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Introduction to chemical safety in the world of work

Session objectives

At the end of the session, you will be able to:

1. Understand why workers are particularly at risk of chemical exposures.
2. Recognize the different chemical forms, including vapours, liquids and dusts.
3. Describe the global chemicals industry.
4. Identify ways in which workers may be exposed.
5. Distinguish the impact of occupational chemicals on the environment.
6. Know key ILO activities in the field of chemical safety.

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Question:

Can you describe a chemical exposure you've had in the past 24 hours?

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Answer:

- There are many possible answers!
- For example, there are chemicals in food, personal care products, disinfectants and in air pollution.

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Introduction

Chemicals are part of our daily lives and are essential for economic development and well-being.

- They provide numerous benefits, including **preventing diseases** and increasing agricultural productivity.
- The chemical industry is the **second largest manufacturing industry** in the world, with more and more chemicals produced every year.
- However, many have **hazardous properties** and can **adversely impact human health**.
- Workers can be exposed to chemicals along the whole supply chain, including manufacturing, handling and use and disposal.

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Question:

Why is it important that chemicals are handled safely in the workplace?

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Answer:

- Many chemicals are toxic and are hazardous to health.
- Workers in a variety of different industries are exposed.
- If managed in an unsound way, they can pose significant risks to human health.

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A global health crisis

Every year >1 billion workers are exposed to hazardous substances in the workplace, including pollutants, dusts, vapours and fumes.

- One worker **dies every 30 seconds** due to occupational chemical exposure *(UN 2018)*.
- Many lives are lost due to **fatal diseases, cancers and poisonings**, or from fatal injuries following fires or explosions.
- The burden of non-fatal injuries, resulting in **disability and debilitating chronic diseases**, must also be considered.
- All of these deaths, injuries and illnesses are entirely preventable.

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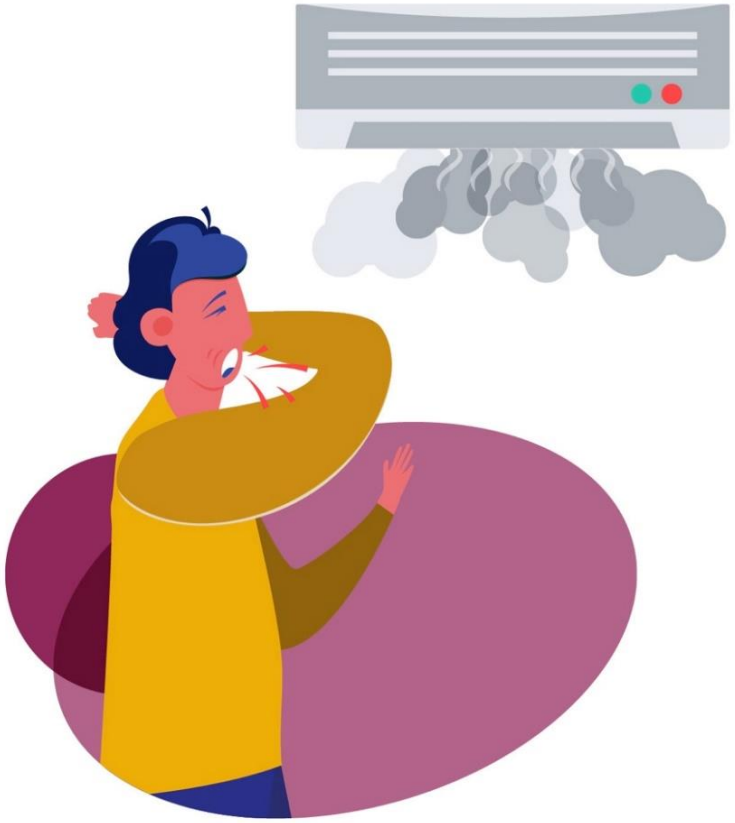
Why focus on workers?

- Protecting workers from hazardous chemicals is essential for healthy populations and sustainable environments.
- However, **workers are disproportionately exposed to hazardous chemicals across almost all workplace sectors** and new chemicals are introduced yearly.
- Workers have a heightened risk, as they may be exposed to **higher concentrations over longer periods** (imagine 8 hours a day, 5 days a week etc).

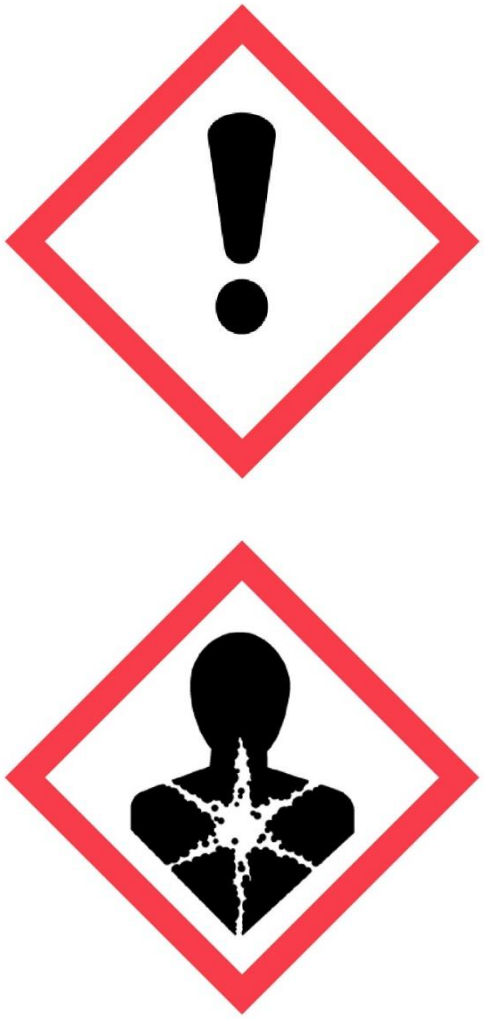


Case study: Health impacts of asbestos exposure

- Workers will often be the **first sub-population to show health effects** after chemical exposure.
- A good example of this is asbestos, which was used widely in the first half of the century.
- It was not known that it was a carcinogen until **workers** started showing symptoms of **lung cancer** and **mesothelioma**.
- This was because workers were exposed to **high doses over long time periods**.
- The discovery of mesothelioma in the worker population rang an alarm among the medical community and led to a series of toxicological tests that **revealed asbestos as a carcinogen**.

Health impacts for workers

- Health impacts may be:
  - **Acute** (e.g. poisoning incidents or allergic reactions)
  - **Chronic** (e.g. cancer or respiratory conditions)
- The production, use and storage of chemicals can also cause **fires and explosions**, resulting in large scale fatal and non-fatal injuries (e.g. Beirut explosion).



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Types of chemicals

What are chemicals?

According to ILO Chemicals Convention, 1990 (No. 170):

- **Chemicals** are chemical elements and compounds, and mixtures thereof, whether natural or synthetic.
- **Hazardous chemicals** include any chemical which has been classified as hazardous in accordance with Article 6 or for which relevant information exists to indicate that the chemical is hazardous.
- **Use of chemicals at work** means any work activity which may expose a worker to a chemical, including production, handling, storage, transport, disposal and treatment.

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Types of chemicals

Workers may be exposed to chemicals in various different forms:

- Gases
- Liquids
- Vapours
- Fumes
- Dusts and powders
- Fibres

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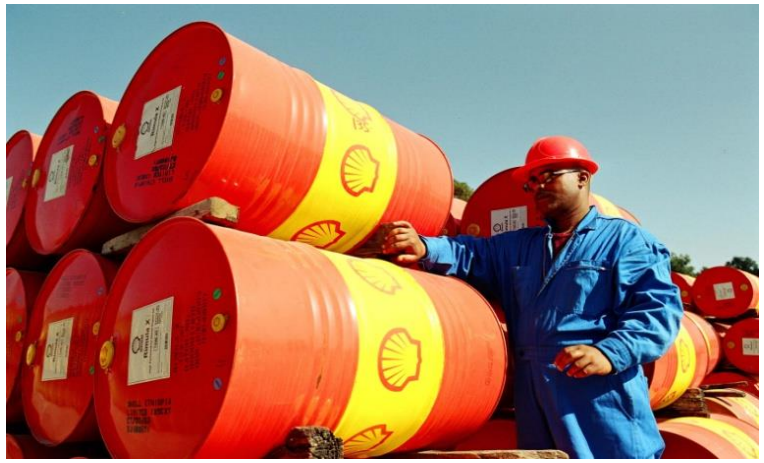
Question:

Can you identify the chemicals in these photos?



Gases

Such as chlorine or carbon monoxide.

- Do not necessarily have a warning odour.
- Can be **irritants** or enter the blood and cause **internal damage**.
- Sulphur oxides, nitrogen oxides, chlorine and ammonia are toxic gases that are **corrosive** and irritating to the respiratory system.
- Gases are **widely used in industry**, for example, as bleaching agents and disinfectants, in paper manufacturing and to manufacture chemicals, such as fertilizers.
- Carbon monoxide is a **toxic, odourless, colourless gas** which is formed by the incomplete burning of materials of organic origin. It may enter the blood circulation.
- Some gases can **pass through skin**, for example, hydrogen cyanide.

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Liquids

Such as degreasing solvents, cleaning materials, petrol, diesel, hydraulic oils, grease, degreasers, paints and thinners.

- Used in **numerous sectors** including construction, gold mining, painting, printing, dry cleaning, footwear manufacturing, car mechanics and plastic product works.
- Often **flammable** and may ignite by heat from smoking, welding or static electricity.
- Strong acids and bases are **corrosive to human tissue**. They can give rise to mists, which have similar corrosive properties.
- Some readily evaporate at room temperature to become **dangerous vapours** e.g. liquid metals.

Vapours

Include metal vapours, such as mercury, and solvent vapour released from adhesives, paints and inks.

- Workers may be exposed in industries using solvents, for example dry cleaners and painters, as well as those those using liquid metals, such as mercury.
- Vapours move with air currents and can be ignited even by a distant heat source.
- **Inhalation** is the most common way for vapours to enter the body, but some can also penetrate intact healthy skin.
- Once in the blood stream the chemical can be **transported to different organs** e.g. the brain and liver.

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Fumes

Such as welding, hot rubber, soldering or galvanizing fumes.

- Present in many industries, for example, construction, metal-working and mining.
- Often **invisible** to the naked eye and not perceived as a risk.
- Welding is a particular concern, as fumes contain diverse mixtures of **highly toxic components**.
- When chemicals such as zinc oxide and aluminium oxide are heated, fumes are produced as a by-product.
- Can lead to adverse health effects, such as **metal fume fever**, a flu-like illness, also known as ‘welding shivers.’

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Dusts and powders

Such as wood, cement, metal or stone dust.

- Dusts are solid particles ranging in size from **<1µm to around 100 µm**.
- Common in **mining**, **construction** and **agriculture**.
- They may become airborne, depending on their origin, physical characteristics and ambient conditions.
- The smaller the particle, the deeper the penetration into the lungs.
- Inhaled particles may accumulate over time, causing diseases such as **pneumoconiosis, cancer and asthma**.

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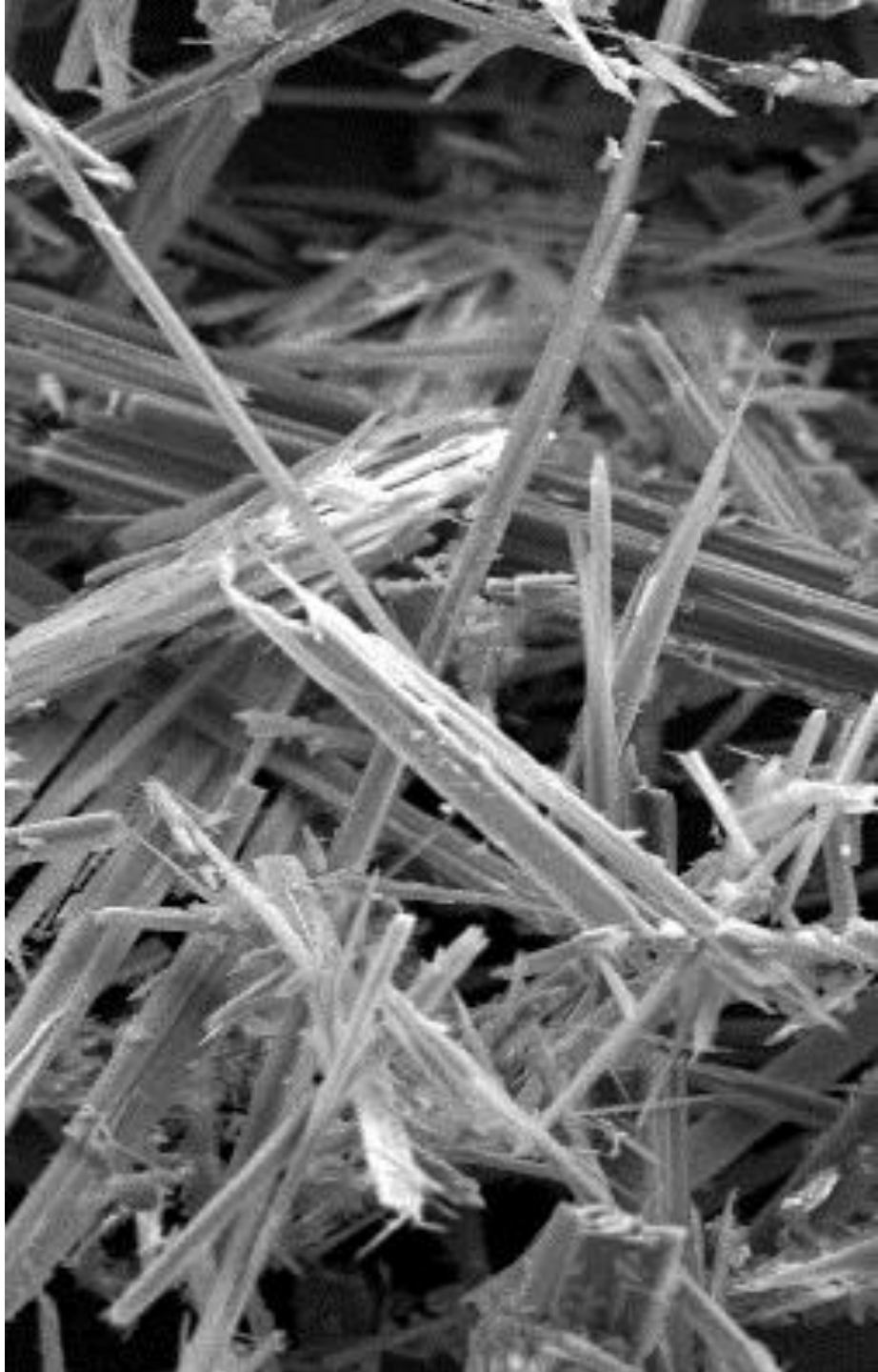
Fibres

Such as asbestos

- Fibres can penetrate the lungs and remain lodged in the tissue. This can lead to irritation, inflammation and chronic damage, such as scarring (pulmonary fibrosis).
- Asbestos is a natural mineral fibre which is very resistant to fire and to many chemicals.
- It can cause **lung cancer, asbestosis and mesothelioma**.
- Diseases often have **long latencies** and take years to appear.
- Workers in construction, ship-renovation and insulation work are particularly at risk.



How chemicals are used in industry

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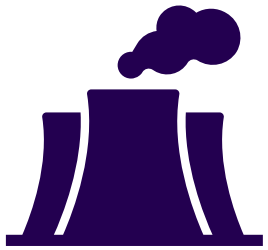
Question:

Can you name some common chemicals and say how they are used in the world of work?



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Answer:

- Pesticides used for pest control in agriculture.
- Mercury used in mining to separate ore from rock.
- Disinfectants used in hospital by cleaning staff.
- Can you think of any other examples?

Global chemical industry

- Global chemical sales were valued at **€3.47 trillion** in 2017.
- The chemicals industry is the **world's second largest production sector** *(ILO 2018)*.
- Asia currently produces and consumes the largest amount of chemicals.
- Workers are exposed to chemicals across almost **all economic sectors**, including agriculture, mining, construction, manufacturing and services.
- Hazardous chemical are both classic (e.g. asbestos) or emerging (e.g. manufactured nanomaterials).

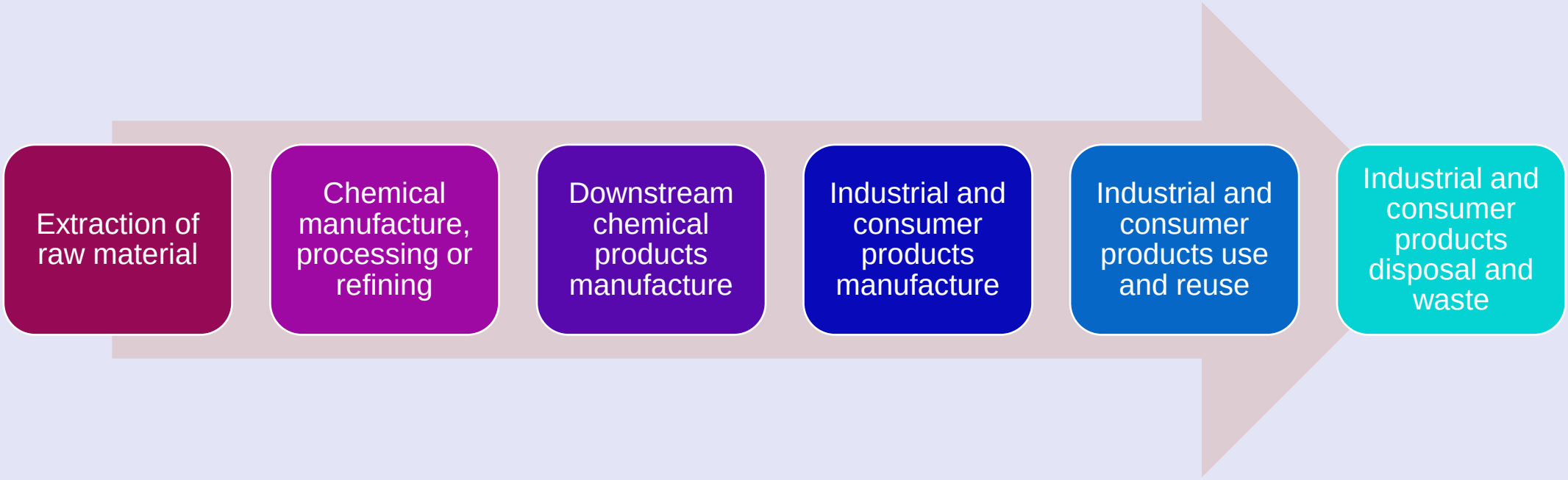
Largest global chemical sales: China (37%), European Union (16%), United States of America (13%).

Examples of key areas of focus for the ILO

Substances	Sectors
▶ Metals ▶ Solvents ▶ Dusts and fibres (asbestos) ▶ Fumes ▶ Acids and bases ▶ Pesticides	▶ Mining ▶ Textile, clothing, leather and footwear ▶ Agriculture, plantations, other rural sectors ▶ Construction ▶ Electronics manufacturing and engineering ▶ Waste management ▶ Emerging chemical risks

Global value chain of the chemical industry

From extraction to finished products



Source: UNEP 2019

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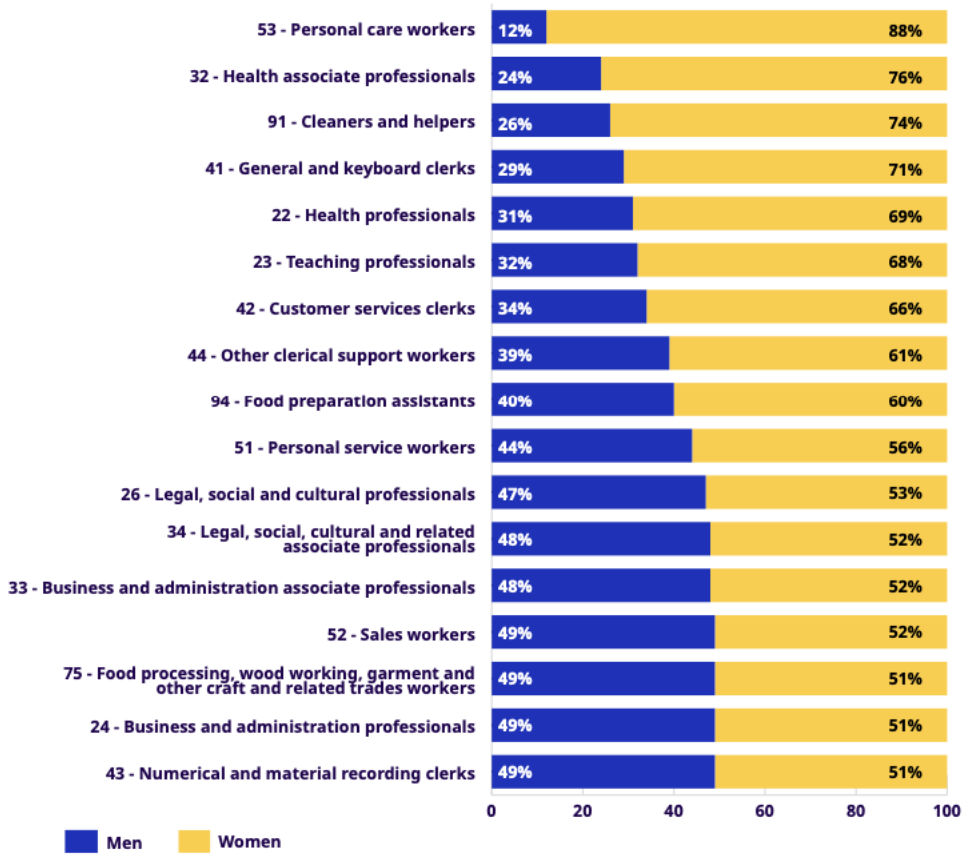
New occupational safety and health (OSH) concerns

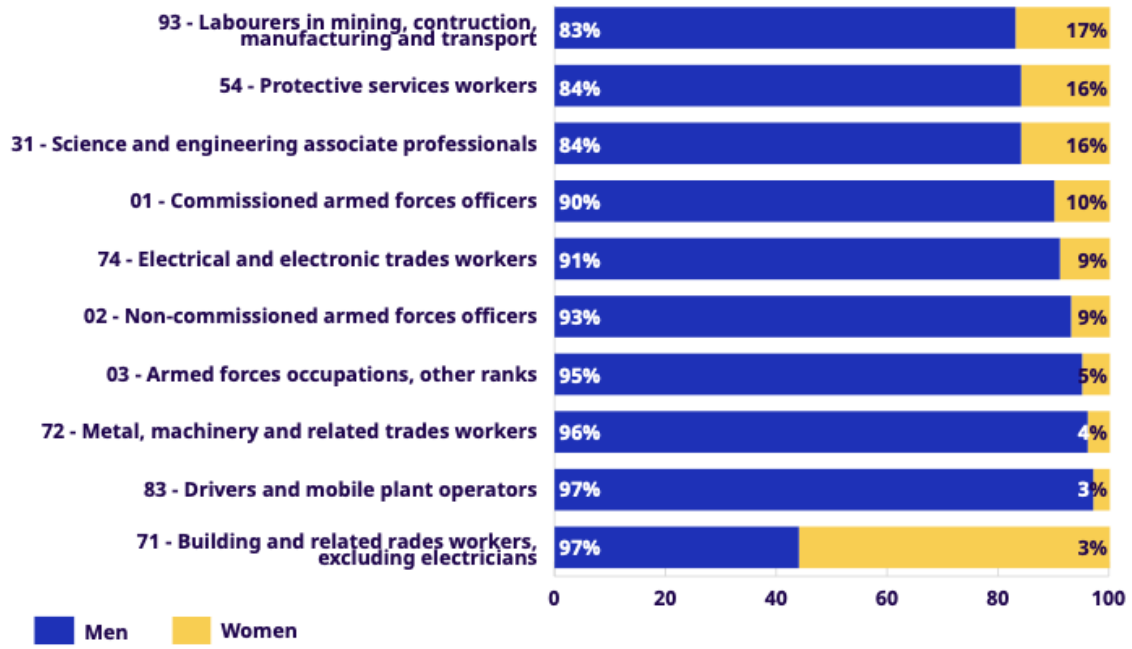
- New OSH concerns and **growing occupational health inequalities** from changes in working practices, demographics, technology and the environment.
- **Young people, aging populations, migrant workers, women and workers in the informal sector** may be more at risk of hazardous chemical exposures and may suffer disproportionate adverse health impacts.
- The protection of workers against exposure to chemicals is closely linked to the ILO's efforts to promote decent work and especially **Fundamental Principles and Rights at Work (FPRWs)**.

Sectors with prevalent female workforce



Source: ILOSTAT 2020

Sectors with prevalent male workforce



LOSTAT 2020

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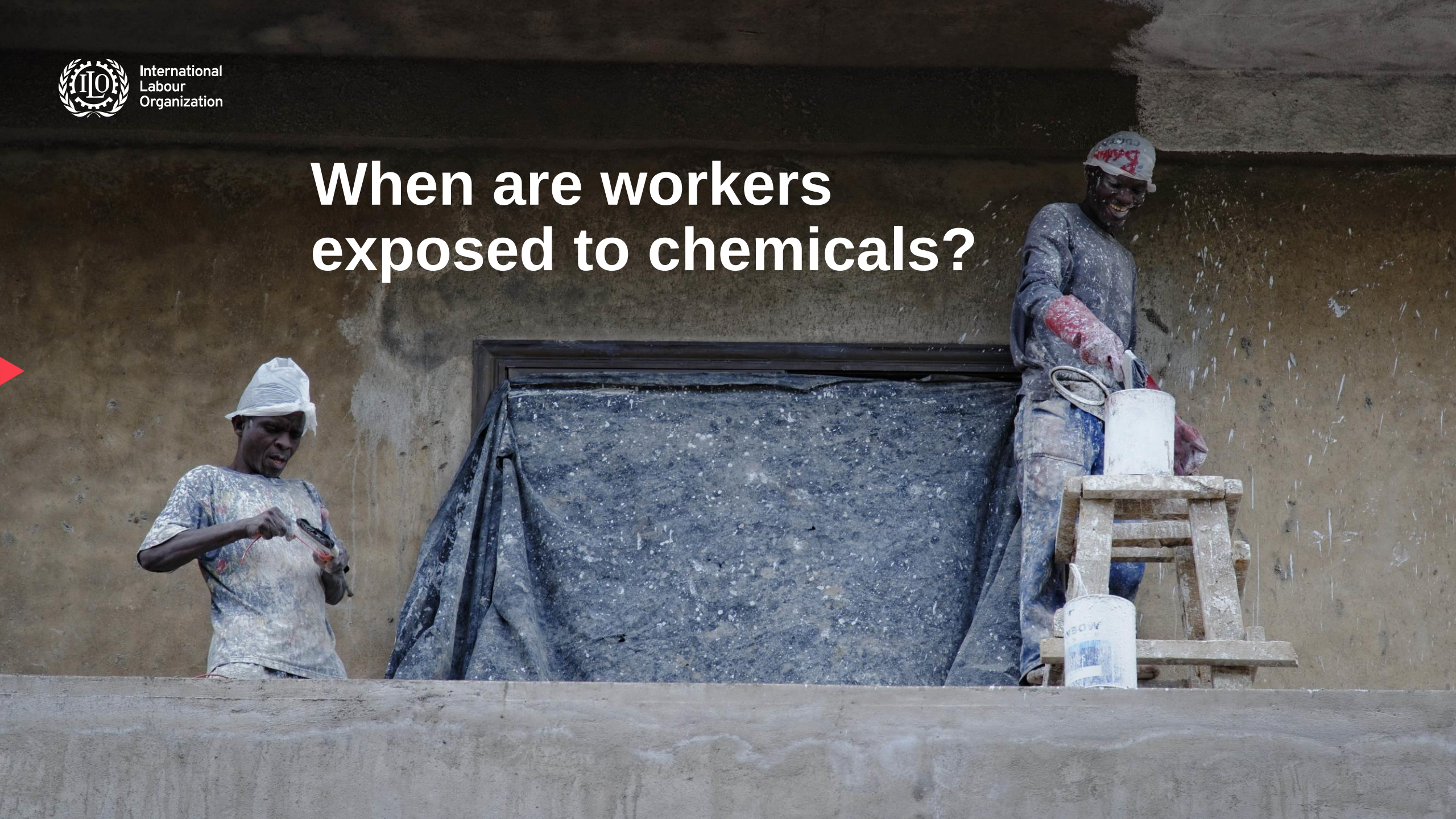
When are workers exposed to chemicals?



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Question:

Have you experienced any chemical exposures in your workplace?

Workers may be exposed along the entire supply chain

Stage	How workers are exposed	Example
Extraction	During processes used to extract chemicals	Mercury mining
Chemical manufacture, processing or refining	During manufacturing, processing or refining of chemicals for production or manufacturing processes	Production of dyes for paint manufacturing
Downstream chemical products manufacture	During downstream product manufacturing	Mercury use in vinyl chloride monomer production
Products manufacture	During the production of industrial and consumer products	Production of electronic equipment
Products use and reuse	When industrial and consumer products are used during the course of work	Breakage of mercury-containing thermometers in healthcare
Disposal and waste	During industrial and consumer product disposal (recycling, incineration or waste picking)	Lead exposures during battery recycling

Major industrial accidents

Workers may also be exposed when major industrial accidents occur.

- Chemical accidents may occur whenever toxic materials are **stored**, **transported** or **used**.
- Most serious involve **major chemical manufacturing or storage facilities**.
- Events include **fires**, **explosions** (e.g. 2020 Beirut) and **leakages** (e.g. 1984 Bhopal gas tragedy).
- Have occurred during **plant shut-downs**, such as during the COVID-19 pandemic (e.g. 2020 hazardous gas leak in a polymer plant in India).

[Photos/CFP]

Case study: The Bhopal disaster, India

- A **gas leak incident** in 1984 at the Union Carbide India Limited pesticide plant in Bhopal.
- Considered the **world's worst industrial disaster**.
- Over 500,000 people were exposed to **highly toxic** methyl isocyanate (MIC) gas.
- **Thousands died** and others developed **long-term health effects** including neurological deficits, pulmonary fibrosis, vision impairments and PTSD.
- Created a real **need for increased chemical management**, particularly in major industrial undertakings.

The impact of occupational chemical exposures on the environment

Impact of everyday use of chemicals on the environment

- The environment has a certain capacity to biodegrade toxic substances.
- However, some substances are **resistant** to decomposing processes.
- Adverse effects increase with the concentration of substances and their **accumulation in food chains**.
- Chemicals released from worksites can cause **long-term environmental damage**.
- Damage highest in agricultural, chemical and energy sectors.

Chemical pollution is one of the main drivers of biodiversity loss

- **Mercury**: Anthropogenic emissions are increasing, polluting the air, freshwater and oceans.
- **POPs**: Human-made chemicals that are persistent in the environment and are found around the globe in air, water and soil. PCBs and DDT continue to be found in biota.
- **Pesticides:** Threats to bees and soil ecosystems, impacting global food security. Agricultural runoff is a major source of water pollution.
- **Hazardous waste dumps**: Mismanagement of hazardous wastes in large waste dumps globally is resulting in serious impacts on biological diversity.
- **Plastics**: Production is expected to double by 2050, have demonstrated impacts on marine species and terrestrial ecosystems, including soils.

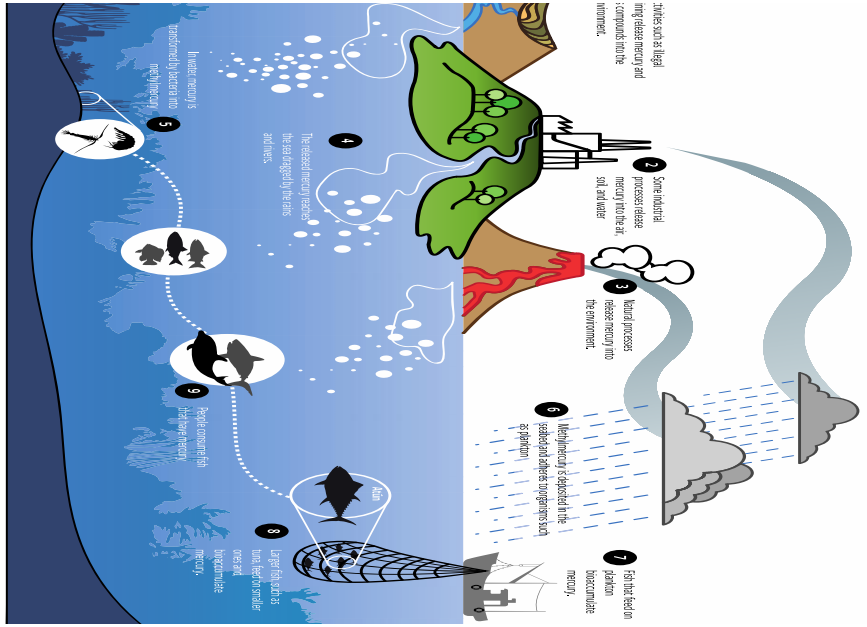
Case study: 2000 Baia Mare cyanide spill in Romania

Major chemical accidents can have a devastating impact on the environment.

- Leak of cyanide into the Somes River by gold mining company Aurul had disastrous environmental impacts in Hungary, Serbia and Romania.
- Drinking water was **contaminated** and huge numbers of **aquatic life were killed**.
- The cyanide concentration in the river Tisza was **100 times the limit value for drinking water**, causing a significant threat to public health.
- **Extensive damage to the river ecosystem**, with 80-100% of fish stocks killed, with swans, foxes and other animals also affected.

Double burden of exposure for some workers

- Some workers at may face a double burden of exposure, from **environmental exposures**, as well as **occupational exposures**.
- This may occur when workers live near their place of work. In this case food sources, such as fish and seafood, may be **contaminated by waste chemicals.**
- For example, waste mercury from factories can bioaccumulate in fish as methylmercury.

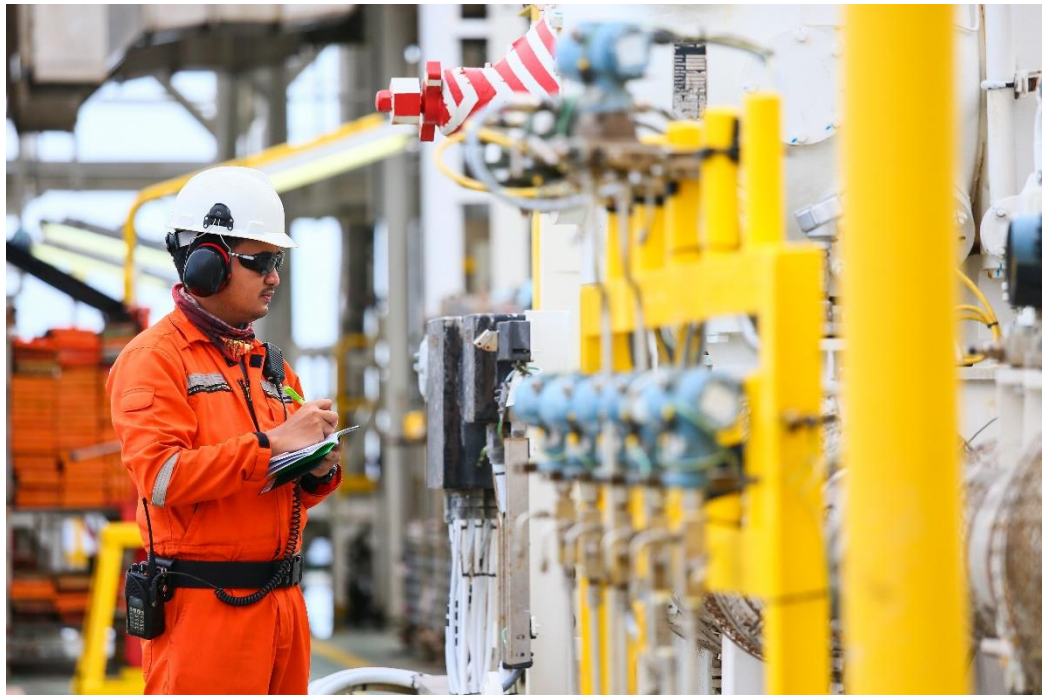


Source: Martinez 2020

ILO activities in the field of chemical safety

The ILO and chemical safety

- The ILO has long recognized that the **protection of workers** from the harmful effects of chemicals also **enhances the protection of the general public and the environment.**
- The ILO is dedicated to **standard setting** and **technical assistance** in chemical safety for all workers.



Difficulties in chemical safety

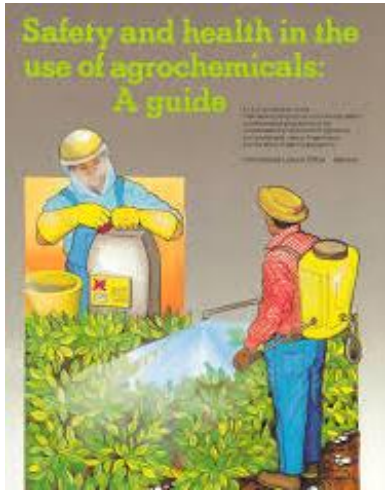
- Each chemical presents a **unique hazard** for human health.
- Many chemicals can be present at one time.
- Users usually cannot analyse hazards completely.
- Chemicals must be **handled safely along the whole supply chain**.
- Chemicals are used by people with **different languages** and **varying levels of education**.

History of ILO involvement in chemical safety

- The ILO was created in 1919.
- Lead Poisoning (Women and Children) Recommendation, 1919 (No. 4).
- First binding instrument was the White Lead (Painting) Convention, 1921 (No. 13).
- UNEP/ILO/WHO – International Programme on Chemical Safety (IPCS), 1980.
- Chemicals Convention (No.170), 1990.
- Prevention of Major Industrial Accidents Convention (No.174), 1993.
- The United Nations Conference on Environment and Development (UNCED) and follow-up (1992 onwards).
- ILO List of Occupational Diseases (revised 2010)

ILO activities and products: After Bhopal

- A series of programmes were started after Bhopal disaster in 1984.
- Technical cooperation projects on chemical and industrial safety (India etc).
- Promotion of Conventions (C170 and C174).
- Development of various Codes of Practice (Chemicals, Major industrial accidents, Asbestos).
- Major Hazard Control: ILO Manual.



ILO response

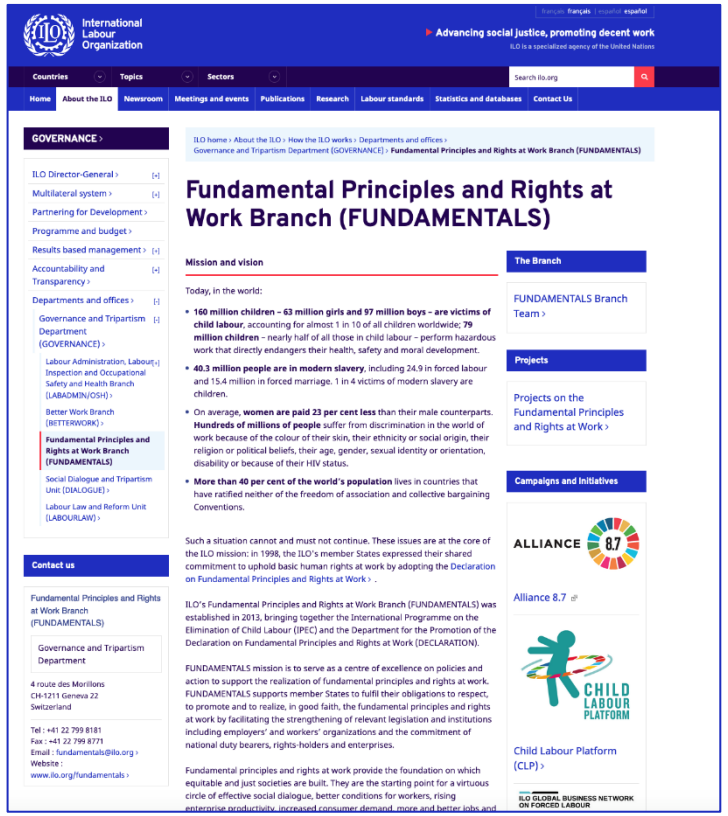
The central goal of the ILO response was to standardize and formalize chemical safety.

- Chemicals Convention (No.170), 1990.
- Prevention of Major Industrial Accidents Convention, 1993 (No. 174).
- Other Chemical Conventions and Recommendations.
- Globally Harmonized System for the Classification and Labelling of Chemicals (GHS).
- International Chemical Safety Cards (ICSC).
- ILO Chemical Control Toolkit.
- International collaborations: Strategic Approach to International Chemicals Management (SAICM).

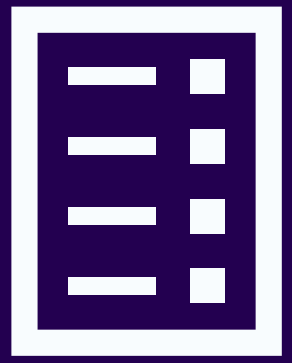
Fundamental Principles and Rights at Work (FPRWs)

The protection of workers against exposure to chemicals is closely linked to the ILO's efforts to promote decent work and especially FPRWs.

- Four categories of labour standards that should be considered as fundamental, because they protect basic workers' rights:
  - **Freedom of association** and the effective recognition of the **right to collective bargaining.**
  - The elimination of all forms of **forced or compulsory labour.**
  - The effective abolition of **child labour.**
  - The elimination of **discrimination** in respect of employment and occupation.



End of session activity



Quiz

Quiz

1. How many workers are exposed to hazardous substances in the workplace every year?
2. Which continent currently produces and consumes the largest amount of chemicals?
3. Which gas tragedy occurred in 1984?
4. What are POPs? Can you give an example?
5. Why do some workers face a ‘double burden of chemical exposure’?
6. Name 3 reasons why chemical safety is difficult.
7. When was the ILO created?

Can you fill in the blanks with the words below?

1. Some …… metals, for example ……, can readily evaporate at room temperature to become dangerous vapours.
2. Gases can be particularly dangerous because they are ……, for example …….
3. Fumes may result from ……, which can lead to adverse health impacts such as …….
4. The …… the dust particle, the …… the penetration into the lungs.
5. …… is an example of a ……, which can cause diseases with long latencies.

Liquid	**Deeper**	**Odourless**	**Asbestos**	**Smaller**
Fibre	**Phosgene**	**Metal fume fever**	**Welding**	**Mercury**

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Key ILO resources

- Exposure to hazardous chemicals at work and resulting health impacts: A global review (2021).
- The GHS in the world of work: Mapping synergies between ILO Instruments and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).
- ILO Instruments on Chemical Safety – Analysis and synergies with other international frameworks on the sound management of chemicals (2020).
- The Sound Management of Chemicals and Waste in the World of Work (2019).
- All You Need to Know: Convention No. 170.
- Guidelines on occupational safety and health management systems (2001).
- Major hazard control: A practical manual (1993).
- Safety in the use of chemicals at work: code of practice (1991).
- Prevention of major industrial accidents: code of practice (1991).
- ILO indicators of progress in implementing SAICM (2021).