

# Solid and Hazardous Waste

Minato Nakazawa  
<minato-nakazawa@umin.net>

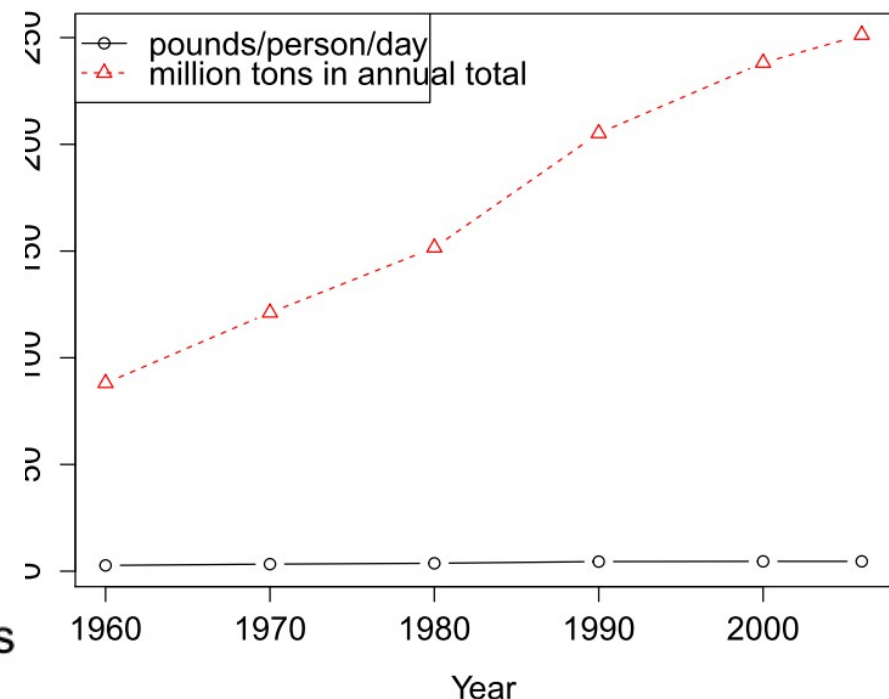
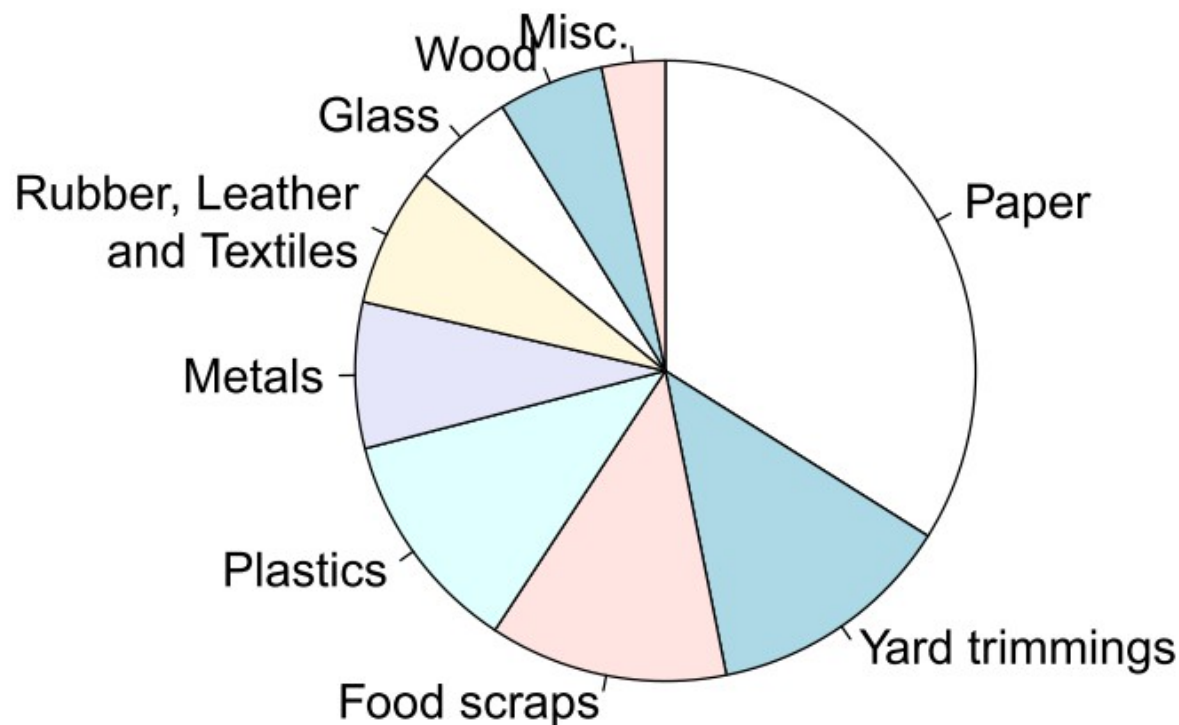
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# What is waste?

- Difficult to define. There were long history of controversial discussion.
- In general, "Value-lost goods" accompanying human subsistence and economic activities
  - Subjective
  - Changeable with time passing
- It's more in urban than rural, resulting in pollution
  - Raw garbage and human waste (urine and feces)  
-> source of fertilizer in rural, but solely waste in urban
  - Various materials gather into urban area
  - Various industries make various waste
  - More populated -> more human waste
- Urbanization/Modernization made waste increased even in rural area -> regulations by laws are required
- Classification of solid waste in USA: Municipal solid waste / Special waste / Hazardous waste

# Municipal solid waste

- Consists of everyday items that are commonly generated from homes. More than half of USA municipal solid waste consists of containers, packaging, nondurable goods (newspapers, magazines)
- Recent laws prohibit the yard trimmings as municipal solid waste: those are to be recycled (composted)
- USA municipal solid waste increased by 70% from 1960 to 2006.
- Historically medieval London/Paris were full of disposals. Current cities in developing countries are also full of disposals in the road-side.



# Special waste - with its own rules and regulations

- **Medical waste**: generated from health care treatment or research facilities, contacted with body fluids (thus probably infectious)
  - Soiled or blood-soaked bandages, Culture dishes, Items such as gloves, gowns, and scalpels used during surgery, Needles used to give injections/drawing blood, Tissues
- **Construction debris**: generated from construction and demolition of buildings
- **Asbestos**: extensively used in the past, but most uses in USA have been banned.
- **Mining waste**: the disposal of this leftover rubble and liquid material is regulated both by solid waste laws and regulations, by water pollution control
- **Agricultural waste**: Food production is industrialized in developed countries. Concentrated Animal Feed Operation (CAFO) can bring thousands of poultry, swine or cattle together in confined spaces, where becomes large scale source of agricultural waste as air emission and animal waste
- **Radioactive waste**: Radioactive chemicals: low-level and high-level. In USA, high-level radioactive waste is permanently deposited in Yucca Mountain, Nevada (but most is stored temporarily in spent fuel pools and in dry cask storage facilities). In Japan, it is planned to be recycled (almost impossible).
- **Sewage sludge**: Before waste water is discharged, it is treated at sewage farm: One of main by-product is sewage sludge, partly disinfected to be a compost.
- **Electronic waste (e-waste)**: Unwanted, obsolete, unusable electronic equipment such as computers, televisions, VCRs, DVD players, cell phones.
  - Heavy metals, Rare metals, Brominated flame retardants
  - Reuse, recycle and proper dispose are important. Partly exported to developing countries..

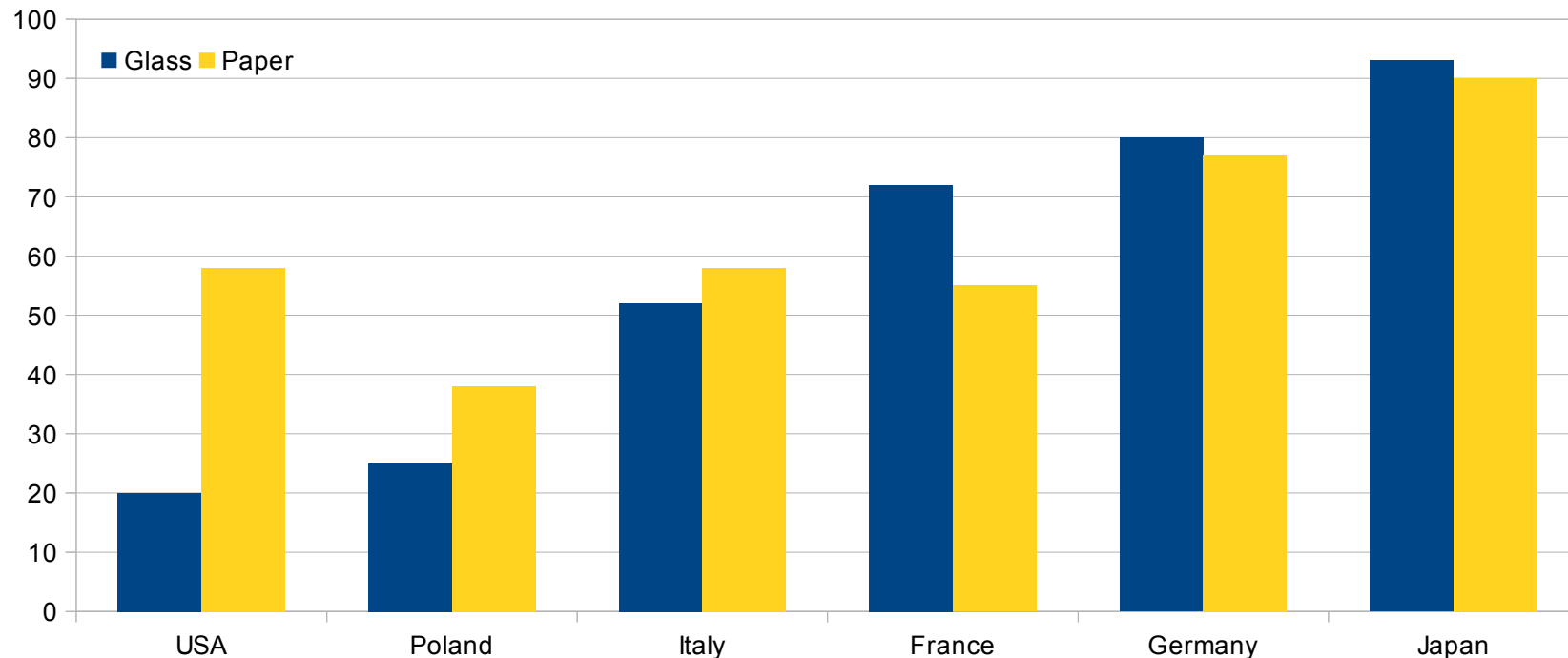
# Hazardous waste

- Simply defined as waste with properties that make it capable of harming human health or the environment.
  - For regulatory purpose, this definition is insufficient.
  - In USA, Environmental Protection Agency (EPA) developed specific criteria to define hazardous waste.
    - Approx. 500 specific industrial waste
    - Standardized test criteria to determine a waste's ignitability, corrosiveness, reactivity, toxicity.
  - In 2005, approx. 38 million tons of hazardous waste was generated in USA. Highest in the world.

# How to prevent waste problem

- Primary prevention of waste
  - Reduce, reuse and recycle: 3R strategy
  - Recycle of municipal solid waste has steadily increased in the USA, approx. 32.5% of waste is recycled. Other industrialized nations tend to have a higher rate of recycling.

Zeller T: Recycling: The big picture. *National Geographic*, Jan 2008, 82-87



# Waste treatment/disposal

- The purpose of treatment is: reducing sizes as much as possible and detoxification
- The disposals are
  - Sanitary landfill: an adequate area to provide waste disposal capacity within a reasonable time period, an adequate elevation/separation to regional ground water, available soil, adequate buffer from surrounding populations: Protecting ground water from leachate is important.
  - Incineration  
<http://www.youtube.com/watch?v=Bb-RoAWv3ro>
  - Deep well injection  
[http://water.epa.gov/type/groundwater/uic/wells\\_drawings.cfm](http://water.epa.gov/type/groundwater/uic/wells_drawings.cfm)
  - Other technologies

# Health concerns

- See also, Grant K, Goldizen FC, Sly PD, et al. (2013) Health consequences of exposure to e-waste: a systematic review. *Lancet*, published online Oct. 30, 2013, [http://dx.doi.org/10.1016/S2214-109X\(13\)70101-3](http://dx.doi.org/10.1016/S2214-109X(13)70101-3)
- At least five kinds of health hazards may be generated by solid and hazardous wastes
  - Infectious disease risks from poorly managed solid waste
  - Contamination of drinking water and soil by biological, chemical and mining waste
  - Gas migration and leachate discharges from landfills
  - Emissions of air pollutants from incinerations
  - Contamination of food by waste chemicals that escape into the environment