"Overview of the problem – Health, Ecosystem & Sources"

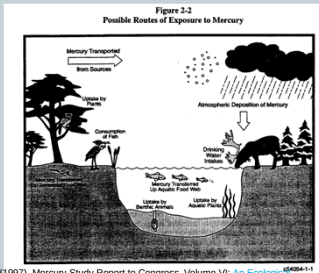
Mercury

Hg Mercury
Atomic Number: 80
Atomic Mass: 200

Carol Ann Gross-Davis, MS, PhDc
EPA R3, Air Protection Division

Mercury - What is it and where it comes from

- Forms of Mercury - Elemental, Inorganic and Organic
  - *Methylmercury*
- Sources of Mercury
  - Natural sources
  - **Anthropogenic**
    - Combustion
    - Manufacturing
    - Mining
  - Re-mobilization

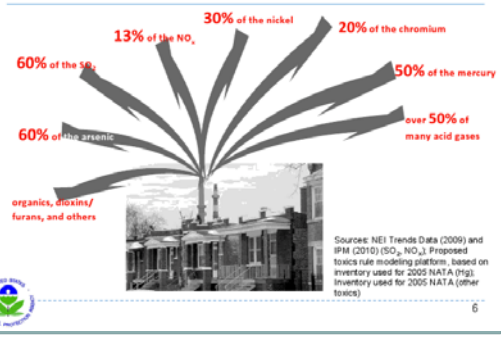


EPA (U.S. Environmental Protection Agency). (1997). Mercury Study Report to Congress. Volume VI: An Ecological Assessment for Anthropogenic Mercury Emissions in the United States

Uses

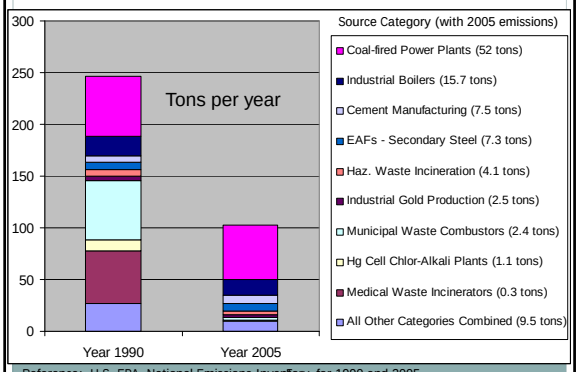
- Amalgams – alloys w/ other metals (dentists use a silver–mercury amalgam to fill cavities in teeth)
- Industrial Hg uses: drugs and chemicals, mercury-vapor lamps, arc rectifiers, power-control switches, barometers, thermometers, chemical reactions, gold mining

In the U.S., Power Plants Emit:



6

Mercury Air Emissions Estimates for 1990 and 2005 in U.S.A.

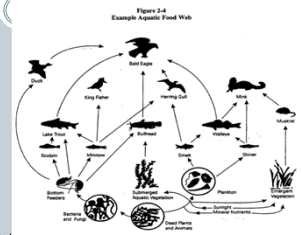


Reference: U.S. EPA, National Emissions Inventory, for 1990 and 2005

5

Exposure to Mercury

- Environmental Effects
  - Ecosystems
    - aquatic
    - terrestrial
  - Bioaccumulation
- Health Effects
  - Consumption of fish
  - Dental amalgams
  - Spills, Products, Airborne Mercury
  - *Minamata Disease*



EPA (U.S. Environmental Protection Agency). (1997). Mercury Study Report to Congress. Volume VI: An Ecological Assessment for Anthropogenic Mercury Emissions in the United States

Disclaimer: The contents of this presentation were not reviewed by the US Environmental Protection Agency.

Potential for exposure

- Occurs naturally in soil and in the atmosphere from volcanic emissions
- From industrial use, enters air/water as pollution, exposes workers/ population
- Formerly used in many medications, causing direct exposure, e.g., thimerosal (Merthiolate), diuretics, topical preparations

Hg – inorganic & organic

Hg^0 = elemental (metallic)

$Hg^{+, ++}$ = inorganic salts

Organic – e.g., methyl mercury

$Hg — CH_3$

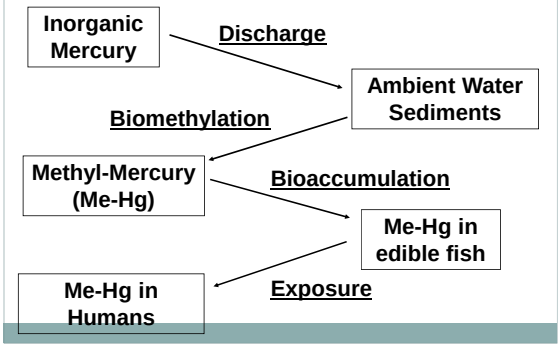
Elemental mercury

- Valence state = 0
- Very toxic to: CNS, PNS, kidneys, lungs
- But….**very poorly absorbed by the GI tract so ingestion poses little risk**
- Inhalation route = higher exposure
- Mercury in dental fillings is elemental Hg

Hg vapor, current

- Exposure occasional, many settings
  - Efforts made to remove elemental Hg from American workplaces and consumer products
  - Remains a hazard: workers, and general public
- Utility workers – natural gas delivery systems
  - Gas-pressure regulators, thermostats, installed 1950's – 1970's (millions of homes/ businesses)
  - Spills occur when handling the equipment (e.g., during in-home repairs; transporting equipment)
  - Publicized spills in homes: Chicago, Philadelphia

Biotransformation of mercury



Mercury health effects

w/ increasing urinary concentrations ≥ 20 µg/L

- 20 – 100 – abnormal psychometric test results, nerve conduction velocities
- 100 – 500 – tremor, memory loss, irritability, depression, other CNS abnormalities, renal impairment, (peripheral neuropathy?)
- 500 – 1000 – overt CNS disorder, stomatitis, renal failure, severe tremor, perip. neuropathy

Ref: ATSDR, 1999

Disclaimer: The contents of this presentation were not reviewed by the US Environmental Protection Agency.

The Mad Hatter

1865 ILLUSTRATION BY JOHN TENNIEL

Twinkle, twinkle, little bat
How I wonder what you're at

Methylmercury

- Alkyl-mercury – far more toxic than other forms; well absorbed by ingestion
- Can be measured in blood and hair
- Me-Hg: slowly eliminated, ½-life of 2 to 3 months (mean = 70 days)

Methylmercury in fish

- Bacteria biotransform elemental mercury into methyl mercury (Me-Hg)
- Mollusks, crustaceans, plankton, etc., eat bacteria
- Me-Hg poorly eliminated; concentrates up the food chain… biggest and oldest predators at the top of ecosystem have the highest concentrations
- Me-Hg is distributed evenly throughout the fish, not changed by cooking

How much Hg is toxic?

- National Academy of Sciences. Toxicologic effects of methylmercury. Washington, DC: National Research Council, 2000
- Reference Dose (RfD) recommended to EPA is 0.1 micrograms/kg/day
  ("safe" daily intake to avoid toxicity)

How much Hg is toxic? (2)

- To comply with EPA reference dose:
  - Do not eat fish with levels $\geq$ 1 part per million (ppm)
  - Limit fish with levels > 0.2 ppm to once per week

Do vaccines containing thimerosal cause autism?

- Some parents say "yes;" science says "no"
- Hviid A, et al. Association between thimerosal-containing vaccine and autism (Denmark registry) JAMA October 1, 2003;290:1763-6 – totally negative
- Inst. of Medicine: Immunization Safety Review: Vaccines and Autism Report: **No Association**, May 2004
- AAP, CDC – **no association**
- Paul Offitt, book, 2008 – **no association**

Disclaimer: The contents of this presentation were not reviewed by the US Environmental Protection Agency.

Acknowledgements

Special Thanks to

Curtis E Cummings, MD MPH EOH Department, School of Public Health
Drexel University

Disclaimer: The contents of this presentation were not reviewed by the US Environmental Protection Agency.