OCCUPATIONAL HEALTH

Chemical Hazards

5TH MAY 2024

PROF. DR. WAQAR AL-KUBAISY

Chemical hazards

Occupational exposure to Toxic Metals

"heavy metals"

PROF DR. WAQAR AL – KUBAISY

Toxic metals,

- ✓ Toxic metals, including "heavy metals,"
- ✓ are individual metals and metal compounds
- ✓ that negatively affect people's health.
- ✓ very small amounts many of these metals, are necessary to support life.
- ✓ However, in larger amounts, they become toxic.
- ✓ They may build up in biological systems and become a significant health hazard.

Most hazardous:

Lead
Mercury
Arsenic
Cadmium
Beryllium
Hexa -valent Chromium

Other toxic metals:

- Aluminum
- Antimony
- Cobalt
- Copper
- Iron
- Manganese
- Molybdenum
- Nickel
- Selenium
- Silver
- Tin
- Vanadium
- Zinc

OCCUPATIONAL HEALTH

Chemical Hazards
Toxic Metals

MERCURY POISONING


Iraq mercury contaminated seed grain – CP

5TH MAY 2024

PROF DR. WAQAR AL – KUBAISY

MERCURY POISONING

- **Mercury**
- **is a naturally occurring metal, that is in many products everyday, although in tiny amounts**

- **Small amounts of mercury are present in everyday foods and products, which may not affect our health.**

Mercury itself is naturally occurring,

- **but the amounts in the environment** have **been on the rise from industrialization**
- **It is often a by-product of industrial processes, such as burning coal for power.**

- Mercury is a liquid at room temperature and

Cont. Mercury Poisoning

- Mercury is a liquid at room temperature and
- readily vaporizes into the air around it.
- Vaporized mercury can make its way into the rain, soil, and water and
- where it poses a risk to humans. plants, animals, like fish
- Consuming foods with mercury is the most common cause of this type of poisoning.
- The most common cause of mercury poisoning is from consuming too much methyl mercury or organic mercury which is linked to eating seafood.
- Children and unborn babies are the most vulnerable to the effects of mercury poisoning

- Ingesting or coming into contact with too much mercury can cause poisonous
- Mercury is a type of toxic metal that comes in different forms within the environment

Cont. …Mercury Poisoning

- **Ingesting or coming into contact with too much mercury can** cause **poisonous**
- Mercury is a **type of toxic metal** that **comes in different forms within the environment**

- **Mercury and its compounds exist in three general forms:**

I. **Elemental** (or metallic).

II. **Inorganic:** Mercury can combine with other elements (mainly **chlorine, sulfur, and oxygen**) to form **Inorganic Mercury compounds**.

III. **Organic:** Mercury may combine with **carbon or carbon-containing substances** to make **Organic Mercury compounds**.

- **The difference lies in how** it is

✓

Cont. Mercury Poisoning

- **The difference lies in how** it is
  - ✓ **absorbed,** the
  - ✓ **clinical signs** and **symptoms,** and
  - ✓ **Response to treatment** modalities.

- **Elemental mercury is a heavy liquid.**
  - **13.6 times the weight of water**
  - Occurs naturally in **soil** and in the **atmosphere** from volcanic emissions الانبعاثات البركانية
  - Evaporates at room temperature
  - The vapor **evaporates** from the liquid and
  - **evaporation** occurs more **rapidly** when the liquid is **heated.**

Organic compounds

Cont. Mercury Poisoning

Mercury exist in 3 forms
Elemental (or metallic).
Inorganic:
Organic:

❖ **Organic** compounds are **further divided** between

- **alkyl (carbon-chain)** and
- **aryl (aromatic ring) groups.**
- **Although all mercury compounds are toxic**
- the **small-chain alkyl compounds are the most hazardous**

❑ Mercury compounds vary in toxicity, so

❑ OSHA provides standards for each.

❑ It is important to clarify which category a compound belongs to

- before comparing it with a standard or determining its relative toxicity.

Uses and occupations at risk

- Mercury is used mainly for the electrolytic production of

  chlorine gas and caustic soda الصودا الكاوية,
  from brine (chlor-alkali industry).
  batteries , and electrical switches

- Also mercury compounds are used in:
  - pigments;
  - as a catalyst explosives
  - pharmaceuticals
  - chemical applications

- Mercury is commonly found in thermome

Mercury is commonly found in **thermometers**

- Mercury is commonly found in **thermometers, manometers, barometers, gauges, valves, switches, batteries**, and **high-intensity discharge (HID) lamps.**
- Also used **in amalgams for dentistry**,
- **preservatives, heat transfer technology**, **and lubricating oils**
- mercury compounds **used as a seed disinfectant**, **on food crops**,

As a **biocide**، مبيد بيولوجي,

- **in paints** and in **paint formulations**,
- as a **coating for mirrors**, for the
- **manufacture of certain types of glass**,
- as a **fungicide in paper** (has been discontinued or banned).

Permissible Exposure Limits

The Occupational Safety and Health Administration (OSHA) standard for

- **Organo alkyl mercury compound is 0.01 mg /cubic meter of air for TWA8**
- **with a ceiling level of 0.04 mg/cubic meter of air for TWA8**

(TWA8). 8-hour total weight average

- **0.01=14.8**
- **0.04=59.2**

Workers at Risk of being exposed to Mercury:

Some examples

- Workers in facilities where electrical equipment is manufactured
- Workers in fluorescent light bulb (CFL) recycling facilities
- Workers in facilities where automotive parts are manufactured
- Workers in chemical processing plants that use mercury
- Workers in medical, dental, or other health services who work with equipment that contains mercury
- Dentists and their assistants when breathing in mercury vapour released from amalgam fillings

Mercury poisoning can result from

I. vapour inhalation,
II. ingestion,
III. injection,
IV. absorption through the skin.

- **Following ingestion**,
  - Elemental mercury is poorly absorbed and
  - most of it is excreted in the feces.
- **absorbed through the skin**
  - Elemental mercury liquid and vapor can be
  - absorbed through the skin in small amounts.
  - Elemental mercury is transferred
  - Elemental mercury is transferred to the developing child in a pregnant women

Inhalation route

Cont. …Mercury poisoning result from

- **Inhalation route gives higher exposure**
- The **vapor** is **well absorbed following inhalation**.
  - **it accumulates** in the **kidney and the brain.**
- **Very toxic to the nervous system, also to kidneys**

- **Elemental mercury** is **excreted from the body slowly.**
  - It has an **elimination half-life** of **40-60 days**.

- ✓ **Most elemental** mercury is **excreted** in **exhaled air**,
- ✓ **Small amounts** in the **feces and urine**
- ✓ **Very small amounts** can be eliminated in **sweat, saliva and milk**.

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- **Sources of non-occupational exposure** to **inorganic mercury** include **new dental fillings**

Health Effects:

I. Short Term exposure
II. long Term exposure

1. Short Term Exposure

- **Harmful effects are rarely seen any more because of strict controls used in workplaces where mercury exposure might occur.**
- **Historically,**

❑ **short-term exposure to high concentrations of mercury vapor caused harmful effects on the**

i. **Nervous,**
ii. **Digestive**
iii. **Respiratory systems**, and
iv. **the kidneys**.

❑ **In most cases, exposure occurred when mercury was heated**

long term exposure

II. long term exposure

- It is caused by inhalation exposure.
- Mercury liquid and vapor are absorbed through the skin in small amounts and this can contribute to the overall exposure.
- Effects following absorption through the skin are expected to be similar to those reported for long-term inhalation exposure.

- Mercury levels in urine are often used as a general indicator of how much exposure to mercury has occurred.
- As a result, urine mercury levels rather than airborne levels are provided in some of the reports which compare mercury exposures to specific health effects.
- Urine mercury levels are reported in microgram /gr of creatinine

- **Urine mercury levels are reported in microgram /gr of creatinine**

- **The relationship** between **airborne mercury levels** and **urine mercury levels** is complicated and depends on many factors**, including other sources of mercury** exposure & **individual differences**

- **Several studies indicate that an**

airborne exposure of 0.025 mg/m3 compares to approximately
37 micrograms of mercury/gr of creatinine in urine

Urine mercury levels are reported in microgr/gr of creatinine Cont. ….

- Urine mercury levels in adults without occupational exposure are typically less than 3 micrograms/gram of creatinine.

- Urinary mercury levels below 35 micgr/gram of creatinine
  - ✓ are considered to reflect relatively low mercury exposure;

- 35 to 50 micrograms/gram of creatinine reflects
  - ✓ moderate exposure;

- 50 to 100 micrograms/gram of creatinine reflects
  - ✓ moderately high exposure

- above 100 micrograms/gram of creatinine reflects
  - ✓ high exposure.

•0.01=14.8
•0.04=59.2

•0.01=14.8

- Urine mercury levels are reported in **micrograms/gram of creatinine** (a component of the urine).

Urinary mercury levels	Level of mercury exposure
less than 3 micrograms/gram of creatinine	adults without occupational exposure
below 35 micrograms/gram of creatinine	low mercury exposure
35 to 50 micrograms/gram of creatinine	moderate exposure;
50 to 100 micrograms/gram of creatinine	moderately high exposure
above 100 micrograms/gram of creatinine	high exposure

Health Effects

- Initial exposure to high concentrations of mercury vapor produces symptoms similar to "metal fume fever" including fatigue, fever, chills, nausea ,headache, muscle joint pains and lack of appetite in
  - addition metallic taste in the mouth may also be reported,
- Respiratory system effects include cough, shortness of breath, tightness and burning pains in the chest and inflammation of the lungs.
- Occupational exposure to 1-44 mg/m3 of mercury vapor for 4 to 8 hours cause chest pain, cough, coughing up blood, impaired lung function and inflammation of the lungs.

- In some cases, pulmonary edema may occurred potentially life t

Health Effects

- **In some cases, pulmonary edema may occurred potentially life threatening**

- Exposure **to high, but unspecified, concentrations of mercury vapor**
- will **cause death** due to **respiratory failure.**

- **All of the reported deaths resulted from inhaling mercury vapors formed upon heating mercury**

- nervous,
- digestive and
- respiratory systems,
- the kidneys

2. Harmful nervous system effects:

- ❖ Effects on muscle coordination,
- ❖ mood, behavior,
- ❖ memory,
- ❖ feeling ,and nerve conduction
- ❑ These effects are often observed in employees with moderately high or high exposure to mercury. ????

- ❖ Tremors (initially affecting the hands and sometimes spreading to other parts of the body),
- ❖ Emotional Instability (including irritability, excessive shyness, a loss of confidence and nervousness),
- ❖ Sleeplessness, Memory loss, Muscle weakness, Headaches slow reflexes and a loss of feeling or numbness.

Harmful nervous system effects Cont. …

- **Damage** to the **nerves** **of the** **arms and legs** (**poly-neuropathy**) has been reported in employees **with high exposures**.**???**
- **Reduced sensation** and **strength** **in the arms and legs, muscle cramps** and **decreased nerve conduction** have been observed.
- **Employees with episodes of very high exposure** appear to be more at **risk of developing these effects**

- **Pathogenesis of Mercury Neurotoxicity**

❑ Pathogenesis of Mercury Neurotoxicity

❖ • Selectively accumulates in hippocampus, basal ganglia, cerebral cortex

❖ • Prevents presynaptic serotonin release and inhibits serotonin transport; causes calcium disruptions

❖ • Causes demylinating neuropathy

❖ • Causes abnormal neuronal cytoarchitecture; disrupts neuronal migration, microtubules, and cell division

•nervous,
- digestive and
- respiratory systems,
- the kidneys

- **Kidney injury is common following exposure to**
  - **high concentrations** of mercury. **Effects** range from
  - ✓ **increased protein in the urine** to **kidney failure.**
- **Exposure to high concentrations** of mercury has also
  - ✓ caused **increased blood pressure** and **heart rate.**

- **Effect when come in contact with skin:**
  - **Elemental mercury is not known to directly irritate the skin.**
  - However, an **allergic skin reaction may develop following contact with mercury.**
  - **Elemental mercury liquid and vapor can be absorbed through the skin** and may **contribute to the overall** absorption and toxicity

Pregnancy – the risky group

❑ Pregnancy – the risky group

first term pregnancies in the mercury exposed group

- Spontaneous abortion Stillbirth
- Congenital malformations (spina bifida and intra-atrial defect

Diagnosing mercury poisoning

- ➢ Physical exam and
- ➢ blood and
- ➢ urine test

- ❖ Blood mercury is only useful within 3 days of exposure and
- ❖ it is more reliable in methyl mercury (high concentrations in RBCs)
- ❖ A 24-hour urine specimen is a good indicator for inorganic mercury poisoning

Hair mercury level has no role in acute Hg toxicity

WHO, 2002

Mercury Poisoning Treatment

- There's no cure for mercury poisoning.
- Neurological effects from mercury toxicity are often permanent
- When detected early, mercury poisoning can be halted.

❑ The best way is to stop exposure to the metal.

❖ *Eat a lot of mercury-containing seafood, stop immediately*.

❖ If toxicity is linked to workplace,

- Remove from the area to prevent further effects of poisoning.

❖ If mercury levels reach a certain point start chelation therapy.

- *Chelating agents are: drugs that remove the metal from organs and help body dispose of them.*

❑ In inhalational mercury

❑ In inhalational mercury

- ❖ **No role of inducing emesis**
- ❖ **Oral steroid is a common practice but without substantial evidence**
- ❑ **Most inhalational form are self limited**
- ❖ **If mercury levels reach a certain point start chelation therapy.**
- ❑ **Hemodialysis is used in severe cases of toxicity when renal function has declined**

Control hazardous conditions

- **Mercury** is a **VERY TOXIC** liquid. It is also **CORROSIVE** to many metals.
- also forms **amalgams** **with some metals**, **like gold jewelry.**

❑ **Controlling mercury exposure is best accomplished through:**

❖ **substituting** with a non-toxic chemical, *depending on the application*. *If not*:

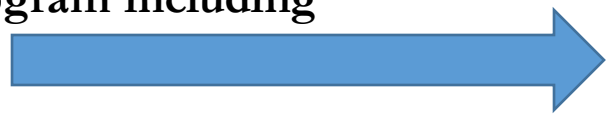
❖ **engineering,**

❖ **administrative,**

❖ **personal protective** **equipment** (PPE)

❑

- **Engineering methods include:**
  - **Mechanical ventilation (dilution and local exhaust),**
  - **Process or personnel enclosure**, *control of process conditions, and process modification*
  - **Stringent صارم control measures (closed handling system)** or
  - **isolation may be necessary.**
  - **Use a corrosion-resistant local exhaust ventilation system**
  - **separate from other exhaust** ventilation systems
  - **Cleaning of contaminated exhaust air before release *to the outdoors may be necessary***
- **Personal protective measures include:**
- **Have appropriate PPE**
  - **Approved respiratory protection**. If respiratory protection is required,
- institute a complete respiratory protection program including



institute a complete respiratory protection program including

- **selection, fit testing, training, maintenance and inspection**
- **A face shield may also be necessary to protect eye and face.**
- **Chemical protective gloves, coveralls, boots, and/or other chemical protective clothing are required to protect skin.**
- **A chemical protective full-body encapsulating suit** and **respiratory protection** may be required in some operations
- **Remove contaminated** clothing immediately and ***put in a closed container***.
- **Discard** or launder before re-wearing.
- Inform laundry personnel of contaminant's hazards.
- **Do not eat, drink,** or smoke in work areas.
- **Wash hands thoroughly after handling** this material.
- **Maintain good housekeeping**

Handling recommendations for the industrial use of mercury.

- **Before handling,** it is important that:
  - **Engineering Controls** are operating and
  - PPE requirements and **personal hygiene measures** are being followed.
  - **People working with** this chemical should be **properly trained regarding its hazards and its safe use.**
  - **Unprotected persons** should **avoid all contact** with this chemical
  - including contaminated equipment
- **Use the type of container recommended** by the manufacturer
- Inspect containers for **leaks before handling**
- **Immediately report leaks, spills or ventilation failures.**
- **Never return contaminated material** to its original container
- **Secondary protective containers must be used** when this material is being carried.

Handling recommendations for the industrial use of mercury Cont. …

- **Label containers.** Avoid damaging containers.
- **Keep containers tightly closed** when not in use.

❖ **Assume that empty containers contain residues which are hazardous**

- **Avoid generating vapors or mists.**
- **Do not heat mercury** in **other than a closed system.**

❖ Good housekeeping is very imp

➢ **Do not use on porous work s .**

✓ **Use work surfaces which can minated**


Thank you ...


Thank
you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Any questions?
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