

OSHA MANUAL FOR PCBs

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OCCUPATIONAL HEALTH AND SAFETY (OSHA) MANUAL FOR POLYCHLORINATED BIPHENYLS (PCBs)



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I. INTRODUCTION

It has been internationally recorded that around 6,300 people die as a result of occupational accidents or more than 2.3 million deaths per year due to work related diseases. Annually, 317 million accidents occur on the job. Therefore long term effects on the health and safety of the human being working in the event is not fully assessed. The cost of human life is huge and the economic burden of poor occupational safety and health practices is estimated at 4 percent of global Gross Domestic Product each year.

Safety and Health at Work place and the Environment, Safe Work practices, Worldwide Awareness of the dimensions and consequences of work-related accidents, injuries and diseases is an important aspect to be dealt with the agencies that are running the work systems.

II. INDIAN NATIONAL POLICY ON SAFETY, HEALTH AND ENVIRONMENT AT WORK PLACE

India has a national policy and following are the details. It is the responsibility of both the governmental or non governmental firms to abide by the policy guidelines and provide necessary safety, health and environmental protection or else the firm is liable to be used by the available laws for the violations.

1. PREAMBLE

- 1.1. The Constitution of India Provides detailed provisions for the rights of the citizens and also lays down the Directive Principles of State Policy which set an aim to which the activities of the state are to be guided.
- 1.2. The Directive Principles Provide guidance on/such that;
 - a) Securing the health and strength of employees, men and women;
 - b) The tender age of children are not abused;
 - c) The citizens are not forced by economic necessity to enter avocations unsuited to their age or strength;
 - e) That the Government shall take steps, by suitable legislation or in any other way, to secure the participation of employee in the management of undertakings, establishments or other organizations engaged in any industry.

2. GOALS

The Government firmly believes that building and maintaining national preventive safety and health culture is the need of the hour with a view to develop such a culture and to improve the safety, health and environment at work place

3. OBJECTIVES

The policy seeks to bring the national objectives into focus as a step towards improvement in safety, health and environment at workplace and continuous reduction in the incidence of work related injuries, fatalities, diseases, disasters and loss of national assets.

4. ACTION PROGRAMME

For the purpose of achieving the goals and objectives, the following action program is drawn up and where necessary time bound action program would be initiated, namely.

4.1. ENFORCEMENT

- By providing effective enforcement machinery as well as suitable provisions for compensation and rehabilitation of affected persons;

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- By effectively enforcing all applicable laws and regulations concerning safety, health and environment at workplaces in all economic activities through an adequate and effective labour inspection system;
- By establishing suitable schemes for subsidy and provision of loans to enable effective implementation of the policy;
- By ensuring that employers, employees and others have separate but complementary responsibilities and rights with respect to achieving safe and healthy working conditions; □ By amending expeditiously existing laws relating to safety, health and environment and bring them in line with the relevant international instruments;
- By monitoring the adoption of national standards through regulatory authorities;
- By facilitating the sharing of best practices and experiences between national and international regulatory authorities;
- By developing new and innovative enforcement methods including financial incentives that encourage and ensure improved workplace performance;

4.2. NATIONAL STANDARDS

- By developing appropriate standards, codes of practices and manuals on safety, health and environment for uniformity at the national level in all economic activities consistent with international standards and implementation by the stake holders in true spirit;
- By ensuring stakeholders awareness of and accessibility to applicable policy, documents, codes, regulations and standards;

4.3. COMPLIANCE

- By encouraging the appropriate Government to assume the fullest responsibility for the administration and enforcement of occupational safety, health and environment at workplace, provide assistance in identifying their needs and responsibilities in the area of safety, health and environment at workplace, to develop plans and program in accordance with the provisions of the applicable acts and to conduct experimental and demonstration projects in connection therewith;
- By calling upon the co-operation of social partners in the supervision of application of legislations and regulations relating to safety, health and environment at work place;

4.4. AWARENESS

- By increasing awareness on safety, health and environment at workplace through appropriate means;
- By providing forums for consultations with employers' representatives, employees representatives and community on matters of national concern relating to safety, health and environment at work place with the overall objective of creating awareness and enhancing national productivity;
- By encouraging joint labor-management efforts to preserve, protect and promote national assets and to eliminate injuries and diseases arising out of employment;
- By raising community awareness through structured, audience specific approach;
- By continuously evaluating the impact of such awareness and information approach;
- By maximizing gains from the substantial investment in awareness campaigns by sharing experience and learning;
- By suitably incorporating teaching inputs on safety, health and environment at work place in schools, technical, medical, professional and vocational courses and distance education program;
- By securing good liaison arrangements with the International organizations;

- By providing for research in the field of safety, health and environment at workplace, including the social and psychological factors involved, and by developing innovative methods, techniques including computer aided Risk Assessment Tools, and approaches for dealing with safety, health and environment at workplace problems which will help in establishing standards;
- By exploring ways to discover latent diseases, establishing causal connections between diseases and work environmental conditions, updating list of occupational diseases and conducting other research relating to safety, health and environmental problems at workplace;
- By ensuring a coordinated research approach and an optimal allocation of resources in Occupational Safety and Health sector for such purposes.

4.6. OCCUPATIONAL SAFETY AND HEALTH SKILLS DEVELOPEMENT

- By building upon advances already made through employer and employee initiative for providing safe and healthy working conditions;
- By providing for training program to increase the number and competence of personnel engaged in the field of occupational safety, health and environment at workplace;
- By providing information and advice, in an appropriate manner, to employers and employees organizations, with a view to eliminating hazards or reducing them as far as practicable;
- By establishing occupational health services aimed at protection and promotion of health of employee and improvement of working conditions and by providing employee access to these services in different sectors of economic activities.

4.7. DATA COLLECTION

- By compiling statistics relating to safety, health and environment at work places, prioritizing key issues for action, conducting national studies or surveys or projects through governmental and non- governmental organizations;
 - By reinforcing and sharing of information and data on national occupational safety, health and environment at work place information amongst different stake holders through a national network system on Occupational Safety and Health;
 - By extending data coverage relevant to work-related injury and disease, including measures of exposure, and occupational groups that are currently excluded, such as self-employed people;
 - By extending data systems to allow timely reporting and provision of information;
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- An initial review and analysis shall be carried out to ascertain the current status of safety, health and environment at workplace and building a national Occupational Safety and Health profile.
 - National Policy and the action program shall be reviewed at least once in five years or earlier if felt necessary to assess relevance of the national goals and objectives.
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- There is a need to develop close involvement of social partners to meet the challenges ahead in the assessment and control of workplace risks by mobilizing local resources and extending

protection to such working population and vulnerable groups where social protection is not adequate.

- Government stands committed to review the National Policy on Safety, Health and Environment at Workplace and legislations through tripartite consultation, improve enforcement, compilation and analysis of statistics; develop special program for hazardous operations and other focus sectors, set up training mechanisms, create nation-wide awareness, arrange for the mobilization of available resources and expertise.

III. SAFETY FEATURES

1.0. Poly Chlorinated Biphenyls: Methodological approach to the Occupational health and safety

- a. Awareness about the chemical
- b. Awareness about the process of treatment
- c. Awareness about the safe storage
- d. Awareness about the accidental spillage
- e. Awareness about the crisis management
- f. Emergency Task Force

1.1. About Poly Chlorinated Biphenyls: Methodological approach to the Occupational health and safety

It may be noted that national policy in place it would be easier to follow the policy in its full description and then have guidelines to ensure the occupational and safety in case of Poly Chlorinated Biphenyls.

Guidelines on occupational health and safety are based on the hazards observed in the historical use PCB's, systematic and comprehensive analysis of hazards existing in a given occupation be it the equipment owner, maintainer, monitoring agency or de-chlorination and final disposal agency. Each nature of work has to have a descriptive guideline so that the worker in each of these area and general public so that overall it would be ensured that health, safety, control of pollution and safe disposal are achieved.

Persistent Organic Pollutants (POP) and Stockholm Convention: Global attention

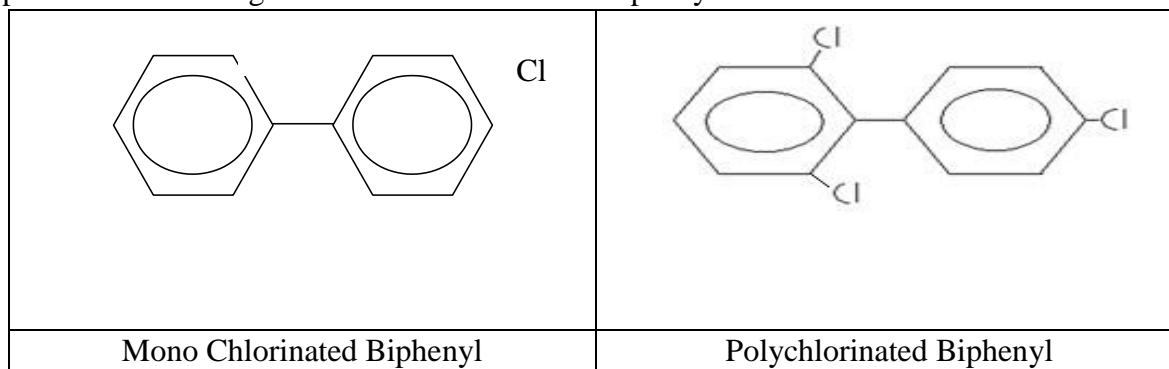
Chemicals that have very stable structure and have toxic effect on living beings have been perceived to be having potential threat for the survival of life itself on the planet. International awareness on this subject led to Stockholm Convention. This convention is a global treaty to protect human health and environment from Persistent Organic Pollutants (POPs). POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in fatty tissue of living organisms and are toxic to humans and wildlife. POPs circulate globally and can cause damage wherever they travel.

1.3. Poly Chlorinated Biphenyls (PCB's) and their Chemistry

These are chemicals which were man made, found to have very good dielectric properties and fire resistance properties. These were manufactured between 1930 to 1980 in large quantities for use in power equipments, hydraulic oils and other applications. Though PCB's were never manufactured in India, but they were imported in the form of electrical and other equipment containing this liquid.

PCB's are usually having their brand names such as Arochlor, Phenochlor and Pyralene. These are also named with numbers along with their brand names such as Arochlor 1242, 1254 & 1260 etc. In these names first two numbers i.e. 12 refer to the presence of 12 Carbon atoms in the structure. Next two numbers refer to the percentage of chlorine in the molecule.

Poly Chlorinated Biphenyls are the organic molecules having two benzene rings connected at one end and chlorination at one or more or all the ten corners of phenyl rings. In view of many type of possible molecular structural combinations around 209 congener molecules are possible. These range from Mono Chlorinated Biphenyl



1.4. Poly Chlorinated Biphenyls (PCB's) and their Toxicity

PCB's were found to highly stable and refuse to be degraded in soil, water, algae, fungi bacteria and other oxidative mechanisms operating in environment in a natural manner.

Toxicity of PCB's increase with the increase in Chlorine % in their molecule. These molecules have been observed to be getting accumulated in fatty tissues in the living bodies and will stay for life time and will also be transferred to their off-springs.

Animal experiments have shown that PCB mixtures produce adverse effects that include liver damage, skin irritations, reproductive and developmental effects, and cancer. People exposed to PCBs in the air for a long time have experienced irritation of the nose and lungs, and skin irritations, such as acne and rashes. There are tests to find out if PCBs are present in human blood, body fat, and breast milk. Blood tests are probably the easiest, safest, and best method for detecting recent exposures to large amounts of PCBs. However, since all people in the industrial countries have some PCBs in their bodies, these tests can only show if one has been exposed to higher than- normal levels of PCBs. However, these measurements cannot determine the exact amount or type of PCBs one has been exposed to or how long exposition was.

Overall it has been felt that Poly Chlorinated Biphenyl and group of chemicals derived from these have been found to show following toxicities

- Carcinogenic effect ; Liver, kidney and other organs
- Found to have neuro-toxic effect on human beings and assumed to be responsible for Alzheimer's and other nerve disorder problems
- Found to have geno-toxicity : PCB's have been observed to reduce sperm counts and also have toxic effects on estrogen levels found in women.
- Found to increase diabetic conditions

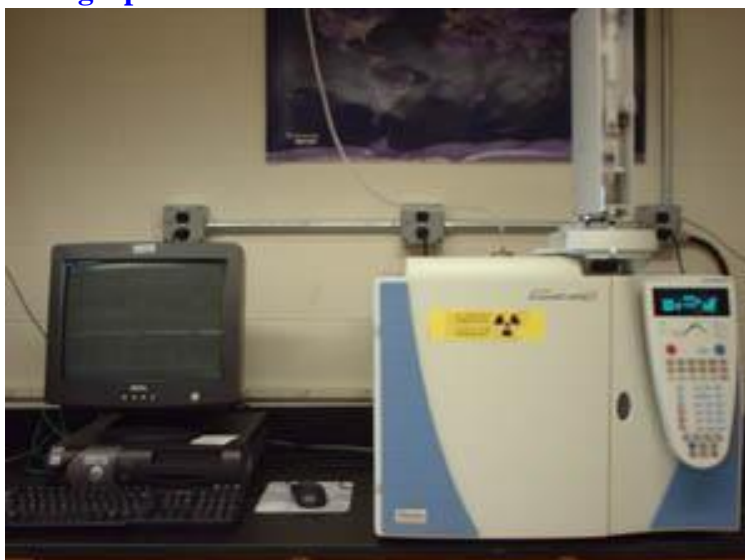
- PCB's are also assumed to have caused many other problems in living organisms.

1.5. Poly Chlorinated Biphenyls (PCB's): their detection and evaluation of their contamination.

Poly Chlorinated Biphenyls are highly soluble in mineral oils which were conventionally used as liquid dielectrics and bulk of PCB's manufactured are used as liquid dielectrics.

Gas Chromatographic (GC) techniques are very good techniques to evaluate chemicals and Electron Capture Detector (ECD) can be very sensitive chlorinated aromatic systems. Hence, internationally gas chromatography with electron capture detector is popularly used for detection of PCB contamination levels. Typically IEC 61619, ASTM 4059 and other standard test methods are used for evaluating PCB's from mineral oil matrix.

Typical Gas Chromatograph



2.0. Poly Chlorinated Biphenyls (PCB's) and their destruction

PCB's were found to highly stable and refuse to be degraded in soil, water, algae, fungi bacteria and other oxidative mechanisms operating in environment in a natural manner. Different countries have used various methods to avoid pollution and to destroy these compounds.

Combustion:

This method of destruction is the most widely used but not considered as environmentally sound technique. PCB's get pyrolysed to water, Carbon dioxide and Hydrochloride (HCl) when burnt at temperatures 1400°C-1600° C. This method has potential danger of producing highly dangerous chemical species which are highly dangerous and toxic and can cause serious implications on living organisms. This is more likely when the temperature of combustion is lower than 1200°C.

Encapsulation / burial: Though this method is not a destruction method but can effectively seal the material and avoid the pollution of this compound for long periods. Concrete capsules can be made and used to bury the PCB's and seal them off by concrete. Once this is done and when the concrete loses its capacity and without allowing leakage of PCB material and finally reach out and contaminate the water resources.

Chemical treatment of PCB's with Sodium Hydroxide: The method has been tried for destruction of PCB's. In this method sodium hydroxide is made to react with PCB's to generate sodium chloride and biphenyl and phenolic mixtures are being generated as side products. Though the technique appears to be simpler, the method has not acquired popularity as the side products of the reaction are phenols and have higher solubility with water and has easy mode of spreading the toxic material by travelling in aqueous systems for long distances. This situation can be very threatening as it can cause much higher damage immediately as compared to PCB's themselves.

Super Critical Water oxidation of PCB's: Super critical conditions can be achieved for any material in which liquid and vapour states co-exist and are not distinguishable. Water achieves this condition

when its temperature is above 374°C & pressure at 221 bar. PCB's, PAH's (Poly Aromatic Hydrocarbons), Waste plastics and other materials can be converted in to simple hydrocarbons and can be reused and recycled. The technology is not yet perfected and needs lot of technological developments to meet the requirements of PCB destruction.

Sodium metal based conversion of PCB's: In this process Sodium metal reacts with the chlorinated systems to dechlorinate the molecules at much lower temperatures than combustion. Whereas combustion seems to be the alternative for much faster and cheaper method. Keeping in view of the geographical conditions we may have to use combination of technologies to get rid of this problem.

2.1. Physical tools to be used

- Hand gloves
- Shoes
- Jackets
- Implementation of physical tools by the workers
- Implementation of basic instructions on arrival
- Minimum certificate course on PCB awareness to all the workers in the premises

2.2. Monitoring systems

- Physical inspection
- Inspection of health authorities
- Inspection of the maintenance engineers
- Soil testing
- Water testing
- Air testing
- Documentation

2.3. Reporting

- Reporting formats : Compliance reports of physical tools of safety
- Reporting formats: Compliance reports of awareness brochures
- Reporting formats: Inspection reports

2.4. Reporting formats should include the following threat perceptions and their probabilities

2.4.1. Threats to the equipment owners: working staff and others

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- Possible leakages in the given equipment, maintenance of gaskets, valves, storage containers, filtration systems and other accessories

2.4.2. Threat of pollution by spillage

- Leakages of valves, taps, gaskets and all other possible components are to be addressed on top priority. Management will ensure all the necessary funds will be given for such maintenance activity.

2.4.3. Threat of pollution by contamination

- Engineers would fully educate the working staff that the contaminated oil should not be mixed with any other oil and further contamination will be avoided.
- The accessories which come in to contact with the contaminated equipment will be cleaned and washings are also stored as contaminated and would be taken up for cleanup procedures
- All the cleaning consumables like waste cloth, cotton, tissues and any other consumables should be collected and would be taken up for clean up procedures.

2.4.4. Threat of pollution by combustion

- All the possible causes of fire near the contaminated equipment should be pre meditated and precautionary measures are to be in place
- In case of fire necessary instructions
 - Instructions for the people to move away and opposite to the direction of wind
 - Instructions for the fire extinguishers with special instructions about the PCB materials

2.4.5. Threat of pollution by oil vapors

- Prevent the high operating temperatures in the transformers having PCB or its contamination by taking measures like reduction of load and other associated activities
- Keep external cooling accessories in the place to prevent higher temperatures
- Keep the rooms ventilated and vapors getting pumped to get the vapors getting adsorbed in to air filter columns

2.4.6. Threat of pollution by oil spillage during transportation

- Keep the driver and his assistant informed of the material
- Keep the driver and his assistant informed of the precautionary measures like not to move with high speed, keep instructions to other vehicles that this vehicle is transporting hazardous material and keep distance.
- Avoid any other possible obstacles like trees and other blocks
- Keep the security agencies informed of the movement of the material
- Keep the emergency task force informed of the movement of the material
- Keep the control room informed of the movement track and updates on the present locations
- Keep the emergency instruction kit
- Keep emergency announcements
- Keep crisis management plan document in the vehicle

2.4.7. Threat of pollution by accidental explosions or mishaps during dechlorination process

- Keep the chemical processing process well below the safety levels
- Keep the monitoring frequency strictly followed
- Keep the status and monthly reports regularly submitted to the Safety officer
- Keep necessary updates during the maintenance schedules and attend to all the replacement necessities such as valves, taps, temperature controllers and pressure controllers
- Keep all the monitoring and inspection documents submitted to safety officer

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- 2.4.8. Responsibilities of Engineers towards prevention of pollution of water, soil, air, food and bio-system
- As engineers, working in the country, we have the responsibility towards preserving environment, preventing pollution, avoid possible spillages by taking pre planned maintenance and avoid any catastrophic failures.
 - It is our responsibility to inform and convince all the authorities concerned about the grave possibilities and measures to be taken to prevent such dangerous situation.
 - Being a citizen of the country and living being on the planet, we have the responsibility to prevent pollution of water, soil, water, air, food and bio system.
 - We are responsible in taking action to prevent pollution of any form and get ourselves educated in taking such action.
- 3.0. Documentation to be made available for the necessary information at easily accessible points for reference and use of all the concerned
- Guidelines for the general public
 - Guidelines for the working engineers
 - Guidelines for the working lab analysts
 - Guidelines for the water boards and other authorities
 - Guidelines for the agricultural authorities
 - Guidelines for the de-chlorination working engineers