

# **Hygiene & Safety in Fermentation Industries**

**-Dr. Ekta Khare**

**Department of Microbiology  
Institute of Biosciences & Biotechnology,  
CSJM University, Kanpur**

# Occupational vs. Industrial Hygiene

- **Definition 1 (International Occupational Hygiene Association – IOHA)**  
“Occupational Hygiene is the discipline of anticipating, recognizing, evaluating and controlling health hazards in the working environment with the objective of protecting worker health and well-being and safeguarding the community at large.”
- **Definition 2 (American Industrial Hygiene Association - AIHA)** “That science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors and stresses arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among citizens of the community”
- The term Industrial Hygiene originated in the USA while in other parts of the world it is known as Occupational Hygiene.
- In some ways the term Occupational is a better description as health risks occur in all places that people work such as offices, shops, hospitals and farms, not just in places you would think of as industrial.
- Ideally, hazards are identified and controlled when a workplace is being planned, when conditions or processes change, or through yearly reviews, before they become an issue for workers.

# Industrial Hygienist

- In order to help ensure proper industrial hygiene and thus the health and safety of your workers, you can employ an industrial hygienist.
- The role of an industrial hygienist is to “anticipate health and safety concerns and design solutions to prevent them.
- The American Board of Industrial Hygiene certifies industrial hygienists, providing a well-respected benchmark in the field.
- Qualification of an Industrial Hygienist :
  - A person having a college or university degree (s) in:
    - engineering,
    - chemistry,
    - physics,
    - medicine or related physical and biological sciences,
  - who has also received specialised training in recognition, evaluation, and control of workplace stressors and therefore achieved competence in industrial hygiene.

# Anticipation of potential risks

- Best done in the design stage of a process or equipment or at the formulation stage of a new substance or chemical
- Advantage: Eliminate the need for review or redesigning, thus save high costs.
- Basic information to consider while anticipation of potential risks:
  - Characteristics of the process or equipment
  - Physical and chemical properties of the formulation
  - Adverse health effects from past experience and reported cases of occupational diseases and poisoning
- The process of anticipation is not easy and requires vast experience.
- Need to engage the assistance of experts such as the industrial hygiene practitioner, toxicologist and occupational health doctor.

# Recognition of Health Hazards

- Industrial hygienists can also conduct a worksite analysis to evaluate all jobs, operations, machinery, and work activities at that site.
- This may be achieved through:
  - Workplace inspection i.e. Look at workplace environment, work processes, types of materials & equipment used;
  - Observe workers at work
  - Health surveillance and area monitoring
  - Workers health records
  - Review of past Incident investigation reports.
  - Discussion with the management and workers
  - Area toxic gas monitoring
- Hazard recognition:
  - Identifying factors or work processes that may be harmful to health.
  - Knowledge of the physicochemical properties of a material/ substance, its harmful effects to health and identification techniques are essential.

# Health Hazards Encountered at Work

- **Key Components of Industrial Hygiene**
  - Chemical Substances
  - Physical agents
  - Biological agents
  - Ergonomics
  - Psychological factors

# Chemical Substances

- Chemical hazards can take many forms, from liquid to fumes to dusts, and can be absorbed, inhaled, or ingested into a worker's system.
- Some common chemicals that can potentially be hazardous are cleaning products, gasoline, and pesticides.
- Many chemicals can be harmless in small doses, but even some common chemicals can cause symptoms in those who are particularly sensitive, and most chemicals can cause adverse effects in large doses or when proper safety precautions are not taken.
- Recognition of Chemical Hazards:
  - Odors – Not all agents have detectable odor
  - Frequent headaches
  - Dermatitis
  - Drowsiness
  - Personality changes
  - Clusters of problems
- These precautions include ventilation, personal hygiene such as hand washing, which can reduce the amount of chemicals absorbed by the skin, and maintaining equipment in order to prevent leaks and breakdowns.

# Physical Hazards

- Excessive exposure to the following physical hazards may cause harm to our health:
- **Noise** recognition:
  - Need to shout
  - Ringing sensation
  - Degraded hearing after work
  - Auditory testing
- Noise issues can be addressed in several ways, including designing a facility to minimize noise, separating workers from noisy machinery as much as possible, and using devices, such as ear muffs or ear plugs, to protect workers.
- **Indoor air quality:** Indoor air quality can be impacted by many factors, including pollution from machines or tools inside the building, highway pollution outside the building, dusts from mechanical processes, or gasses.
  - Poor air quality can cause issues ranging from chronic coughs to nausea to severe headaches.
  - Proper ventilation is important to ensure that fresh air is brought into the work area and air filtering in an heating ventilation air conditioning (HVAC) system can help remove contaminants from the air.



# ...Physical Hazards

- **Radiations:** These are two types: – non-ionizing radiation and ionizing radiation.
- Ultraviolet (UV) radiation and laser radiation are the types of non-ionizing radiation most likely to cause safety concerns, usually burns, for workers.
- UV radiation is a particular problem for outside workers, such as gardeners.
- Ionizing radiation can cause more considerable health risks for workers, and can be found in settings ranging from health care facilities to nuclear reactors and their support facilities.
- This type of radiation damages cells, and possible long term effects include cancer and sterility.
- Exposure to ionizing radiation should be limited as much as possible, and workers should be shielded from radiation by materials such as lead or concrete.
- **Temperature:** Both high and low temperatures can cause problems for workers.
- If temperatures are too high, workers are vulnerable to heat stroke or heat exhaustion; heat stroke is a medical emergency that requires immediate attention.
- Workers should be allowed to slowly adapt to the heat (acclimatization) and drink small amounts of water frequently, and air should be cooled whenever possible.
- Prolonged exposure to low temperatures can lead to hypothermia or frostbite. Workers should be allowed to wear warm clothing, and take breaks in warmer temperatures when possible.

# Biological Hazards

- Living organisms such as fungi, viruses, and bacteria, can enter the body and cause both acute and chronic infections.
- Workers who deal with plants or animals and laboratory or medical workers are particularly at risk for biological hazards, but all workers can be at risk for hazards such as mold, and bacteria that cause Legionnaire's disease.
- Proper hygiene such as hand washing, ventilation, personal protective equipment such as gloves or respirators, and in certain cases, isolation of the hazard, can all help minimize the risks associated with biological hazards.

# Ergonomic Hazards

- The goal of ergonomics (the study of people at work), is to reduce stress and eliminate injuries associated with bad posture, overuse of muscles, and repeated tasks.
- Effects of exposure to ergonomic hazards:
  - Musculoskeletal Disorders (MSDs)
    - Exposure to ergonomic risk factors for MSDs increases a worker's risk of injury
      - Repetition
      - High force
      - Awkward postures
    - Work-related MSDs are among the most frequently reported causes of lost or restricted work time.
- It's important to involve workers in the process to ensure tasks are fit to the worker and workers are properly trained on aspects such as how to lift boxes correctly.
- Ergonomics can be improved through solutions such as changing the chairs or keyboards office workers use, introducing tools to reduce repetitive tasks, or limiting time on certain jobs.



# Psychological Hazards

- Tensions at the workplace may disturb the concentration and mental health of the worker.
- Examples of Tensions at the workplace
  - Monotonous work
  - Excessive workload and overtime
  - Poor work relationships with colleagues and supervisors
  - Shift work
  - Remuneration and annual leave issues
  - Sexual Harassment

# Evaluation of Health Hazards

- To determine the level of worker exposure (high, medium or low) to health hazards and the effectiveness of the existing control measures, and their relationship to the risk of disease.
- To enable decisions to be made on additional control measures to bring the health risks down to within PEL (Permissible Exposure Limit). – e.g. engineering control to reduce airborne contaminants, worker training, health surveillance.

## **Risk Evaluation:** Risk = Hazard x Exposure

- Hazard Component = Magnitude of hazard and the potential adverse health effects from possible routes of entry or contact.
- Exposure Component = Chances of overexposure by taking into account:
  - Characteristics of exposure:
  - Who exposed (job type)?
    - How many exposed?
    - What are they exposed to?
    - How they exposed (inhalation, skin, ingestion)?
  - Level of exposure: Frequency, duration and intensity of exposure
- Risk Conclusion – takes into account the work practices and personal factors including individual susceptibility.

# Control of Health Hazards

- After a hazard is identified, an industrial hygienist will work with the company to control or eliminate the hazard.
- This can include substituting a chemical for a less hazardous one, reducing exposure to hazards, utilization of personal protective equipment such as gloves or goggles, or increasing ventilation.
- Principle of Risk Control:
  - Prioritise the control measures at the source, not the worker (It is easier to control processes, machinery and equipment than to control workers)
  - Prioritise the elimination of hazards, not the reduction of exposure (Reduction of exposure is only recommended where it is not possible to eliminate or isolate the hazard)
  - Controls should target below the permissible exposure limits (Exposure beyond the permissible limits is harmful to worker health)
  - Controls should be as low as reasonably practicable, especially in cases where there is no data on the permissible exposure limit (Many chemicals do not have permissible exposure limits)
  - Use of personal protective equipment (PPE) as a last resort

# Other Methods to increase the levels of Control on health risk at the Workplace

- Provide Information
- Instruction and training to workers.
- Exposure monitoring
- Health surveillance
- First aid and emergency facilities
- Warning signals

# Questions

- What is the hygiene and safety measures guidelines for any fermentation industry.
- Write a short note on hygiene and safety in fermentation industries.
- What is occupational hygiene? Explain the disciplines to be considered for maintenance of hygiene and safety in fermentation industries.