



CE 431

Solid Waste Management



Instructor Autobiography

2003	BSc. Engg. (Civil Engineering), BUET (Major in Environmental Engineering)
2003-'05	Research Officer, ITN-BUET
2005	MSc. Engg. (Environmental Engineering), BUET
2011	PhD. (Environmental Engineering), Department of Civil & Environmental Engineering, Northeastern University, Massachusetts, USA
2012-2013	Assistant Professor, Department of Environmental Science and Management, North South University
Research Interests	Water Quality Assessment and Control, Wastewater treatment and Management, Environment and Ecology

Course Outline

- 1) Introduction to solid waste management
- 2) Sources and types of solid wastes;
- 3) Physical and chemical properties of solid wastes;
- 4) Solid wastes generation;
- 5) On-site handling, storage and processing and collection of solid wastes;
- 6) Transfer stations and transport;
- 7) Ultimate disposal methods;
- 8) Resources and energy recovery;
- 9) Soil pollution;
- 10) Industrial solid waste collection and disposal;
- 11) Hazardous waste management.

Introduction to Solid Waste Management

- What is waste ?
 - Unwanted or useless material
 - Also called as rubbish, trash refuse, garbage and junk.



Introduction to Solid Waste Management

- Since the beginning Human kind has been generating waste

BUT

- With the progress of civilization the waste became of a more complex nature

Introduction to Solid Waste Management

- What is solid waste ?

Non liquid, non soluble materials ranging from municipal garbage to industrial waste that contain complex and sometime hazardous substances



Introduction to Solid Waste Management

- Nature and abundance in different countries depend on :
 - Geographic location
 - Climate
 - Degree of Industrialization
 - Available resources
 - Socio-economic conditions
 - Religious custom
 - Lifestyle
 - Behavior of consumers
 - Season of the year

Risks associated with poor management of solid waste



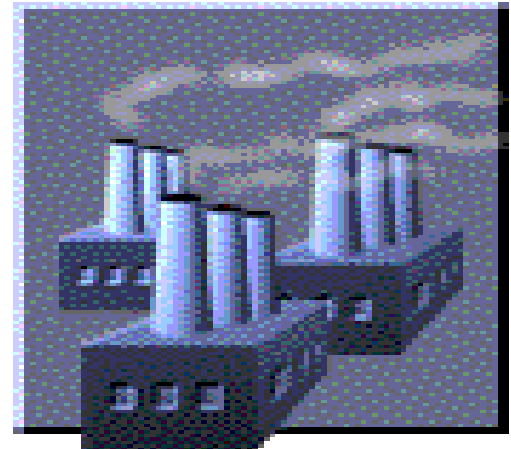
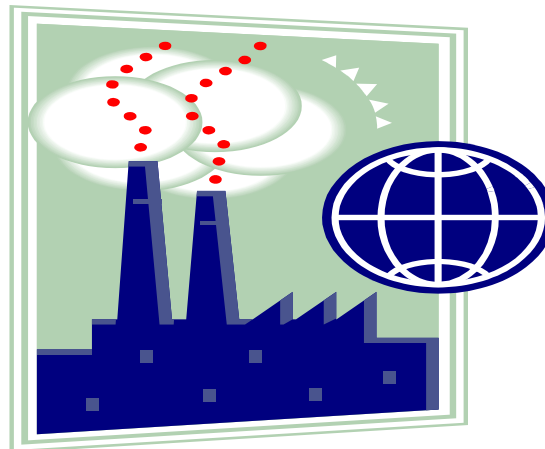
Breeding ground for disease carriers	Rats, flies, mosquitoes, cockroaches, pigs, birds and other disease vectors breed in open dumps, waste storage facilities, piles of rotten refuse, etc.
Spread of disease by animals and other vectors, and food	Above vectors transmit diseases and pathogenic bacteria from waste to the households; consumption of meat from animals eating infected waste.
Spread of diseases by direct contact	Neighbourhoods, waste workers, scavengers in developing countries are in direct contact with waste (in case of organised handling, there is a risk of accident). People using recycled materials are also in direct contact with infected materials (not or poorly disinfected).
Air pollution	Fine grained materials, pathogens, decomposition of waste generating greenhouse gases and other gases, dust and smoke from burning, etc. cause pollution at transfer stations, communal bins, dumping sites.
Contaminated water	Leachate and precipitation (may contain metals, organic pollutants, hazardous substance, etc.) from waste piles and open or inadequately protected disposal sites contaminate surface and ground water.
Fire risk	Piles of waste and gas generated by these present a fire risk.
Connection to other services	Blockage of drains and sewers increase workloads to those services.
Environmental pollution	Overall environmental degradation due to contamination of air, water and soil environment via gaseous emission, particulate matter, ash, leachate, piles of unwanted materials, etc.

Sources of solid waste

- HOUSEHOLDS

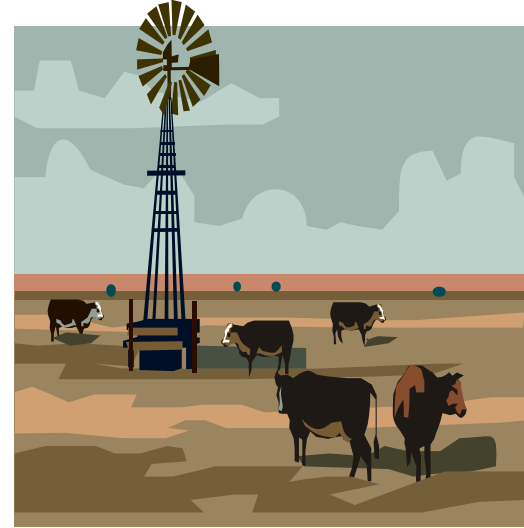


- BUSINESS AND
- INDUSTRIES

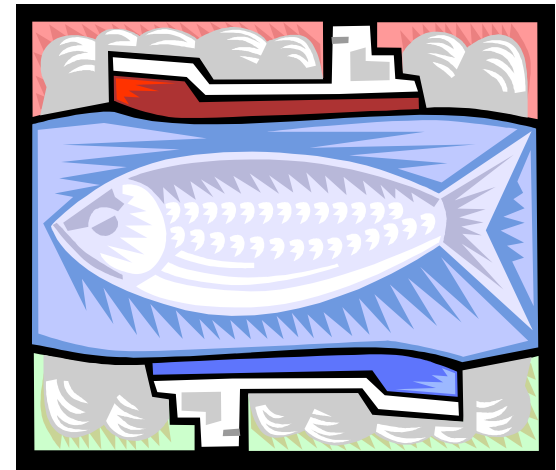


Sources of solid waste

- AGRICULTURE



- Fisheries



Types of solid waste

Solid waste can be classified into different types depending on their source:

- **Household waste or municipal waste:** includes food, paper, cardboard, plastic, textiles, leather, glass, metal, ashes, electronics waste etc.
- **Industrial waste:** includes toxic chemicals, oil, debris from construction site, packaging waste, ashes etc.
- **Biomedical waste or hospital waste:** medicine bottles, expired medicines, syringes, medical instruments such as scissors, blades etc

Types of solid waste

- **Agriculture waste:** includes pesticides, crops, water coming from the fields also consists of small amount of toxic chemicals.
- **Nuclear waste:** includes radioactive substances coming from reactors, fuel (uranium, thorium, plutonium etc). Its highly dangerous and requires proper disposal.
- **Hazardous waste:** includes toxic chemical, acids, corrosive, ignitable and reactive materials, gases etc.

Types of waste according to properties

- **Bio-degradable**
can be degraded (paper, wood, fruits and others)
- **Non-biodegradable**
cannot be degraded (plastics, bottles, old machines, cans, containers and others)



Municipal solid waste management costs in US\$/capita/yr (as percentage of income)

	Low-income country	Middle-income country	Industrialised country
Collection	3 to 6 (0.9 to 1.7)	9 to 21 (0.5 to 1.1)	42 to 72 (0.2 to 0.4)
Public cleansing	0.6 to 1.2 (0.2 to 0.3)	1.8 to 4.2 (0.1 to 0.2)	4.2 to 7.2 (0.02 to 0.04)
Transfer	0.62 to 1.0 (0.2 to 0.3)	1.5 to 4.5 (0.1 to 0.2)	9.0 to 12.0 (0.05 to 0.07)
Disposal	0.2 to 0.6 (0.05 to 0.2)	0.9 to 3.3 (0.05 to 0.2)	9.0 to 30.0 (0.05 to 0.2)

Composition of solid waste

- Depends on
 - Living standards
 - Lifestyle
 - Cultural and religious habits of the people
 - Availability of resources
 - Geographic location
 - Season of the year
 - Climatic condition

Selected material composition (%) of solid waste in industrialized and developing countries

City/ Country	Putrescibles including paper	Paper	Metal	Glass	Plastic, rubber	Textiles	Miscellaneous
Bangladesh	66.0-90.0	1.0-7.0	---	--	1.0-4.0	1.0-7.0	7.0-19.0
Banglore, India ¹	76.7	1.5	0.1	0.2	0.9	3.1	19.0
Kathmandu, Nepal ²	73.0	7.4	2.2	3.1	5.4	1.7	27.5
Manila, Philippines ³	60.0	14.5	4.9	2.7	8.6	1.3	16.0
Abu Dhabi ⁴	55.0	6.0	8.0	9.0	12.0	-	6.6
Qatar ⁴	70.3	17.0	4.3	3.1	15.0	-	8.9
Ibadan, Nigeria ⁵	82.6	6.6	2.5	0.6	4.0	1.4	13.2
Asuncion, Paraguay ³	73.0	12.2	2.3	4.6	4.4	2.5	20.0
Mexico City, Mexico ⁶	71.7	11.9	1.1	3.3	3.5	0.4	17.0
United Kingdom ⁷	53.0	32.0	8.0	9.0	11.0	2.0	8.6
United States ⁸	61.6	38.5	7.7	5.5	9.9	6.8	6.0
Japan ⁹	60.0	38.0	6.0	7.0	11.0	-	16.0
France ⁹	56.0	31.0	6.0	12.0	10.0	-	25.0
Switzerland ⁹	55.0	28.0	3.0	3.0	14.0	-	

Management of solid waste

Objectives:

- Public hygiene and health
- Reuse, Recovery and Recycle
- Energy Generation
- Sustainable Development
- Aesthetics

Management of solid waste

Should be compatible with the following achievable principles

- public health – decrease in diseases
- environmental well-being – to ensure more hygienic and pollution-free
- living conditions
- effective use of technologies – adaptation to cost-effective and
- environmentally clean technology
- responsiveness of stakeholders – involvement of the whole community
- costs – optimization of resources.

Management of solid waste

- Four Rs concept (Reduce, Reuse, Recycle, Refuse)



Refuse

- Use containers that are already at home
- Refuse to buy the new item when they are not required



Reuse

- If you cannot prevent waste then reuse



Recycle

- Use shopping bags made of cloth which can be use over and over again

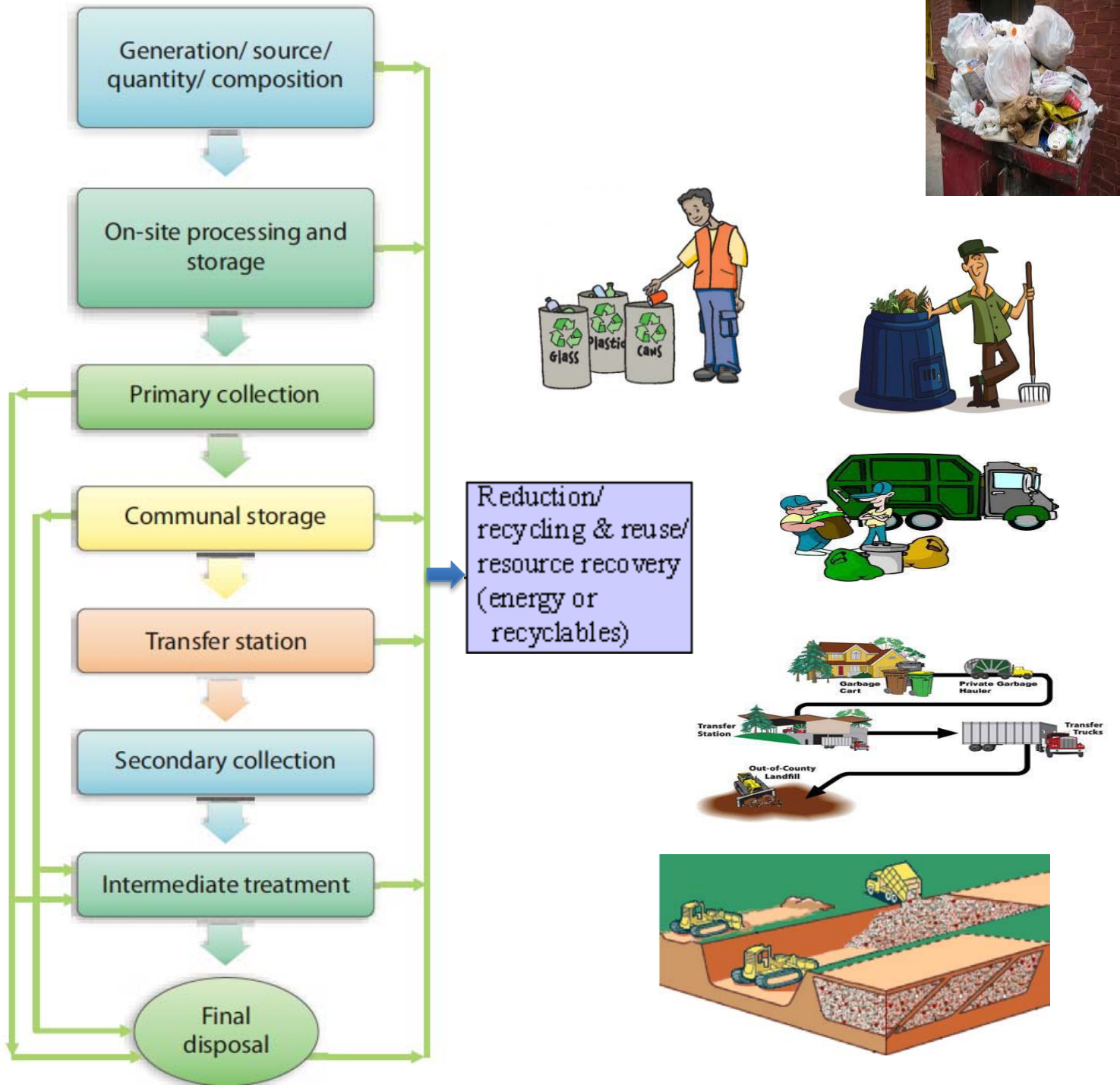


Reduce

- Reduce generation of unnecessary waste



Functional Elements of Waste Management System



Stages of solid waste management

Stage	Description
Source/ generation	Exploitation of natural resources, manufacturing of products, use of products, and material become worthless and is discarded.
On-site processing and storage Primary collection	Processing (includes separation of waste components and resource/energy recovery) and storage at or near the point of generation.
Communal storage	Picking up of waste from sources by external bodies (common in industrialised countries) and transport to transfer station (if any) or closely located disposal sites, or collection of waste by micro-enterprises/ community organisations/ voluntary organisations from source and transport to communal bins/ collection points.
Transfer station	Common in low-income countries (for all categories of waste), storage at communal bins, containers or designated places for picking up of solid waste by external organisations.
Secondary collection	Transfer of waste from small collection vehicles to large haulage vehicles.
Recycling, processing, resource recovery	Picking up of waste from secondary storage sites (communal collection points or transfer station) and transport to final disposal sites. Includes separation of waste components and resource/ energy recovery at different stages beyond the source of generation.
Disposal	Treatment plant and/or final destination of waste.

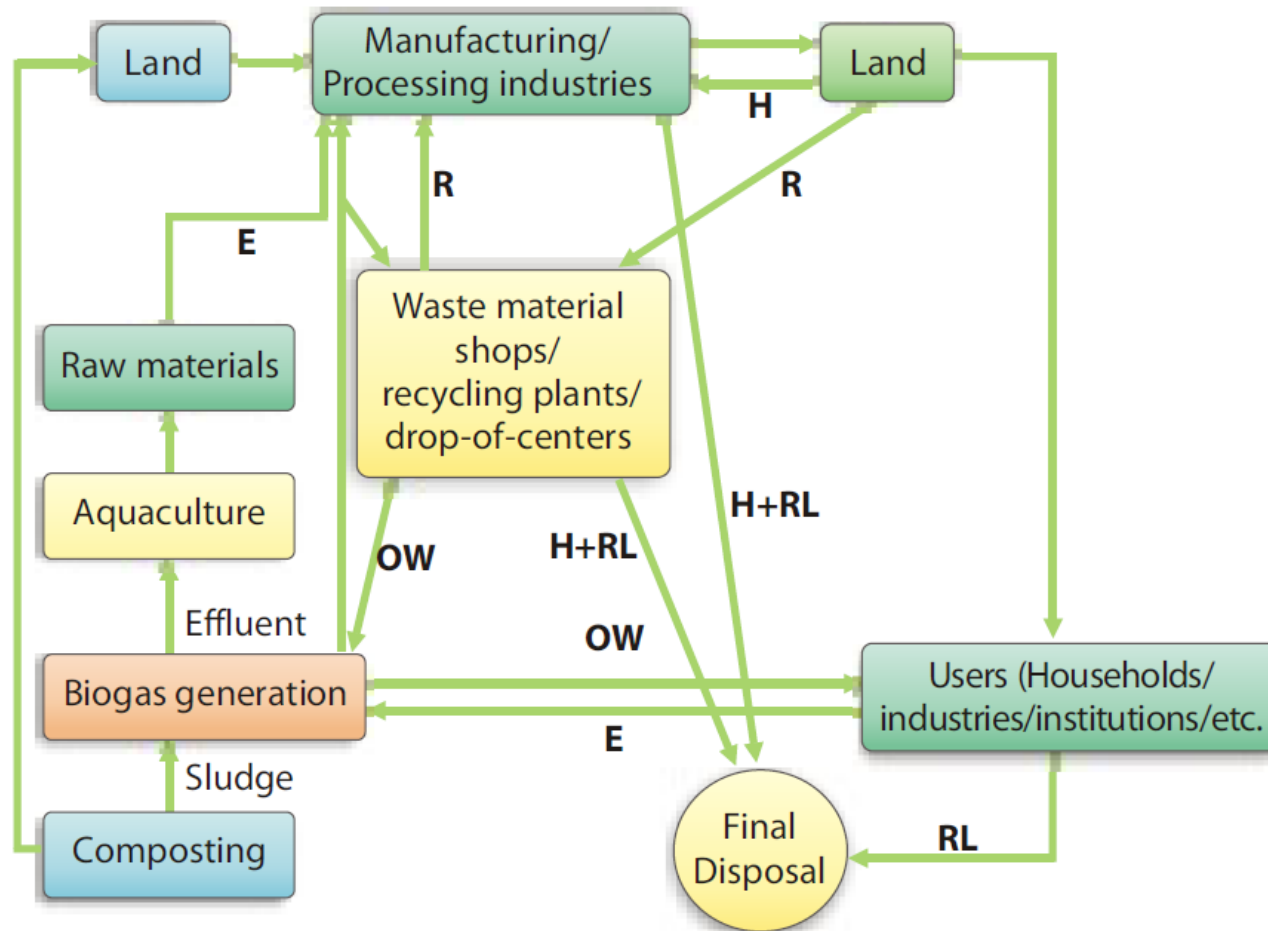
Proposed Recycling and Resource Recovery system in urban centers

Note:

E= Energy ; RL= Residual

OW= Organic waste; R= Recyclables

H= Hazardous



References

- Solid and Hazardous Waste Management - M. Habibur Rahman and Abdullah Al-Muyeed.
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- <http://www.authorstream.com/Presentation/ashu912-661146-solid-waste-management/>