ENVE 430
HAZARDOUS and SPECIAL WASTE MANAGEMENT

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Chapter 1

Hazardous Waste: Sources of Generation and Classification

Hazardous Waste

- Hazardous: posing a substantial present or potential danger to human health or environment
- Term hazardous waste gained acceptance in the early 1970s in the US.
- Formerly hazardous waste was referred to by *special industrial* waste or *chemical* waste.
- In general, hazardous waste is regulated as a subset of solid waste.

Hazardous Waste

- However, many liquids are also considered HW, typically because of their high strength or because they are a mixture of hazardous waste with water.
- Further, many liquid wastes are containerized upon generation and transported as such, thereby making them solid-like.
- Thus, defined hazardous waste can include *solids*, *sludges*, *liquids* and *containerized gases*.

Hazardous Waste

- A waste can be hazardous if it is;
  - ignitable
  - flammable
  - reactive
  - explosive
  - corrosive
  - radioactive
  - infectious
  - irritating
  - sensitizing
  - bioaccumulative

Hazardous Waste

- Hazardous waste definition of United Nations Environment Program (UNEP 1985):

  Wastes other than *radioactive* and *infectious* wastes which, by reason of their chemical activity or toxic, explosive, corrosive or other characteristics, cause danger or likely will cause danger to health or the environment, whether alone or when coming into contact with other waste.

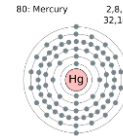
Historical Roots

- Since the early 1980s, hazardous waste is one of the leading environmental issues.
- Generally it dominates the others because the potential for some wastes to cause a toxic reaction in humans is preeminent among public concern.
- Environmental contamination by toxic substances from waste or other sources has a long history.

Landmark Episode: DDT

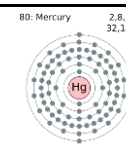
- Extensively used as agricultural insecticide.
- A potential genotoxic and endocrine disrupting compound and bioaccumulates in the body fat.
- Its use was banned in 1972 in US after Rachel Carson's publication of *Silent Spring* in 1962.
- This book documented detrimental effects of DDT on environment, particularly on birds and inspired widespread public concerns with pesticides.

Landmark Episode: Mercury

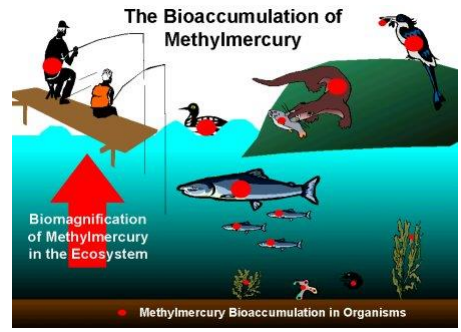


- Has different toxicologic properties depending upon its chemical state.
- Mercury salts led to neurologic disorder.
- Methyl mercury, caused paralysis and sensory loss along Minamata Bay in Japan.
- Methyl mercury from a chemical plant was discharged and then bioaccumulated in shellfish.

Landmark Episode: Mercury



- Because shellfish were the major protein source for local population, this situation caused an epidemic.



- It was the Minamata disaster in the late 1960's that heightened global awareness of industrial pollution.

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Landmark Episode: PCB & PBB

- PCBs (polychlorinated biphenyls) were produced at about 50.000 tons per year during the 1960s and 1970s.
- Used as transformer coolant, plasticizer and in manufacturing of carbonless paper.
- Accidental contamination of rice cooking oil in Japan and Taiwan in the 1960s and 70s exposed thousand of Asians to high PCBs' concentrations.

Landmark Episode: PCB & PBB

- About the same time in Michigan, contamination of cattle feed by PBBs (polybrominated biphenyls) caused a widespread human exposures via milk and other dairy products.
- PBBs were found in mothers' breast milk.
- Afflicted cattles were rendered and then used to prepare chicken feed; thousands of humans were exposed to PBBs through eggs & egg products.

Landmark Episode: Love Canal

- It is a symbol of environmental contamination by hazardous waste.
  - Part 1
  - Part 2

Landmark Episode: Times Beach

- It is another classic example of HW pollution and mismanagement over a period of time.
- The dioxin at Times Beach was a by-product emitted from a chemical plant in Verona, Missouri.
- In the early 1970s, the dioxin at the plant was mixed with used oil by a waste oil recycler to spray onto the roads to keep the dust levels low.
- Thousands of gallons of this oil were sprayed, potentially causing animals in the area to die and the children to become sick.

Landmark Episode: Times Beach

- By 1981, it is reported that 75 horses, several dogs, cats, chickens, rodents and birds had perished.
- The town was officially closed in April 1985.
- Children born during the time of the contamination were born with immune cell alterations.
- Numerous other illnesses, including cancer, were traced to the dioxin.
- The clean up work cost over 200 million dollars.

Regulations

US laws dealing with hazardous wastes:

- Resource Conservation and Recovery Act of 1976 (RCRA) Subtitle C, establishes a system for controlling hazardous waste from the time it is generated until its ultimate disposal - in effect, from “cradle to grave”
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (known as Superfund) is primarily concerned with past practices including cleaning up abondoned hazardous waste sites.

Regulations

EU directives related to hazardous wastes:

- Waste Framework Directive (2008/98/EC) articles 17-20 provides labelling, record keeping, monitoring and control obligations from the "cradle to the grave".
- Directive 91/689/EEC supplements the Waste Framework Directive by setting new controls on HW management, specifically requirements related to traceability, forbidding the mixing of HW with other waste and the obligation to inform the Commission of waste which has hazardous properties, but which is not listed as such.

Regulations

Turkish legislations and EU counterparts:

- TR: Regulation on Waste Management 'RWM' (02.04.2015-29314)

  EU: Waste Framework Directive (2008/98/EC)
- TR: Regulation on Control of Hazardous Waste 'RCHW' (14.03.2005-25755)

  EU: Directive 91/689/EEC on hazardous waste

Regulations

Other Turkish legislations related to hazardous waste:

- Regulation for Control of Waste Oils (30.07.2008-26952)
- Regulation on the Control of used Batteries and Accumulators (31.08.2004-25568)
- Regulation for Control of Medical Waste (24.06.2007-26562)
- Regulation on Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls (27.12.2007-26739)
- Regulation on Incineration of Waste (06.10.2010-27721)
- Regulation on Landfilling of Waste (26.03.2010-27533)

Classification

Determining if a waste is hazardous typically occurs in either of two ways:

1. Laboratory tests may indicate that it exhibits one or more of the characteristics deemed to make a waste hazardous
2. It may be on a list of specific wastes compiled by the government because it is known or suspected of having the potential to exhibit hazardous characteristics

Classification-Testing

Waste Framework Directive (2008/98/EC)

Annex III: Properties of waste which render it hazardous

- H1 Explosive
- H2 Oxidizing
- H3-A Highly flammable
- H3-B Flammable
- H4 Irritant
- H5 Harmful
- H6 Toxic
- H7 Carcinogenic
- H8 Corrosive
- H9 Infectious

Classification-Testing

Annex IIIA (Cont'd):

- H10 Teratogenic (induce non-hereditary malformations or increase their incidence)
- H11 Mutagenic
- H12 Substances & preparations which release toxic gases in contact with water, air or an acid.
- H13 Substances & preparations capable of yielding another substance with hazardous characteristics.
- H14 Ecotoxic: substances and preparations which present immediate or delayed risks for the environment.

Classification-Lists

- RGPWM (05.07.2008-26927) Annex IV-List of Wastes[1] is divided into 20 chapters many of which are industry-based but some are based on materials and processes.
- Each of them has a 2-digit chapter code from 01 to 20.
- Each chapter has one or more sub-chapters identified by 4-digit codes. First 2-digits are the chapter code.
- Within these sub-chapters there are codes for individual waste streams, each of which is assigned a 6-digit code.
- Hazardous wastes also have an asterisk (*)

[1] EU counterpart: European List of Waste (2000/532/EC)

Classification-Lists

- RGPWM (05.07.2008-26927) Annex IV-LOW[1]

Table. Extract from Chapter 3 of the LOW

03	**WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD**	
03 01	**Wastes from wood processing and the production of panels and furniture**	
03 01 01	Waste bark and cork	
03 01 04*	Sawdust, shavings, cuttings, wood, particle board and veneer containing dangerous substances	M
03 01 05	Sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04	
03 01 99	Wastes not otherwise specified	
03 02	**Wastes from wood preservation**	
03 02 01*	Non-halogenated organic wood preservatives	A
03 02 02*	Organochlorinated wood preservatives	A
03 02 03*	Organometallic wood preservatives	A
03 02 04*	Inorganic wood preservatives	A
03 02 05*	Other wood preservatives containing dangerous substances	M
03 02 99	Wood preservatives not otherwise specified	

[1] EU counterpart: European List of Waste (2000/532/EC)

Classification-Lists

- There are two types of HW entries in the list;
  - Mirror entries (M) – used where waste description contains a reference to dangerous substances e.g. ‘03 02 05* - other wood preservatives containing dangerous substances’, or a specific reference to one particular dangerous substance, e.g. ‘17 06 01* - insulation materials containing asbestos’.
  - Absolute entries (A) – so called because they are always hazardous regardless of the composition of substances in the waste.

Identification of a waste in LOW

- Identify the source generating the waste in Chapters 01-12 or 17-20 and identify the appropriate 6-digit code.
- A specific production unit may need to classify its activities in several chapters.
- A car manufacturer may find its wastes listed in Chapter 12 wastes from shaping & surface treatment of metals, Chapter 11 inorganic wastes containing metals from metal treatment and the coating of metals and Chapter 08 wastes from the use of coatings, depending on the different process steps.

Generation

- HWs can originate from a wide range of industrial, agricultural, commercial and household activities.

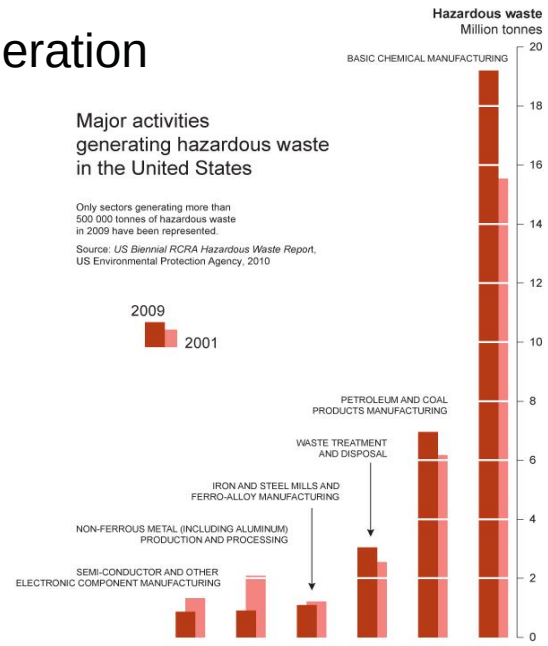
Primary HW generators are;

- Heavy Industries (chemical, leather, paper, metal, etc.)
- Universities & laboratories
- Hospitals
- Households (dyes, solvents)
- Farmers (pesticides & fertiizers)
- Military (explosives)

Generation

- Manufacturing Sources
  - spent material
  - by products
  - sludges from treatment
  - product that becomes waste
- Household Hazardous Wastes
  - Paint
  - Cleaners
  - Car oil
  - Hobby chemicals e.g. photography

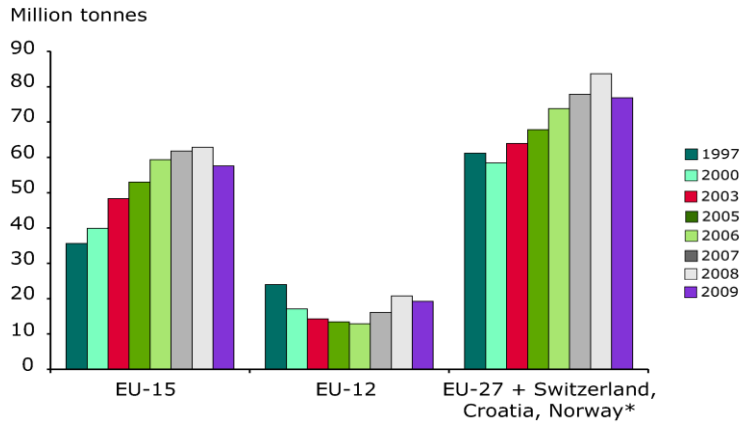
Generation



Generation

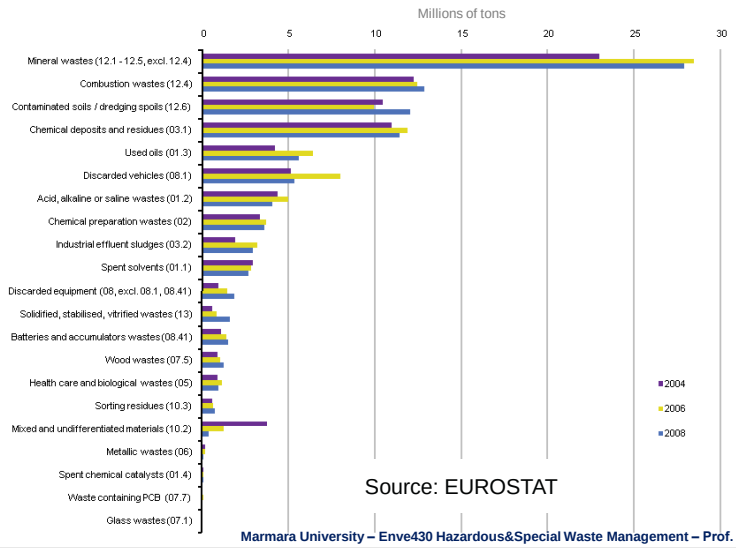
- The generator can manage the HW;
  - on-site or
  - transport it off-site for treatment, disposal or recycling
- Waste managed on site where it is generated is termed on-site waste
- Waste managed at a site other than where it is generated is termed off-site waste and requires the use of waste tracking form.

HW generation in EU (1997-2009)



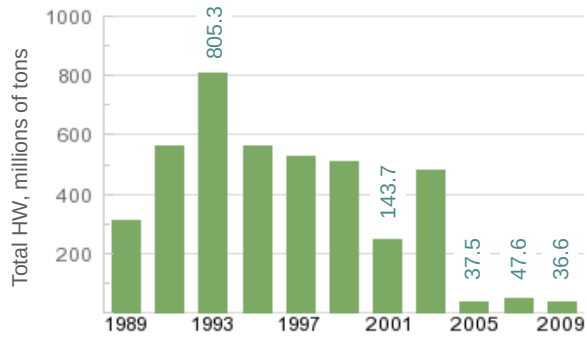
Source: EUROSTAT

HW generation in EU by waste category (2004-2008)



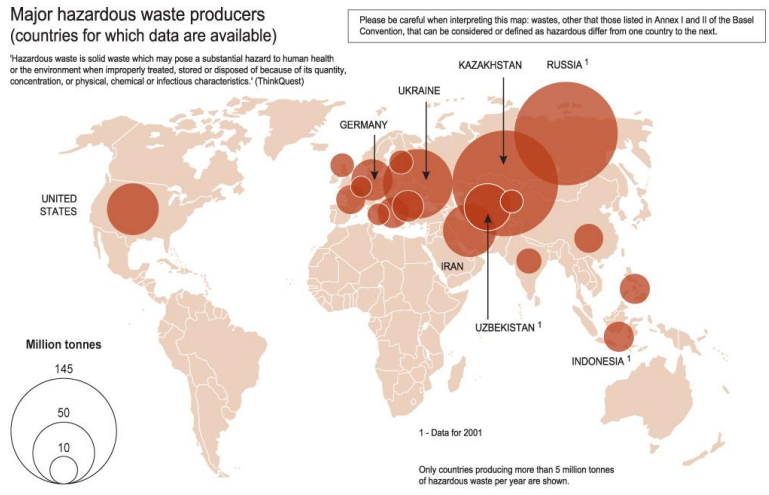
Source: EUROSTAT

HW generation in USA



Source: USEPA

Major HW generating countries



Sources: Basel Convention, 2011 (data for 2007 or latest year available); *Environmental Indicators*, United Nations Statistics Division, 2009; Eurostat 2011 (data for 2008 or latest year available); Philippe Chalmin, Catherine Gaillochet, *Du rare à l'infini. Panorama mondial des déchets 2009*.

HW generation in Turkey

Reference	Estimation, ton/year
TurkStat, 2004	1.20 million
Envest[1], 2005	2.60 million
HAWAMAN[2], 2009	1.30 million
MoEU[3], 2010	0.79 million

[1] Environmental Heavy-Cost Investment Planning in Turkey Project
[2] LIFE 'HAWAMAN' PROJECT TCY/TR/000292
[3] Ministry of Environment and Urbanization