

# OCCUPATIONAL HEALTH

## Chemical hazards

### Occupational exposure to Toxic Metals

"heavy metals"

LIX

28<sup>th</sup> April 2025

PROF DR. WAQAR AL – KUBAISY

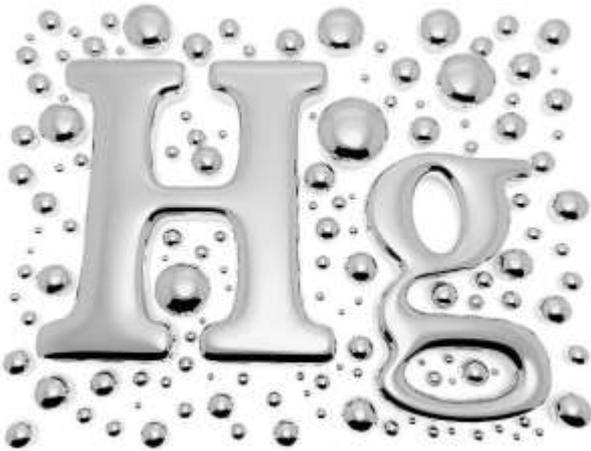




Iraq mercury contaminated seed grain - CP

# MERCURY POISONING

28<sup>TH</sup> APRIL 2025



# 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
  - ❖ readily vaporizes into the air around it.
  - ❖ Vaporized mercury can make its way into the rain, soil, and water and

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(affect health humans)

where it poses a risk to humans

## Cont. Mercury Poisoning

Most of seafood contaminated  
it

❖ 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

☐ 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

✓ **Absorbed**, the

✓ **Clinical signs** and **symptoms**, and

✓ **Response to treatment** modalities.

That's why you should know type?  
Depend on type.

Elemental mercury

## Cont. Mercury Poisoning

Mercury exist in 3 forms

Elemental (or metallic).

Inorganic:

Organic:

☐ **Elemental mercury** is a **heavy liquid**.

•• **13.6 times** the <sup>heavier than</sup> 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**.  
*in high concentration*

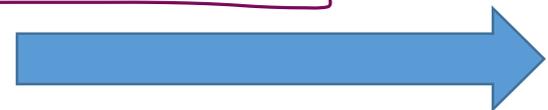
☐ **Organic compounds** are further divided between

❖ **alkyl** (carbon-chain) and *More Dangerous Aryl*

❖ **aryl** (aromatic ring) groups.

• Although all mercury compounds **are toxic**,

• the **small-chain alkyl compounds** are the **most hazardous**



Occupation Safety & Health

☐ 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



WHERE IS IT LOCATED?



❑ Mercury is commonly found in **thermometers, manometers, barometers, gauges** المقاييس, 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).



# 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 (CARS)
- ❖ 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,

*elementary HgCl<sub>2</sub>*

- **Elemental mercury** is **poorly** absorbed and **most of it** is **excreted in the feces.**

*minamata disease in Japan eating seafood*

## absorbed through the skin

- **Elemental mercury liquid and vapor** can be
- **absorbed** through the **skin** in small amounts.
- **Elemental mercury** is **transferred to the developing child** in a pregnant women

Cont. ...Mercury poisoning result from

↑ Higher Absorption



- ❑ 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.

## ❑ Health Effects:

### 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:

- Nervous,
- Digestive
- Respiratory systems, and
- the kidneys.

❑ In most cases, exposure occurred when mercury was heated

*(high concentration cause heating)*

I. Short Term exposure

II. long Term exposure

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. *No6 AIC*
- ❖ 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**

❑ 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/m<sup>3</sup>** compares to approximately **37 micrograms of mercury/gr of creatinine in urine**

❑ **Permissible Exposure Limits**

•0.01=14.8

•0.04=59.2

The Occupational Safety and Health Administration (OSHA) standard for

❖ **Organo alkyl mercury** compound is **0.01 mg /cubic meter** of air for TWA8 (TWA8). 8-hour total weight average *مجموع*

❖ with a ceiling level of **0.04 mg/cubic meter** of air for TWA8

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**

•0.01=14.8  
•0.04=59.2

❖ **above 100** micrograms/gram of **creatinine** reflects **high exposure**.

•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 lung inflammation
- ❑ Occupational exposure to 1-44 mg/m<sup>3</sup> 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 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

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- 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.

- ❖ **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

- ❖ • Selectively accumulates in **hippocampus**, basal ganglia, **cerebral cortex**
- ❖ • **Prevents** presynaptic serotonin release and **inhibits** serotonin transport; causes **calcium disruptions**
- ❖ • Causes **demyelinating neuropathy**
- ❖ • Causes abnormal neuronal cyto architecture; disrupts neuronal migration, microtubules, and cell

- ❑ **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

first term pregnancies<sup>1</sup> 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

## ☐ 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<sup>22</sup>.
  - ❖ 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

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## ❑ 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:



## Control hazardous conditions

- ❖ **substituting** with a non-toxic chemical, *depending on the application. If not.*
- ❖ **engineering,**
- ❖ **administrative,**
- ❖ **personal protective equipment (PPE)**

### ❑ **Engineering methods include:**

First line prevention

- ❖ **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** 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 important
- **Do not use on porous work surfaces** (e.g. wood).
- ✓ **Use work surfaces which can be easily decontaminated**

vaporated  
عنه ما يتبخر

Thank you ...



**Thank  
you**

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**Any questions?**  
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# BIOLOGICAL HAZARD

## (Biohazards)

**Which of the following is the most common cause of mercury poisoning?**

- A) Inhalation of mercury vapor**
- B) Consumption of contaminated seafood**
- C) Skin contact with mercury**
- D) Injection of mercury compounds**

**Answer: B) Consumption of contaminated seafood**

**What is a major environmental source of increased mercury levels due to industrialization?**

- A) Plastic production**
- B) Coal burning**
- C) Oil drilling**
- D) Automobile emissions**

**Answer: B) Coal burning**

**Which group is especially vulnerable to the effects of mercury poisoning?**

- A) Elderly individuals**
- B) Athletes**
- C) Children and unborn babies**
- D) Healthcare workers**

**Answer: C) Children and unborn babies**

**Organic mercury compounds are characterized by mercury binding to which types of chemical groups?**

- A) Oxygen and nitrogen groups**
- B) Carbon chains or aromatic rings**
- C) Sulfur and chlorine groups**
- D) Phosphate groups**

**Answer: B) Carbon chains or aromatic rings**