among them are diapers, grocery bags and balloons. Today only 3% of all plastic containers are recycled.

Plastic threatens the lives of millions of marine animals who get entangled in plastic netting. Autopsied marine animals have revealed that their intestines were full of nonbiodegradable plastic. Marine mammals and birds have suffocated, strangled, and been poisoned by the plastic waste such as can rings or balloons that have been expelled into the oceans and into the air. Fishermen currently dump around 175,000 tons of plastic into the oceans each year. It is thought that as many as a million sea birds and 100,000 marine mammals in the Northern Pacific Ocean die each year from eating or becoming entangled in plastic waste. Many more marine lives are poisoned in the Atlantic Ocean by raw sewage, chemical waste, and pesticide waste flowing from rivers into these water bodies.

2. Tires

Discarded tires pose two particular vector health threats to a community: rats and mosquitoes. Tires create an excellent breeding place for rats and mosquitoes, which in turn carry diseases to humans.

An automobile tire contains about 10 liters of oil, which has the potential to produce enough electricity to serve a small town. Unfortunately, when tires burn in an uncontrolled environment, they are extremely difficult to contain or
extinguish. There are actually some tire graveyards that have been burning for years. Although 15 million old tires are recycled each year, the number of recycled tires is actually going down each year as new blends of rubber and steel-belted tires cannot use recycled tires.

3. Paper

Paper is the single most frequently seen item in most landfills, taking up more land space. It accounts for more than 40% of a landfill's contents. Newspapers alone may take up as much as 13 to 30% of the space in landfills. It is not enough to just change from paper grocery bags to recyclable cloth bags.

Garbage archeologists from the University of Arizona have discovered that most materials buried deep in a landfill change very little. Newspapers from the 1950s could still be read in 1992. Paper in landfills does not biodegrade; it mummifies.

Paper may be one of the most recyclable waste products. To establish a newsprint recycling mill, it takes three to five years and costs from $300 to $500 million to build. Can the capital investment be recouped if there is no community plan to market the recycled paper? If economic incentives were given to creative entrepreneurs, more products could easily be developed.

Obstacles to resource recovery

- heterogeneity of the waste
- putrescibility of the waste
- location of the waste
- low value of product
- uncertainty of supply
- unproven technology

Techniques involved in resource recovery

1. compaction, which mechanically reduces the volume of solid waste
2. chemical volume reduction by incineration
3. mechanical size reduction by shredding, grinding and milling

4. component separation by hand-sorting, air separation, magnetic separation and screening.

8.EXPLAIN WASTE MINIMISATION IN

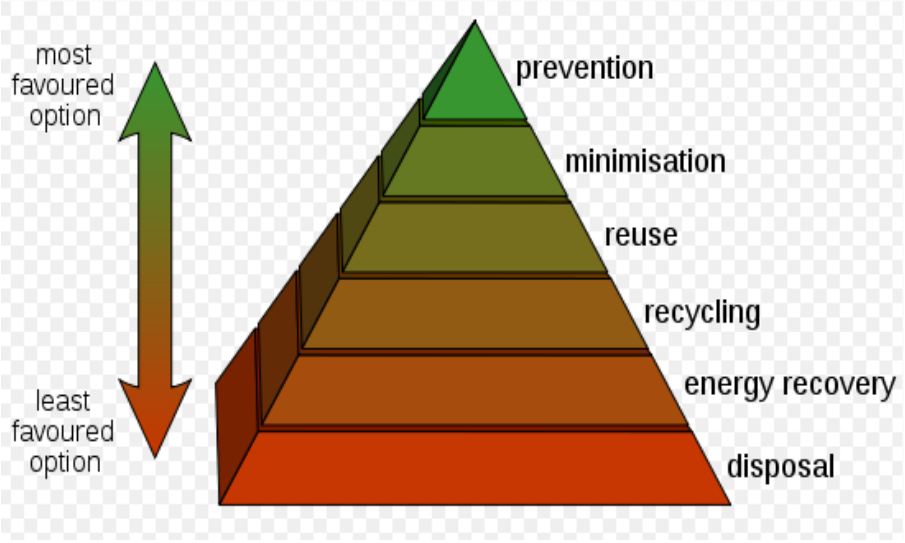
MSWM. waste minimization

Key methods for waste minimization

- Reduce
  - Purchase only what you need
- Reuse
  - Reuse empty containers to collect waste
  - Discarded material could be used in another projects
- Recycle
  - Some waste oils and paints can be recycled
  - Remember that Paper, Metals and some Plastics can be recycle

WASTE MINIMISATION

- Prevention of waste being created is known as waste reduction which is an important method of waste management.
- The modern concepts based on the three 'R's are: Reduce, Reuse and Recycle.
- Methods of avoidance include reuse of second hand products, designing products to be refillable or reusable, repairing broken items instead of buying new etc.



HIERARCHY OF WASTE MINIMIZATION

PROCESSES CARRIED OUT DURING THE SOLID WASTE MANAGEMENT

Integrated solid waste managementthrough the following processes can provide abetter reliable solution for the problem of municipal solid waste generation.

- **WASTE COLLECTION**
- **SEGREGATION**
- **RECYCLING**
- **SHREDDING OR PULVERIZING**

COMPOSTING

WASTE COLLECTION

- **From individual houses, wastes can be collected in person with the help of vehicle.**
- **To minimize the time and cost involved in collecting waste through vehicles, public can be given instruction to dump their house wastes in one place (nearby their street).**

SEGREGATION

- **Segregation of wastes into degradable and non-degradable wastes is to be done to recover or divert non-degradable wastes (electric items, plastics, tyres etc.) and degradable items (wood, textiles etc.) to its recycling plant and if possible, it can be reused.**
- **It is a tedious process which therefore needs labour. Magnets can also be used to segregate ferrous metals.**
- **This process will help in reducing the amounts of waste going for composting and also earns money (through selling wastes to recycling plant.**

RECYCLING

- **The non-degradable and degradable wastes can be recycled very economically in the recycling plants.**
- **Apart from sending wastes to recycling plant, recycling of some organic waste is possible.**
- **Some of the waste recycling techniques are: Fly ash, Organic wastes, Slag and scrap, Industrial gases, Waste waters, Recovery of silver from photographic films.**

SHREDDING OR PULVERIZING

- **This process involves in size reduction of organic wastes before it goes for composting.**

- **This process reduces the overall volume by 40%.**

ADVANTAGES:

- **It will increase surface area availability for bacterial activity (decomposition).**
- **Facilitates easy handling of moisture content and aeration.**

<u>COMPOSTING</u>

- **Aerobic composting is one of the cheapest and easiest methods that are being available for MSW.**
- **Generally, composting can be carried out in three techniques. They are**

i) windrow composting

ii) Aerated static pile method iii) In vessel method

9.Explain the source reduction process.

source reduction *(waste prevention)— also called — pre cycling*
1) definition*— the reduction of the amount and/or toxicity of waste at or before the point of generation*
a) reduction of waste
b) conservation of resources

2) examples
a) making packaging lighter, using less materials
b) use email rather than paper mail
c) keep records and store them electronically
d) donation of unwanted items to charities and thrift stores
e) selling unwanted items online
f) photocopying two-sided documents
g) product maintenance and repair rather than disposal
h) buy items with less bulky packaging
i) mulching and backyard composting of yard waste

3) benefits
a) *saves natural resources*
b) *reduces toxicity of waste*
c) *reduces costs to communities, businesses, schools and consumers*
d) *prevents emissions of many GHG (Greenhouse gases)*
e) *saves energy*
f) *reduces the need for new landfills and combustors*

4) source reduction and reuse facts

a) —More than 55 million tons of MSW were source reduced in the U.S. in 2000, the latest year for which these figures are available.
b) Containers and packaging represented approximately 28 percent of the materials source reduced in 2000, in addition to nondurable goods (e.g., newspapers, clothing) at 17 percent, durable goods (e.g., appliances, furniture, tires) at 10 percent, and other MSW (e.g., yard trimmings, food scraps) at 45 percent.

10.Explain Recycling process.

recycling solution

basic terminology.

a)*reduce*—decreased production of waste
b) *reuse*—finding another use for the object or substance without any transformation
c) *recycle*—use of the material as a source raw material, involves physical transformation
d) *recovery*—process to recover useful material from mixed waste
e) *raw materials*: crude or processed materials that can be converted by manufacture, processing, or combination into a new and useful product

2) levels of recycling
a) **primary recycling**—*when the original waste material is made back into the same material* (newspaper newsprint paper)
b) **secondary recycling**—*when the original waste material is made into some other product* (newspaper cardboard)
c) **tertiary recycling**—*breaking material down to components that composed the original product*; often through depolymerization

3) municipal recycling
a) different cities have different guidelines for pickup etc.
b) *characteristics of a successful recycling program*
 PAYT charges
 mandatory, with fines for violators
 curbside pickup with free bins
 a community effort—business and residential
 organized and clear-cut guidelines and goals

recycling of paper and paper products
a) plain paper, envelopes, newspaper, magazines, phone books, cardboard…
b) **post-consumer waste**—*paper recycled by consumers*
 this is really recycled paper
 look for a high % of post-consumer waste on the label
c) **pre-consumer waste**—*scrap paper at the processing plant*, not ever Sent out as a product
d) demand for recycled paper fluctuates; some forest-poor countries pay

for used paper
e) recycled paper is made into new newsprint, boxes and office paper, paper towels, tissue products, insulation, cereal boxes, molded packaging, hydro-mulch, gypsum wallboard, even compost and cat litter
f) info and stats

recycling of glass
a) food and beverage containers; clear/green/brown
b) some characteristics of glass
- nonporous and impermeable
- does not deteriorate, corrode, stain or fade
- glass is *100% recyclable*

- glass recycling is a *closed-loop system*, creating no additional waste or by-products
- *Glass containers can go from recycling bin to store shelf in as little as 30 days.*

c) basic glass vocabulary