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Lecture 12

Wastes and waste treatment

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What is the Waste?

Waste (also known as rubbish, trash, refuse, garbage, junk, litter, and ort) is unwanted or useless materials. In biology, waste is any of the many unwanted substances or toxins that are expelled from living organisms, metabolic waste; such as urea and sweat.

Basel Convention Definition of Wastes

"substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of the law"

Disposal means

"any operation which may lead to resource recovery, recycling, reclamation, direct re-use or alternative uses (Annex IVB of the Basel convention)"

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Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, usually known simply as Basel Convention, is an international treaty that was designed to reduce the movements of hazardous waste between nations, specially to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste. The convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate.

The Convention was opened for signature on 22nd March 1989, and entered into force on 5 May 1992.

The definition……

Produced by the United Nations Statistics Division (U.N.S.D.):

"Wastes are materials that are not prime products (that is products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded."

Kinds of Wastes

Solid wastes: wastes in solid forms, domestic, commercial and industrial wastes

Examples: plastics, styrofoam containers, bottles, cans, papers, scrap iron, and other trash

Liquid Wastes: wastes in liquid form

Examples: domestic washings, chemicals, oils, waste water from ponds, manufacturing industries and other sources

According to EPA regulations, SOLID WASTE is

Any garbage or refuse (Municipal Solid Waste)
Sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility
Other discarded material
Solid, liquid, semi-solid, or contained gaseous material from industrial, commercial, mining, and agricultural operations, and from community activities

http://www.epa.gov/epaoswer/osw/basifact.htm#solidwaste

Classification of Wastes according to their Properties

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

Classification of Wastes according to their Effects on Human Health and the Environment

Hazardous wastes
Substances unsafe to use commercially, industrially, agriculturally, or economically and have any of the following properties- ignitability, corrosivity, reactivity & toxicity.

Non-hazardous
Substances safe to use commercially, industrially, agriculturally, or economically and do not have any of those properties mentioned above. These substances usually create disposal problems.

Classification of wastes according to their origin and type

Municipal Solid wastes: Solid wastes that include household garbage, rubbish, construction & demolition debris, sanitation residues, packaging materials, trade refuges etc. are managed by any municipality.

Bio-medical wastes: Solid or liquid wastes including containers, intermediate or end products generated during diagnosis, treatment & research activities of medical sciences.

Industrial wastes: Liquid and solid wastes that are generated by manufacturing & processing units of various industries like chemical, petroleum, coal, metal gas, sanitary & paper etc.

Agricultural wastes: Wastes generated from farming activities. These substances are mostly biodegradable.

Fishery wastes: Wastes generated due to fishery activities. These are extensively found in coastal & estuarine areas.

Radioactive wastes: Waste containing radioactive materials. Usually these are byproducts of nuclear processes. Sometimes industries that are not directly involved in nuclear activities, may also produce some radioactive wastes, e.g. radio-isotopes, chemical sludge etc.

E-wastes: Electronic wastes generated from any modern establishments. They may be described as discarded electrical or electronic devices. Some electronic scrap components, such as CRTs, may contain contaminants such as Pb, Cd, Be or brominated flame retardants.

Waste is classified as hazardous if:

- it is listed in the Hazardous Waste List;
- it is mixed with or contaminated by any of the components listed in the Hazardous Waste List;
- it should display one or more of the hazardous properties.

Cause of hazard – occurence of dangerous chemicals and their mixtures.

Most dangerous – hazardous waste from industry, especially from chemical industry and other industries dealing with chemical processes (metallurgy, pharmacy, petrochemistry, glass, machinery, etc.) containing mixtures of chemicals often of unknown composition and origin.

Treatment of them requires special approaches with higher cost and health and environmental risk.

Effects: Hazardous waste is a waste which may pose a substantial present or potential hazard to human health or the environment when impropoperly treated, stored or disposed of, or otherwise mismanaged.

Council Directive 91/689/EEC of 12 December 1991 on hazardous waste:

For the purpose of this Directive 'hazardous waste` means:
- wastes featuring on a list to be drawn up in accordance with the procedure laid down in Article 18 of Directive 75/442/EEC on the basis of Annexes I and II to this Directive, not later than six months before the date of implementation of this Directive. These wastes must have one or more of the properties listed in Annex III. The list shall take into account the origin and composition of the waste and, where necessary, limit values of concentration. This list shall be periodically reviewed and if necessary by the same procedure,
- any other waste which is considered by a Member State to display any of the properties listed in Annex III. Such cases shall be notified to the Commission and reviewed in accordance with the procedure laid down in Article 18 of Directive 75/442/EEC with a view to adaptation of the list.

Properties of wastes which render them hazardous*
explosive, oxidizing, highly flamable, flamable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, teratogenic, mutagenic, substances and preparations which release toxic or very toxic gases in contact with water, air or an acid, substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above, ecotoxic

**see appendix at the end of presentation*

The total amount of waste produced in the European Union is currently about 1 800 000 000 tonnes per year. Approximately 90 000 000 tonnes of this waste is hazardous.

Czech Republic in 2010*

	total (tons)	category of waste	
		hazardous (tons)	other (tons)
production of waste	24 123 560	1 370 679	22 752 881
manufacturing industry (including chemical industry)	4 202 463	550 376	3 652 088
waste and water management	2 507 187	550 690	1 956 497
municipal waste	3 334 240	5 028	3 329 212

* Statistical Yearbook of the Czech Republic

The approach used to develop systems to treat and dispose of industrial wastes is distinctly different from the approach used for municipal wastes.

There is a lot of similarity in the characteristics of wastes from one municipality, or one region, to another. Best approach to designing a treatment system for municipal wastes is to analyze the performance characteristcs of many existing municipal systems and deduce an optimal set of design parameters for the system under consideration.

In the case of industrial wastes, however, few industrial plants have a high degree of similarity between products produced and waste generated. Therefore, emphasis is placed on analysis of the wastes under consideration, rather than on what is taking place at other industrial locations.

Wastes from industries are customarily produced as:

- **liquid wastes (process wastes, which go to an on-site or off-site wastewaster treatment systems),**
- **solid wastes (including hazardous wastes, which include some liquids)**
- **air pollutants**

These wastes are managed and regulated differently depending on the characteristics of the wastes and process producing them. The three phases of wastes are closely interrelated, both as they are generated and managed by individual industrial facilities. Industrial wastes that are discharged to neither air nor water are classified as solid, industrial or hazardous wastes.

Solid wastes disposed of in the ground can influence the quality of groundwater and surface waters by way of leachate entering groundwater and traveling with it through the ground, then entering a surface water body with groundwater recharge.

Volatile organics in that recharge water can contaminate the air. Air pollutants can fall out to become surface water or groundwater pollutants, and water pollutants can infiltrate the ground or volatilize into the air.

Additionally, waste treatment proces can transfer substances from one of the three waste categories to one or both of the others.

Waste treatment or disposal systems themselves can directly impact the quality of the air, water or ground.

Chemical methods - changing the chemical structure involve exchanging or sharing electrons between atoms.

Physical methods - without necessarily changing the chemical structure of substances.

Biological methods - involve living organisms like bacteria or other microorganisms using organic or, in some instances, inorganic substances for food. In so doing , the chemical and physical characteristcs of the organic and/or inorganic substances are changed. In being so used, complex organic molecules are systematically broken down, than reassembled as new cell protoplasm.

Thank you for your attention...

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