SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2017-18
M.Sc. INDUSTRIAL HYGIENE AND SAFETY
SEMESTER-II

PS02CIHS21: INDUSTRIAL VENTILATION

1.Introduction of ventilation

1.1 Purpose of ventilation
1.2Types of ventilation

1.3 General principles of ventilation

Introduction

Supply system, Exhaust systems, Basic Definitions such as static pressure, velocity pressure, total pressure, etc.

Principles of Air flow
Acceleration of Air and Hood Entry losses
Duct Losses
Multiple-Hood Exhaust systems
Air Flow Characteristics of Blowing and Exhausting

1.4 General Industrial Ventilation

Introduction, Dilution Ventilation Principles, Dilution Ventilation for Health

Mixtures-Dilution Ventilation for Health Dilution Ventilation for Fire and Explosion

Ventilation for Heat control, Heat Balance and Exchange. Ventilation system

2.0 Local exhaust ventilation systems

2.1 Applications, components of a local exhaust system, types of losses, losses and velocity pressure, friction, elbow and branch entry losses
2.2 Hood design and selection, selecting and designing ductwork, fan selection
Hood Design,Contaminant Characteristics, Hood Types, Hood Design Factors, Hood Losses, Special hood Requirement
2.3 Duct, Types of Duct, Flow in Ducts,Losses, Correction in ductwork
2.4 Air Cleaning Devices
Selection of Dust Collection Equipment, Dust Collector Types
Control of Mist, Gas and Vapor Contaminants
Gaseous Contaminant Collectors, Selection of Air Filtration Equipment
2.5 Fans Basic Definitions, Fan selection
2.6 Non-Standard Condition Corrections for water vapor in air (Relative Humidity)
Density Correction factor Air flow, Velocity Pressure, Vapor generation, System design

3.0 HVAC and makeup air systems

3.1 Introduction of HVAC
3.2 Makeup air systems
3.3 Placement of supply registers, Supplied-air islands
3.4 HVAC component and system types

4.0 Testing of Ventilation Systems

4.1 Introduction

4.2 Pressure Measurement, Volumetric Flow Measurement

4.3 Air Velocity Instruments, Calibration of Air/Measuring Instruments

4.4 Evaluating Exhaust Systems

Suggested Books

1. Industrial ventilation "A manual of recommended practice": Committee on industrial ventilation, sold by ACGIH 1220 kemper – Meadow Drive, Cincinnati, CH 45240
2. D Jeff Burton, Industrial Ventilation Workbook, Edition III
3. Ventilation: 91 3rd International Symposium on Ventilation for Contaminant Control by : Robert T Hughes, Howard D Goodfellow, gyan S Rajhans
4. Industrial ventilation, A Manual of Recommended Practice Edition 14, by ACGIH
5. ***Industrial ventilation, A Manual of Recommended Practice Edition 28,2013, by ACGIH***
6. Industrial ventilation, A Manual of Recommended Practice Edition 23, by ACGIH
7. Vitalized Ventilation and Air Conditioning by ILG
8. ***Industrial Ventilation Workbook Edition 4 by D Jeff Burton***
9. Managing Indoor Air Quality by Shirley J Hansen
10. Indoor Air Quality by Phillip J Walsh, Charles S Dudney and Emily D Copenhaver
11. Indoor Air Quality: Design Guide by Milton Meckler
12. Controlling Radon Measurment, Mitigation and Prevention by Kenneth Q.Lao
13. Industrial Ventilation 23rd Edition,A Self sudy companion to the ACGIH ventilation manual

PS02CIHS22: Hazard Identification, Assessment and Control Techniques

1. Types of accidents and performance rates

1.0 Definitions

1.0.1 Accidents – Reportable, Non-Reportable, Fatal, Non-Fatal. Near miss and loss time accidents. Disabling injury.

1.0.2 Accidents reportable under the factories act, ESI Act and Electricity Act.

1.1 Safety Performance Rates

1.1.1 Frequency rate, severity rate, incidence rate, frequency severity index, safety score.

1.1.2 Worked examples.

1.2 Types of disablement

1.2.1 Temporary and permanent disablement

1.2.2 Partial and total disablement

1.2.3 Time charges schedules in workmen's compensation act 1923

1.2.4 National and international standards.

1.2.5 Worked examples

2. Accident and incident investigation, reporting and analysis

2.0 Accident and incident investigation

2.0.1 Philosophy, purposes, process and types of investigations.

2.0.2 Identifying the key factors and the immediate and basic causes. Corrective action.

2.0.3 Agencies investigating accident.
2.0.4 Accident investigation form.
2.0.5 Methods of writing of accident investigation report.

2.1 Accident reporting

2.1.1 Reporting to authorities in statutory forms.
2.1.2 Writing reports. Essential elements
2.1.3 Reporting within prescribed time limits.
2.1.4 Reporting of dangerous occurrences.
2.2 Accident and incident analysis
2.2.1 Standard classification of factors associated with accident
2.2.2 Methods of collating and tabulating data.
2.2.3 Record keeping.
2.3 Safety appraisal and control techniques
2.3.1Plant safety rules and procedures
2.3Safe operating procedures (SOP)
2.3.2Safety checklists.
2.3.3Safety work permits
2.3.4Plant safety inspections
2.3.5Safety sampling and Safety survey.
2.4 Job safety analysis (JSA).
2.5 Safety inventory system. Safety tag system
2.6 Total loss control and prevention

3.0 Hazard identification and risk assessment techniques

3.1 Hazards and risks
3.1.1 Definitions and terminology for hazard and risk assessment
3.1.2Difference between hazard and risk and their co-relation
3.1.3Prioritization of hazards and risks
3.2 Hazard and risk progression chart
3.2.1 Hazard identification
3.2.2 Hazard analysis
3.2.3 Risk analysis
3.2.4 Risk assessment
3.2.5 Risk management
3.3 Hazard and risk analysis
3.3.1 Quantitative and qualitative risk analysis
3.3.2 Failure mode and effect analysis (FMEA).
3.3.3 Failure mode, effect and criticality analysis (FMECA)
3.3.4 Maximum credible accident analysis. Example of each
3.3.5 Preliminary hazard analysis (PHA) and Hazard Analysis (HAZAN).
3.3.6 Hazard and Operability study (HAZOP).
3.3.7 Management oversight review technique (MORT)
3.3.8 Incident Recall Technique
3.3.9 Critical incident review techniques etc.
3.3.10 Use of safety audit and checklists for Hazard Analysis.
3.4 Risk Assessment
3.4.1 Comparing analysed risks with acceptable criteria (permissible limits) and giving judgement for further safety measures if necessary.
3.4.2 Variety of risks and assessment methods including FTA, ETA etc.
3.4.3 Use of Computer Models.

4.0 **Major accident hazard (MAH) controls**
4.1 Concept of MAH:
4.2 Definition of “Major Accident Hazard”

4.3 Identification and assessment of MAH units. criteria and classification of threshold quantities of hazardous materials.
4.3 Applicability of respective rules (MSIHC Rules or Rule 68-J, GFR).
4.5 Compliance of statutory provisions.
4.4 Assessment of fire, explosion and toxicity by Dow and Mond Index.
4.5 Assessment of reliability of vessels and safety fittings. Data of failures rates and its utility.
4.6 Gas dispersion, fire and explosion events.
4.6.1 Assessment of probability (frequency) and consequence (effect) of such hazardous events. Scenario identification and Consequence Analysis.
4.6.2 Computer modeling
4.6.3 Population density, vulnerable zones, probit equation and percentage fatality,
4.6.4 Types of damage and damage distances. Risk counter.
4.6.5 F-X and F-N curves
4.6.6 Criteria for acceptable risks. Assessment and areas of evacuation.
4.7 Safety audit, safety report and risk assessment report.
4.7.1 Preparation of safety audit as per IS:14489
4.7.2 Preparation of Risk Assessment Report and its compliance.
4.7.3 Preparation of Safety Report.
4.7.4 Use of identified risks and scenarios from safety audit, safety report and risk assessment report for emergency planning. Compliance.
4.8 Emergency planning (disaster management plans)
4.8.1 Preparation of Rehearsal of On site and off site emergency plans
4.8.2 Execution of chemical accidents (EPPR) rules. Role of govt., role of management local authorities and public.

Suggested Books

1. Accident prevention manual for industrial manual for industrial Operations, national Safety Council 425, North Michigan Ave, Chicago, Illinois, USA.
2. Encyclopedia of occupational Health and safety, fourth edition, ILO, Geneva.
3. Safety and Health for engineers, by Roger L. Brauer, Van Nostrain Reinhold, New York.
4. Loss prevention in the process industries, Frank P Lees, Butterworth Heinemann,
5. Occupational Safety Management & Engineering by Willi Hammer.
3. Safety At work by John Ridley.
4. Handbook of Industrial safety by K.U. Mistry, Siddharth Prakashan, 108 western plaza, Near Bhulka Bhavan School, Adajan Road, Surat – 395 009. (Gujarat)
5. Major Hazard Control – A Practical Manual, ILO, Geneva.
6. Chemical Process Safety Fundamentals with applications by Daniel A crawl and Joseph F. Louvar, Prantice Hall, New Jersey.

PS02CIHS23: PHYSICAL ASPECTS OF THE ENVIRONMENT

Noise

1. Basic of Noise

1.1 Physiology of Hearing, Definition, How to produce, Characteristics of Noise, Physics of sound, Properties of Noise

1.2 Operation with Decibels: Sound pressure, Sound Powar, Internsity, Conversion, Amplitude, Sound weighing

1.3 Kind of Noise, Limit of ACGIH, NIOSH, OSHA, Factory Act 1948

1.4.Instrumentaion for Sound Measurement

1.5 Types of Instruments: Sound Level Meter, Dosimeter, And Integrated Sound Level Meter, Octave Band Analyzer (Frequency Analyzer), Calibrator

1.6 Application, Purpose and use of Instruments

1.7 Basic elements of Sound Level Meter with block diagram, Introduction of Microphone,

Attenuator, Amplifier, Networking Weighing and display.

Definitions: Criterian Level, Exchange Rate and Threshold

1.8. **Sound Measurement Techniques**

Identification of Noise problem in Workplace, General Noise inspection data

Important points while planning noise measurement

Measurement Method: Addition Method

Background Noise Level Correction

a. Environmental Factor Consideration during Noise Survey
b. Contour (Noise Mapping) Continuous, variable, Impulsive/Impact Noise Measurement, Noise Calculation: Dose, TWA, LA, Permissible Noise Exposure , Octave Band Analysis

1.10 **Effects of Noise :**Audiometry and Non audiometry

1.11 Control of Noise

Basic Principles of noise control

Single and double wall transmission loss calculations.

Application of engineering Noise control measures

Vibration measurement and control Sound level specifications

1.12Personal Hearing- Protective Devices

1.13 Noise Monitoring Programme

2 .Human Vibration **10**

2.1 Definitions: vibration, frequency, amplitude, acceleration, and resonance.

2.2 Types of vibration: Segmental and whole body vibrations and examples

2.3 Quantifying vibration level, vibration parameters, acceleration, velocity and displacement

2.4 Industrial Equipment causes vibration and reasons.

2.5 Health effects of hand and arm vibrations and its symptoms.

2.6 Accelerometer types, characteristic, frequency range and mounting of accelerometer.

2.7 Taylor-Pelmear classification of vibration-induced white finger by stages and The Stockholm Workshop classification scale for cold-induced vascular (blood flow) Symptoms in fingers with hand-arm vibration syndrome.

Vibration measurement, calibration, frequency analysis, force and impedance measurement , logarithmic scale and decibels, defining filter bandwidth and filter bandwidth considerations, environmental influences on vibration

2.8 Controlling exposure to vibrations with examples, safe work practices, employee education

2.9 Standards Or Guidelines For Exposure To Hand-Arm Vibration and whole body Vibration.

Heat Stress

3 .1 **Introduction of Heat Stress**: **10**

Causal Factors,Definitions:Heat,Calories,Conduction,Convection,Evoprative Cooling,Radiation,globe Temperature, Metabolic Heat, Natural Wet Bulb Temperature, Dry bulb Temperature, Globe Temperature

Investigation Guideline : Employer and Employee Interview Examples"

Activity Assessment of Work, Walk around inspection,Work load Assessment

3.2 Sampling Methods : Body Temperature Measurement and Environmental Temperature Measurement

3.3Wet bulb globe temperature index3.4 Average Web Bulb Globe Temperature (WBGT)

3.4.1 WBGT measurement for Indoor

3.4.2 WBGT measurement for Outdoor

3.4.4 WBGT correction Factor

3.4 Permissible heat exposure threshold limit values

4. **Ionizing radiation** **12**

4.1 Definitions, Types of ionizing radiation: Alpha, beta, neutrons, X- radiation, gamma radiation, Atomic and nuclear structure, Radiation source: Natural and Manmade

4.2 Biological Effect of Radiation: Types of injuries, Relating dosage to damage

4.3 Standards and Guides

4.4 Monitoring Instruments: Film Badge,Thermoluminescence detectors, Pocket Dosemeter,Other dosemeter,Ionization Chamber, Geiger-Mueller Counters, Calibrator

4.5 Basic Safety Factors: Time, Distance and Shielding with Examples

4.6 Control Programmes : Consider the sources of radiation, consider operational factors, consider employee exposure potential, records

4.7 Radioactive Waste and Standards, Radiation protection and emergencies

4.8 Radiation Protection Rule and Act**4.9 Non-Ionizing Radiation**

4.9.1 Review of electromagnetic energy spectrum

4.9.2 Physics of Non ionizing radiation (Microwave and radio Frequency

4.9.3 4.9.3Bio effects of Non-ionizing radiation

4.9.4 Exposure criteria and future concerns

Reference Books

1. Bruel & Kjaer : Noise Control : Principles and Practice
2. Arnold P G Peterson & Ervin E Gross Jr. : Handbook of Noise Measurement
3. Peter L. Pelmear, William Taylor, Donald E. Wasserman : Hand-Arm vibration : A Comprehensive Guide for Occupational Health Professionals
4. A J Brammer & W. Taylor : Vibration Effects on the Hand and Arm In Industry
5. Donald C Gasaway : Hearing Conservation : A Practical manual and Guide
6. NIOSH: Manual for measuring occupational Electric and Magnetic Field Exposure
7. Vibration Effects on the Hand and Arm in Industry by A J Brammer and W. Taylor
8. Guidelines on Noise by American petroleum Institute
9. Environmental Radioactivity Edition 3, by Merril Eisenpud
10. Electron Impact Phenomena and the Properties of Gaseous Ions by F H Field
11. Low-Level Radioactive Waste Regulation : Science, Politics and Fear by Michael E Burns
12. A Handbook of Radioactivity Measurements Procedures by Natonal Council
13. Understanding Radioactive Waste Edition 3, by Raymond L Murray
14. Environmental Aspects of Nuclear Power by Geoffrey G Eichholz
15. and-Arm Vibration by Pelmear, Taylor and Wasserman

16. Hearing Conservation : A Practical manual and Guide by Donald C Gasaway
17. Noise Control in Industry : A Practical Guide by Nicholas P Cheremisinoff
18. Industrial Noise and Hearing Conservation by Ollishifiski and Harford
19. Extremely Low Frequency Electromagnetic Fields : The Question of Cancer by Bary W Wilson, Richard G. Stevens, Larry E. Anderson
20. Basic Industrial Hearing Conservation by Barr and Miller
21. An Introduction to Radiation Protection Edition 3 by Martin and Harbison
22. Hearing Conservation Programs Practical Guidelines for Success by julia Doswell Royster and Larry H Royster
23. Handbook of Noise Measurement by Arnol P G Peterson and Ervin E Gross
24. Occupational Noise Exposure Revised Criteria 1998 CDC
25. Radiation Protection (Which was xerox from notes given by Dr. Narayan)

PS02CIHS24 : SAFETY IN CHEMICAL INDUSTRY

1.0 GENERAL

Inevitable place of Chemical Industry in society. Need of safety in chemical industry. Types of chemical industries.

1.1 Process flow chart and its importance for safety inspection

1.2 Types of Chemical Hazards – Hazards due to material (property), unloading and transfer, process, vessel or equipment, utility, pollution, fire explosion, toxic release, packing and loading etc. appropriate control measures.

1.3 Interpretation, use and training of material safety data sheets (MSDS)

1.4 Supervision by qualified supervisors

1.5 U.N, HAZCHEM and other classification of chemical. Classification as solid, liquid, gases, explosive, reactive, toxic, radioactive, corrosive etc.

1.6 Safety and Risk Phrases.

1.7 Criteria for sitting and safe layout of chemical plants

1.8 Statutory provisions

1.9 Information to workers (Safety Manual), Factory Inspectorate, District Authorities and the Public. Information to surrounding hospitals.

1.10 Instrumentation for safe plant operations. Auto controls, trips, alarms interlocks, PLC, DCS etc. for storage and process vessels.

2. Storage Hazards and Controls:

2.1 Receiving, Storing and Handling of Chemicals

2.1.1 Safe unloading procedure to storage tank or go-down

2.1.2 Purpose and design of dyke, its floor, slope, pit, valve and lining

2.1.3 Prevention of overflow, pressure, temperature and process flow.

2.1.4 Types of gauges and valves for the vessel, its inlets and outlets.

2.1.5 Need of remote and auto control valves.

2.2 Safety measures for storage tanks of Oleum, Acids, Alkalis, Chlorine, Ammonia, LPG and Ethylene oxide.

2.3 Safety of storing and using gas cylinders, colour coding, marking and ensuring safe connection of cylinder. Testing of safety fittings.

2.4 Design of storage shed or go down, retention basin, catch pot or dump vessel etc. safe placement of containers. Compatibility considerations.

2.5 PROCESS HAZARDS AND CONTROLS:

2.6 Safe design of process vessels and their fittings. Material of construction and lining depending on type of chemical and its process.

2.7 Hazards and controls in Unit Processes and Unit Operations including exothermic or runaway reaction, solvent distillation, toxic reaction and other hazardous processes evolving gas, dust vapor etc.

2.8 Use of measuring vessel for safe transfer, safe charging of material in close or vacuum system, use of scrubber, column, condenser, catch pot, vent, header and safe discharges. Use of appropriate gauges, valves, trips, alarms, interlocks, auto controls and other instrumentation. Safety features of DCS control room.

2.9 Process Safety Management .

Product Safety

Product Secret

2.10 Safety in Laboratory. Sampling and analysis.

3.0 . **TRANSFER OF CHEMICALS**

3.1 Pipeline Transfer

Safe transfer of chemicals by pipelines within and outside installations, above and underground and submarines.

3.2 Safety of pipelines

Work permit while opening or repairing pipelines of hazardous contents.

Colour coding, earthing, bonding and testing of pipelines

3.3 Work permit while opening or repairing pipelines of hazardous contents.

3.4 Avoiding use of air pressure transfer in open condition so as to cause hazard.

3.5 Transfer in closed system or vacuum with appropriate controls and with the use of PPE.

3.6 Safety in connection and operation of valves and fittings.

3.7 TRANSPORTATION OF CHEMICALS:

3.8 Safety precautions for transporting hazardous / toxic / flammable / explosive / radioactive substances by all modes.

3.9 Threshold quantities as per Public Liability Insurance Act.

3.10 Training to drivers, safety checklists for transport vehicles and use of "Tremcard".

4.0 **INSPECTION, TESTING AND MAINTENANCE**

Inspection techniques for plants, storage and reaction vessels

4.1 Checklists for routine inspection, preventive and break down maintenance.

4.2 Testing, certification and records in prescribed Forms.

4.3 Types of testing including NDT.

4.4 Fired and unfired pressure vessels, their design, construction, operation and testing. Compliance of codes and statutory provisions. Role of a competent Person.

4.5 Corrosion, erosion, location, causes, inspection and prevention. Cathodic protection.

4.6 Safe start up and shut down procedures emergency shutdown. Use of work permit or checklist.

REFERENCES

1. Laboratory Health and Safety Handbook : A Guide for the Preparation of a Chemical Hygiene Plan by R Scott Stricoff, Douglas B Walters
2. Accident Investigation and Loss Control by Jeffry W Vincoli
3. Product Labeling And Health Risks : By Louis A Morris
4. Guide to Safe Handling of Compressed Gases by Matheson
5. Responding to Community Outrage : Strategy for Effective Risk Communication by Peter M Sandman
6. Handbook of Occupational Safety and Health by Lawrence Slote
7. Accident Prevention Manual for Industrial Operations Edition 8 y National Safety Council
8. A Safe Place of Work by D W B James
9. Compendium of Safety Data Sheets for research and industrial Chemicals Part 4 by Keith and Walters
10. Compendium of Safety Data Sheets for research and industrial Chemicals Part 5 by Keith and Walters
11. Handbook of Emergency Response to Toxic Chemical Releases by Nicholas P Cheremisinoff
12. The MSDS - your Guide to Chemical Safety
13. Chemical Process Safety Fundamental with Applications by Daniel Crowl
14. Safety and Accident Prevention in Chemical Operation,Second Edition,Howard H.
15. Process Safety Management : OSHA Audit Protocol

PS02CIHS25: Practical's, Seminar and VIVA Based on PT02CIHC21 and PT02CIHC23

Sr. No.	Particles/Seminars/Work Exercise
1	Seminar on need of general ventilation in Factory
2	Seminar on need of local exhaust ventilation system in factory
3	Exercise on emission source behaviour and problem characterization of industrial ventilation
4	Seminar indoor air quality study
5	Exercise on air density, Velocity pressure, Duct diameter, selection of fan and air horse power etc.
6	Exercise on Design of General and Local /Exhaust Ventilation system
7	Introduction of Velometer and Anenometer Practical on measurement of velocity and pressure from LEV and General Ventilation installed for various occupations
	Total
Sr. No.	Particles/Seminars/Work Exercise
1	Demonstration and Practice of Sound Level Meter, Integrated Sound Level Meter, Noise Dosimeter, Calibrator
2	Preparation of Noise Monitoring Form, Checklist, Interview sheet
3	Workplace Noise monitoring in Workshop/Engineering Unit
4	Personal Noise Monitoring in Industry/Bus Driver by using Sound Level Meter
5	Hand Arm and Whole body Vibration monitoring by using vibration meter/accelerometer
7	Illumination measurement in Factory by using luxmeter
8	Environmental heat stress monitor in foundry operation by using quest heat stress monitor
9	Seminar on Ionisation and non ionization radiation (30 mins per student)
	Total

PS02EIHS21: Industrial Visits and Seminars

- **Industry visits to learn about processes and Industrial Hygiene & Safety Management practice.**
- **Practical workshop in industry include all exercise of industrial hygiene and safety**

1.0) Industrial Visit :First Two Months of Semester and as when possible during course of study)

1.1 As a part fulfillment of study for Master of Industrial Hygiene & Safety, the students are required to make industrial visit, study the existing Hygiene and Safety conditions on shop floor.

1. The students along with faculty shall carry out ***at least 10 Industrial visits.***

2. Each student will prepare his/her **visit report** and **submit to the faculty**.

Industrial visits are useful to see and experience the actual implementation of the best hygiene and safety provisions including statutory requirements. The students see the application of various control measures including ventilation system, machine guards, safety devices, personal protective equipment and process controls.

2.0) Seminars (First in first Month of the Semester)

2.1 Preparation of the Seminar on various issue on Industrial hygiene, safety and health .

The preparation and presentation of seminar will also help the students to understand the subject thoroughly and to improve his drafting and presentation skill for a technical document.

Sample topics for the seminar are given below

1. The concept of safety
2. Importance of "Man" in Accident Prevention Work.
3. Main problems of industrial safety.
4. Usefulness of Accident causation theory
5. Accident pronness
6. Best Method for safety motivation
7. Managerial Functions for a safety officer.
8. Planning for Safety.
9. Organising for safety
10. Directing and controlling for safety
11. Participation for safety
12. Good Housekeeping
13. Machine Guarding
14. Safety while using hand tools
15. Effects of good ventilation
16. Effects of good lighting
17. Effects of colour on Safety
18. Electrical hazards and control measures
19. Static electricity – hazards and controls
20. Best fire control measures
21. Techniques of noise control

22. Fall accidents and remedial measures
23. Working in a confined space
24. Storage hazards and controls
25. Process hazards and controls
26. Transportation hazards and controls
27. Safety in textile industry
28. Safety in pesticides industry
29. Accident investigation technique
30. Difference between hazard and risk
31. Difference between hazard and risk
32. Step of Risk Assessment
33. MAH Control
34. Concept of threshold quantities
35. Difference between industrial Hygiene and Health
36. Co-ordination between safety officer, industrial hygienist and factory medical officer.
37. Works of Competent Person
38. Ergonomics and its usefulness
39. Hazards of load carrying
40. Criteria for Work Station Design
41. Best use of PPE
42. Occupational Diseases – Detection and Control
43. First Ad – Its Key Point
44. Safety provisions under the factories act 1948
45. Safety provisions under the Gujarat Factories Rules 1963
46. Sitting Criteria
47. Bulk Storages – Hazards and Controls
48. Safety in Pipeline Transport
49. Safety aspects of Pressure Vessel

PS02EIHS22: Accident Case Studies

1. Need of Accident Case Studies.

1.1 Effects of Accident

2. The World Scenario

2.1 History of industrial disasters

3. Some Fatal Accidents

3.1 Bhopal Gas Disaster
3.2 Flixborough Explosion
3.3 Toxic Release at Seveso
3.4 Chernobyl Nuclear Diaster
3.5 Toluene Distillation
3.6 Fire of Ethylene oxide
3.7 Phosphine Exposure
3.8 2-4 and 2-5 Dichlorophenol
3.9 Exothermic Reactions
3.10 Hydrogen Explosion
3.11 HCN Gassing
3.12 Acrylonitrile Fumes
3.13 Grinding Wheel
3.14 Ball Digestor Blunder
3.15 Pugmill Gearing
3.16 Fire while Ship breaking
3.17 Mistake of Valve Operation
3.18 HPCL Refinery Fire at Vizag
3.19 Wrong Connection of Gas-cylinder

3.20 Any Accidents happened during course of study

4.0 SAFETY MEASURES TO AVOID ACCIDENTS

4.1 Preventive Actions
4.2 Corrective Actions

Suggested Books

1. Safety Circulars of Factory Inspection Offices.
2. What Went Wrong? - Trevor A. Kletz, Gulf Publishing Co., Houston.
3. Lessons from Typical Accidents in the Indian Chemical Industry, ICMA, Mumbai-23.
4. Still Going Wrong! Case Histories of Process Plant Disasters and How They Could Have Been Avoided by Trevor Kletz
5. Fundamentals of Industrial Safety and health by Dr K U Mistry 2012 Revised