

CH21 - Solid and Hazardous Waste

Love Canal Tragedy

- 1942-1953 Hooker Chemicals and Plastics dumped chemical wastes into the love canal
- The company filled the canal and sold it to the Niagara Falls school board warning them not to disturb the clay cap covering the wastes.
- development of the area causes a “bathtub” effect that released harmful contaminants.
- Many health problems resulted.
- The company was sued for damages

Wasting Resources: The high-waste approach

- 33% of solid waste is in the USA
- solid waste: Any unwanted material that is not liquid or gas,
- 75% of solid waste comes from mining and oil/natural gas production.
- Industrial Solid Waste includes: wasted scraps, sludge, fly ash, old machinery
- Remaining 1.5% is Municipal Solid Waste- from homes and businesses in urban areas
- Often the disposal of this waste often goes unchecked

What is hazardous waste, and how much is produced?

- Includes: (categories designated by Resource, Conservation and Recovery Act of 1976)
 - 1) contains one or more of the 39 toxic, etc. compounds.
 - 2) caustic.
 - 3) flammable.
 - 4) is reactive enough to explode or pollute the air with its fumes.
- Does not include:
 - 1) Radioactive wastes
 - 2) Hazardous wastes discarded by households
 - 3) Mining wastes
 - 4) Waste from small businesses and factories
- 5.5 billion metric tons of hazardous waste are disposed of each year
- 6% is legal hazardous waste
- 94% is unregulated waste

Producing Less Waste and Pollution: Reducing Throughput

What are the options?

- 1) High-waste approach - Burying, burning, or shipping hazardous waste to another country/county.
 - 2) Low-waste approach - Views waste as a potential resource: Recycle, compost, or reuse. Also try to avoid contributing to the amount of hazardous waste
- Goals:
 1. Reduce
 2. Reuse
 3. Recycle and compost
 4. Incinerate
 5. Bury

Why is producing less waste and pollution the best choice?

- 1) Saves energy and virgin resources
- 2) Reduce environmental effects of extracting processing, and using resources
- 3) Improve worker health and safety
- 4) Decrease pollution control and waste management costs

Pollution Prevention Pays (3p) Program: (3M Corp)

- Redesigned equipment and processes, identified chemical outputs, and recycled or sold them as raw material to other companies

- Saved 750 million in waste disposal

Solutions: How can we reduce waste and pollution?

- Redesign manufacturing processes to be more efficient
- Design products that use less pollution and waste fewer resources in their production
- Redesign manufacturing processes to produce less waste
- Individual reduction of hazardous cleaning products
- Green design and life cycle assessment help develop products that last longer and are easy to repair, reuse, manufacture, compost, or recycle
- Trash taxes- Charging money per bag of trash
- "Pay as you throw away" system is being used in parts of the US.

Reuse

What are the advantages of refillable containers?

- Reuse
 - Extends resource supplies
 - Keeps high-quality matter resources from being reduced to low-quality matter waste
 - Reduces energy use and pollution.
- Reuse of glass bottles has virtually gone away
- Some want the reinstatement of the system because of the money it saves
- Examples of reusable containers include lunchboxes and Tupperware

What kind of bags should you use for groceries?

- Plastic containers degrade slowly.
- Paper bags use trees and pollute the air and water
- Overall paper bags do more environmental damage, and cost more to produce.
- The best kind of bag to use is canvas

What can we do with used tires?

- 1) 2.5-4 billion used tires are in landfills, old mines, abandoned houses, and other dump sites.
 - 2) Fire hazard
 - 3) Also produces air pollutants and toxic run-off when burned
- **Reuse** by retreading the tires, using for foundations of homes, artificial reefs, walls for highways, or use to produce electricity,
 - **Recycle** to make resins to manufacture certain products.

Recycling

How can we recycle organic solid wastes? Community Composting

- **Compost**
 - dark-brown, humus-like material that is rich in organic matter and soil nutrients.
 - produced when microorganisms break down organic matter
 - 35% of municipal solid waste is biodegradable
 - To compost mix unwanted wastes with soil, put the mixture in a pile or container, stir occasionally, and let rot for months.
 - Resulting compost can be used as an organic soil fertilizer, topsoil, landfill cover
 - Also restores eroded soil on hills, highways, strip-mined land, overgrazed land, and eroded cropland.
- You need to control compost in order to be successful. 3 ways:
 - 1) Enclosing the facilities and filtering the air inside.
 - 2) Creating municipal compost operations near existing landfills
 - 3) Decomposing biodegradable wastes in a closed metal container

What are the two types of Recycling?

Primary or secondary.

- 1) **Primary or closed-loop recycling**

- Wastes from consumers are recycled to create products of the same type.
- Primary recycling reduces virgin material use by 20-90%
- 2) **Secondary or open-loop recycling**
 - Waste material is converted into other products.
 - Secondary reduces virgin material use by only 25%

Case Study: Recycling municipal solid waste in the US

- 27% of municipal solid waste was recycled or composted in 1996.
- Many US cities have curbside recycling programs showing a 50-80% recycling rate.
- “Pay as You Throw”- Charge money for amount of non-recycled garbage per family
- Recycling also creates jobs.

Is centralized recycling of mixed solid waste the answer?

- Large scale recycling can be achieved by collecting mixed urban waste and transporting it to centralized **Materials-recovery facilities (MRFs)**
- Machines separate the materials into paper, plastic, etc. from glass and valuable resources which are sold to companies.
- Plastic and paper are burned to use for electricity.
- Negatives:
 - Plants are expensive and difficult to maintain
 - There must be a large input of garbage to outweigh the costs
 - These plants can release toxic air pollutants
 - Create health threats for the workers
 - Odor, Noise, Truck Traffic

Is separating solid wastes for recycling the answer?

- Most solid waste experts say it makes sense for trash to be sorted into reusable and nonusable before it is picked up.
- Many small source separation operations are being squeezed out by large waste management companies operating the material recovery facilities.
- Some government contracts allow the large companies to take the business.
- The aluminum and paper separated from recycling are worth a lot of money, and are sometimes stolen.

Does recycling make economic sense?

Yes and No

- Recycling programs should not be judged on whether they pay for themselves.
- Problems: recycling....
 1. Is almost a religion that is above criticism
 2. Doesn't make sense if cost outweighs putting garbage in a landfill or burning it.
 3. Is often not needed to save landfill space
 4. Makes sense for easily, but plentiful recyclable materials, but does not make sense for abundant, hard to recycle materials like glass.
- Benefits: recycling...
 1. Does help the economy, health, and environment overall
 2. Been found to make money in cities with high recycling rates
 3. Reduces the use of virgin resources
 4. Reduces throughput of matter and energy resources
 5. Reduces environmental degradation

Why don't we have more Reuse and Recycling?

- Three factors that hinder recycling:
 - 1) Environmental and health costs are not added to the price of raw materials
 - 2) Resource extracting industries get better tax breaks than recycling companies
 - 3) There is not a big enough market for recycled goods
- The best way to overcome obstacles to recycling is to make recycling cheaper and to make raw materials and waste disposal (non-recyclable) more expensive.

Case studies: Recycling aluminum, wastepaper, and plastics

How much aluminum is being recycled?

- Benefits of Recycling aluminum as opposed to mining:
 - 95% less air pollution
 - 95% less water pollution
 - 95% less energy used
- In 1994 62% of aluminum cans were recycled (only 15% in 1973).

How much wastepaper is recycled?

- Paper is one of the easiest materials to recycle
- In 1996 the US recycled 40% of its waste paper
- **Benefits:** Saves energy, reduces air pollution, water pollution, groundwater contamination, saves water, saves money.

Is it possible to recycle plastics?

- Plastics industry is a leading producer of toxic waste
- Most plastics are nondegradable or take 200-400 years to degrade
- Environmentalists believe that many uses for plastics are unnecessary

Detoxifying, burning, burying, and exporting wastes

How can hazardous waste be detoxified?

- If waste can't be reused and it is toxic, it must be converted into a less toxic form
- Denmark has the best toxic waste detoxification program in the world
- **Bioremediation** - using microorganisms to detoxify
- **Photoremediation** - using plants to remove contaminants

Is burning solid and hazardous waste the answer?

- 15% of municipal solid waste, and 7% of hazardous waste was burned in 150 incinerators
- All incinerators burning hazardous waste pollute the air
- Many incinerators are being shut down
- Japan uses incinerators the most, and consequently have the most air pollution

Is land disposal of solid waste the answer?

- Sanitary landfill
 - 57% of solid waste
 - **benefits:** cheap, easy, reduces air pollution
 - **drawbacks:** groundwater pollution, and gases from anaerobic decomposition

Is land disposal of hazardous wastes the answer?

- Deep Well Disposal
 - pumping waste into layers of rock below
 - aquifers used for groundwater

Surface Impoundment

- ponds and lagoons
- pollute groundwater and air

Is exporting waste the answer?

- Many countries are trying to ban the export of toxic waste
- Companies export waste because it is cheaper than proper disposal

Case studies: Lead, dioxins, and chlorine

How can we reduce exposure to lead?

- High levels of lead blood causes lower IQ, hyperactivity, nervous system impairment, and other disorders.
- Sources: leaded gasoline, lead paint, etc.

How dangerous are dioxins?

- Definition: a family of 75 chlorinated hydrocarbon compounds formed as unwanted by-products in chemical reactions involving chlorine and hydrocarbons.
- TCDD is a dioxin- could cause cancer
- However, a study in 1996 showed that 86% of dioxins produced in the US could be eliminated without economic sacrifice.

What should we do about chlorine?

- Chlorine is used for plastics (manufacturing), solvents, and paper, pulp bleaching
- In so many cases, there are alternatives to chlorine use - but they are more expensive to use.

Hazardous-waste regulation in the US

What is the Resource Conservation and Recovery Act?

- Passed in 1976: Forces EPA to identify and manage disposal of toxic waste, helps states establish waste management programs.
- However, most producers of hazardous waste are able to get away with illegal dumping.

What is the Superfund Act?

- 1980: Comprehensive Environmental Response, Compensation and Liability Act- Cleans up abandoned dumping sites.
- This act forces the polluter to pay in many cases
- The government still has to pay billions in disaster

Solutions: Achieving a Low-waste society

What is the role of Grassroots action? Bottom-up change

- Everyone can help to stop pollution if they oppose: Polluters, hazardous waste landfills, wells, incinerators, and exports

How can we make the transition to a lower-waste society?

- The Principals:
 - 1) Everything is connected
 - 2) There is no "Away"
 - 3) Dilution is not the solution (to pollution)
 - 4) Prevention and recycling is the cheapest way to deal with pollution