BAHAYA KIMIA DI TEMPAT KERJA

(SESI - 11)

Pengertian...

• Bahaya kimia merupakan bahaya yang berasal dari bahan kimia yang ada di tempat kerja.

• Bahan kimia berupa:
  – Padat
  – Cair
  – Gas
Bahan Kimia di tempat kerja...

- Bahan kimia di tempat kerja dapat berupa:
  - Bahan baku
  - Bahan tambahan
  - Bahan yang membantu proses (katalisator, pelarut, oksidator, dll)
  - Buangan proses (Gas buang, hasil samping)
  - Produk
  - Sisa proses (limbah)
  - dll

Factors contributing to hazardous situations

- Toxicity
- Routes of entry
- Physical properties
- Work practices
- The nature of exposure
- Combined exposure
- Susceptibility of worker
Routes of entry

• Inhalation
  – In industry, inhalation is the most significant route of entry.
  – A healthy adult, a worker performing a moderate task inhales about 8.5 M³ of air in the course of an eight–hours shift.

  Remember:
  *Extreme care must be taken because chemicals in the form of vapour, fumes, dust or gas can easily enter the body through breathing*

Routes of entry

• Ingestion
  – Entry via ingestion is possible when workers eat their meals at their workstation where food and drink may be contaminated by vapours in the air.
  – A second way in which chemical substances are ingested in when inhaled particles are transported to the throat.

  Remember:
  *If you eat or drink at your workstation, you may be introducing hazardous chemicals into your digestive system because the substance may coat the food or eating utensils.*
Routes of entry

• Skin absorption
  – The thickness of the skin, together with its natural covering of sweat and grease, provide some protection against chemical exposure.
  
  – The solubility (such as organic solvents and phenol) in fats enable their absorption through the skin. If the skin is damaged by cuts or abrasions, or is diseased, the chemical would be absorbed into the body even quicker.

Concentration and type of exposure

• In the case of inhalation, the dose depends mainly on the concentration of the substance in the air and the duration of the exposure.
Combined effects of chemicals

- Occupational exposure is rarely confined to a single chemical. In most instances worker are exposed to two or more chemicals.
- The combined effect of multiple exposure to chemicals is an area for which sufficient information is often lacking. It may happen that a combination of two chemicals, by chemical reaction or absorption into the body, produce a new substance with totally different properties and even more harmful to health than the chemicals acting separately.

Remember:
Avoid mixing several chemicals together. The combination may result in very dangerous effects.

Hyper susceptible groups

- There is great variation in individual response to a chemical. Exposure to a particular dose over a similar time period will induce different responses among different people.
- Individual sensitivity may also depend on age, sex, and general state of health.
- Children will be more sensitive than adults.
- The unborn fetus may be very susceptible to the risks of chemical substances.
Bentuk Bahaya Bahan Kimia...

- **Bahaya Keselamatan**
  - Bahan kimia yang dampak kerugiannya segera terlihat; seperti
    - Bahan mudah terbakar
    - Bahan mudah meledak
    - Bahan mudah menyala
    - Bahan yang korosif

- **Bahaya Kesehatan**
  - Bahan kimia yang dampak kerugiannya tidak segera terlihat; seperti
    - Bahan kimia toksik
    - Karsinogenik
    - Patologik
    - Reproductive hazard dll

The toxic effects of chemicals

- The effects of chemicals can be categorized into the following groups:
  - Causing irritation
  - Allergies
  - Lack of oxygen
  - Systemic poisoning
  - Cancer
  - Damage to the unborn fetus
  - Effects on future generations
  - Pneumoconiosis (dusty lung)
Irritation

- Irritation means a condition that is aggravated when chemicals come into contact with the body.
  - Skin
  - Eyes
  - Respiratory tract

Allergy

- An allergy can be acquired through exposure to chemicals.
- Skin
  - An allergic reaction of the skin is a condition that often looks like dermatitis. Examples of sensitizer are epoxy resin, amine hardeners, ozo dyes, coal tal derivatives and chromic acids.
- Respiratory tract
  - Sensitization of the respiratory tract causes occupational asthma. The symptoms of this reaction often include coughing, especially at night, and difficulties in breathing such as wheezing and shortness of breath.
  - Examples of chemicals: toluene diisocynate, formaldehyde
Lack of oxygen (asphyxiation)

- **Simple asphyxiation**
  - Condition whereby oxygen in the air is replaced by an inert gas such as nitrogen, CO2, ethane, hydrogen, helium to a level where it cannot sustain life.

- **Chemical asphyxiation**
  - In this situation direct chemical action interferes with the body’s ability to transport and use oxygen.

Narcosis and anaesthesia

- **Exposure to relatively high concentration, such as:**
  - ethyl and propyl alcohols,
  - acetone and methyl-ethyl ketones,
  - acetylene hydrocarbons,
  - ethyl and isopropyl ethers.

- **Single exposure to a high concentration may result in unconsciousness or even death.** There are also cases where workers have become addicted to these substances.
Systemic poisoning

- Systemic poisoning refers to the adverse response induced by chemical to one or more body system, which in turn spreads throughout the body.

- The effect is not localized at any one spot or area of the body.

- Examples:
  - Liver
  - Kidney
  - Nervous system
  - Reproductive system

Cancer

- Long exposure to certain chemicals may cause an uncontrolled growth of cells, resulting in cancerous tumors.

- Tumors may appear many years after the first exposure to the substances. This period is called latency period and many range from 4 – 40 years.
Damage to the unborn foetus (teratogenesis)

- Congenital malformation resulting from exposure to chemicals may interfere with the development of the normal fetus.

- Example:
  - Anaesthetic gases
  - Mercury and organic solvent

Genetic effects on future generation (mutagenesis)

- The genetic effects of certain chemicals on workers may lead to undesired changes in future generation.

- However, results of laboratory test suggest that 80% to 85% of carcinogenic chemicals may also have effects on future generation.
Dusty lung (pneumoconiosis)

- Dusty lung or pneumoconiosis is a condition caused by the deposit of small dust particles in the gas exchange areas of the lung and reaction of the tissues to their presence.

- The effect is irreversible. Example:
  - Crystalline silica
  - Asbestos
  - Talc
  - Coal
  - beryllium

Kelompok Bahan Kimia

A. GAS BERTEKANAN
   - Umumnya yang disimpan di dalam tabung-tabung yang bertekanan tinggi

B. MATERIAL YANG FLAMMABLE DAN COMBUSTIBLE
   - Flammable gases
   - Flammable liquids/solids
   - Combustible liquids/solids
Kelompok Bahan Kimia

- MATERIAL YANG FLAMMABLE DAN COMBUSTIBLE
  - Flammable aerosol
  - Reactive flammable (spontaneously combustible in air, or react with water to produce a flammable gas)

Kelompok Bahan Kimia

- MATERIAL YANG FLAMMABLE DAN COMBUSTIBLE
  - Flash point: suhu terendah dimana suatu cairan dapat berubah menjadi uap dan menyala jika diberi percikan api.
  - Flammable limits: rentang konsentrasi uap suatu material yang dapat menyala jika diberi percikan api.
  - Autoignition temp.: suhu dimana uap dari suatu cairan dapat menyala dengan sendirinya tanpa ada percikan api.
Kelompok Bahan Kimia

C. OXIDIZING MATERIALS

- Bahan kimia yang mudah bereaksi dengan mengoksidasi material yang dipajannya.
- Umumnya mengandung unsur hidrogen
- Contoh:
  - Asam kromat dan dikromat
  - Asam nitrat
  - Asam perklorat
  - Permanganat
  - dll

Kelompok Bahan Kimia

D. TOXIC MATERIALS

- Semua material yang dapat merusak tubuh dan organ tubuh baik struktur maupun fungsinya.
- Umumnya memajam dalam jumlah yang kecil
  - D1 – Material yang menyebabkan efek toksik yang cepat dan serius
  - D2 – Material yang menyebabkan efek: kronik, karsinogenik, teratogenik, reproduktif, mutagenik, dan iritan atau efek sensitif
  - D3 – Biohazard dan material infeksius
Kelompok Bahan Kimia

E. CORROSIVE MATERIALS

- Material yang pada saat kontak menyebabkan kerusakan yang terlihat, atau perubahan yang irreversible pada jaringan tubuh maupun logam.
- Mata adalah bagian yang sangat sensitif untuk mengalami kerusakan jika terkena bahan yang korosif.
- Umumnya dalam bentuk asam dan basa kuat

Kelompok Bahan Kimia

F. DANGEROUSLY REACTIVE MATERIALS

- Material yang sangat reaktif jika berinteraksi dengan material lain. Menghasilkan gas yang beracun bila bereaksi dengan air. Reaktif bila ada pengaruh suhu dan tekanan, gencangan, dll.
- Contoh:
  - Asam pirik kering
Lambang Bahaya Bahan Kimia

- Flammable Liquid
- Corrosive
- Poison
- Harmful Stow Away From Foodstuffs
- Marine Pollutant

Lambang Bahaya Bahan Kimia

- Dangerous When Wet
- Oxidizer
- Flammable Solid
- Non-Flammable Gas
- Flammable Gas
Lambang Bahaya Bahan Kimia

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<thead>
<tr>
<th>Rating Summary</th>
<th>Health (Blue)</th>
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<tr>
<td>4</td>
<td>Danger: May be fatal on short exposure. Specialized protective equipment required</td>
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<tr>
<td>3</td>
<td>Warning: Corrosive or toxic. Avoid skin contact or inhalation</td>
</tr>
<tr>
<td>2</td>
<td>Warning: May be harmful Inhaled or absorbed</td>
</tr>
<tr>
<td>1</td>
<td>Caution: May be irritating</td>
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<tr>
<td>0</td>
<td>No unusual hazard</td>
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<tr>
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<table>
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Special Notice Key (White)

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<th>Water Reactive</th>
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<tbody>
<tr>
<td>Oxidizing Agent</td>
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</table>
Sampling dan Pengukuran

- Environmental sampling
  - Sumber
  - Area yang terpajian/berisiko

- Personal sampling
  - Breathing zone
  - Biological monitoring

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Sampling dan Pengukuran

- Jenis sampel
  - Sampel udara (paling sering dimonitor)
  - Sampel air
  - Dll

- Alat sampel (udara)
  - Sampling bag
  - Impinger (media larutan)
  - Charcoal
  - Silica gel

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Sampling dan Pengukuran

• Sorbent Tube
  – Most widely used media for gases and vapors
  – Consist of small granules or beads
  – Adsorb the contaminant onto the surface
  – Packed into tubes to collect various amounts and types of chemicals

SAMPLE COLLECTION WITH SORBENT TUBES
Sampling dan Pengukuran

- **SAMPLE BAGS**
  - Used since the 1950’s to collect a fixed volume of an air-contaminant mixture into a flexible container for subsequent analysis.
  - Called “grab” samples in industrial hygiene and “whole air” samples in environmental field.

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Positive Pressure

Negative Pressure

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Sampling dan Pengukuran

- Alat Ukur (Analisis)
  - Gas chromatography
  - High Performance Liquid Chromatography
  - Atomic Absorption Spectroscopy
  - dll

Pengendalian

- Pengendalian pada sumber
  - Mengganti bahan kimia atau proses yang lebih aman
  - Modifikasi proses kerja
  - Isolasi/enclosure process

- Pengendalian di sepanjang area pajaran
  - Local exhaust ventilation
  - General ventilation
  - House keeping
Pengendalian

- Pengendalian pada pekerja
  - Pendidikan dan latihan
  - Menutup (enclose) pekerja
  - Respirators, gloves, dan chemical protective clothing
  - Lunch and locker rooms, lavatories, eye wash, shower.

Pengendalian (menurut bentuk fisik)

- Dust, Fume, Fiber, Mist
  - Ventilation
  - House keeping, HEPA vacuum
  - Respirators
  - Clean break and lunch room
  - Clean storage for food, etc.
  - Hand washing facilities
  - Gloves
  - Chemical protective clothing
Pengendalian (menurut bentuk fisik)

- Vapor, Gas
  - Ventilation
  - Respirators
- Liquid (jika ada vapor, lihat point di atas)
  - Hand washing facilities
  - Gloves
  - Chemical protective clothing

Pengendalian (menurut cara masuk)

- INHALASI
  - Ventilation
  - Housekeeping, HEPA vacuum
  - Respirators
- INGESTI
  - Clean break and lunch room
  - Clean storage for food, etc
  - Hand washing facilities
Pengendalian (menurut cara masuk)

- **ABSORPSI KULIT**
  - Gloves
  - Chemical Protective Clothing
- **INJEKSI**
  - Desain pekerjaan yang memungkinkan terhindar dari kontak dengan cara tersebut.

TERIMA KASIH