ISSN No. : 0972-1266

ENVIS Newsletter

Vol. 20 No. 2 May 2013

Special Issue on Occupational Cancer

CSIR-Indian Institute of Toxicology Research
Lucknow, India

IN THIS ISSUE

EDITORIAL

Various types of occupational risks are known to cause cancer. It is estimated that every year millions of people die of cancer. These cases could be prevented through well planned interventions in the working environment to reduce the exposure. Occupational exposure is exposure to chemicals; groups of chemicals and mixtures; as well as specific type exposures in the working environment. There are some industrial occupations those are recognized as having higher risk for development of occupational cancers, lifestyle factors, are also adding towards development of some of the occupational diseases viz: tobacco smoking increases the development of lung cancer.

WHO's International Agency for Research on Cancer (IARC) has classified 107 agents, mixtures, and exposure situations as carcinogenic to humans. These include all forms of asbestos and a number of agents found in the environment such as benzene, arsenic in water, cadmium, ethylene oxide, benzo[a]pyrene, silica, ionizing radiation including radon, ultraviolet radiation, tanning devices, aluminium & coke production, iron & steel founding and the rubber manufacturing industry. As per WHO estimates 125 million people in the world are exposed to asbestos at the workplace more than 107000 people die each year from asbestos related lung cancer, mesothelioma and asbestosis. One in three deaths from occupational cancer is caused by asbestos. Lung cancer, mesothelioma, and bladder cancer are the most common types of occupational cancer.

When it comes to actual counting of occupational cancer cases it may be only a small portion of the total cancer cases, but here it is important to mention that occupational cancers are preventable and avoidable hazards to which individuals are involuntarily exposed. So giving priority to its prevention is a matter of social justice. There are large numbers of known and suspected occupational carcinogens present in the working environment but the current scientific as well as regulatory efforts are not keeping pace with the need.

Editors :
Dr. Anvita Shaw & Dr. Shailendra K. Gupta
ENVIS Team :
Mr. S.H.N. Naqvi, Ms. Vidisha Srivastava,
Mr. Krishna Pal Singh, Ms. Madhumita Karmakar
Published By :
Environment Information System (ENVIS)
Centre on Toxic Chemicals at
CSIR - Indian Institute of Toxicology Research,
Lucknow India

ODDS AND ENDS

Silicosis in India: past and present.

This particular review focuses on the burden of the problem of silicosis and its clinical manifestations reported from India. In recent estimates from India, there are over 3 million workers exposed to silica dust, whilst 8.5 million more work in construction and building activities, similarly exposed to quartz. Several recent reports on lung function assessment show both restrictive and obstructive patterns. Tuberculosis is a common complication reported in Indian studies. Occasionally, silicomycosis, lung cancer and connective tissue disorders in association with silicosis are also reported. The National Human Rights Commission (NHRC) in response to the direction from the Supreme Court of India has made several recommendations on preventive, remedial and rehabilitative measures. The NHRC has been asked to work with various stakeholders such as individual organizations, state and central governments and other agencies to implement the measures. Silicosis is a common occupational disorder seen all over India, particularly in the Central and Western States. It is an important cause of respiratory morbidity. The problem has been highlighted on the national level as a major human-rights concern in India.

Curr Opin Pulm Med. 2013 Mar; 19(2): 163-8.

CYP1A1 gene polymorphisms : modulator of genetic damage in coal-tar workers.

It is well known that polycyclic aromatic hydrocarbons (PAHs) such as benzo (a) pyrene have carcinogenic properties and may cause many types of cancers in human populations. Genetic susceptibility might be due to variation in genes encoding for carcinogen metabolizing enzymes, such as cytochrome P-450 (CYP450). This study aimed to investigate the effect of genetic polymorphisms of CYP1A1 (m1 and m2) on genetic damage in 115 coal-tar workers exposed to PAHs in their work place. Genetic polymorphisms of CYP1A1 were determined by the PCR-RFLP method. Comet and buccal micronucleus assays were used to evaluate genetic damage among 115 coal tar workers and 105 control subjects. Both CYP1A1 m1 and CYP1A1 m2 heterozygous and homozygous (wt/mt+mt/mt) variants individually as well as synergistically showed significant association ($P<0.05$) with genetic damage as measured by tail moment (TM) and buccal micronuclei (BMN) frequencies in control and exposed subjects. In this study authors found significant association of CYP1A1 m1 and m2 heterozygous (wt/mt) +homozygous (mt/mt) variants with genetic damage suggesting that these polymorphisms may modulate the effects of PAH exposure in occupational settings.

Asian Pac J Cancer Prev. 2012; 13(7):3409-16.

Evaluation of chromosomal alteration in electrical workers occupationally exposed to low frequency of electromagnetic field (EMFs) in Coimbatore population, India.

Extremely low frequency electromagnetic fields (EMFs) have been classified as possibly carcinogenic to humans by the International Agency for Research on Cancer. An increased number of chromosomal alterations in peripheral lymphocytes are correlated with elevated incidence of cancer. The aim of the present study was to assess occupationally induced chromosomal damage in EMF workers exposed to low levels of radiation. Authors used conventional metaphase chromosome aberration (CA) analysis and the micronucleus (MN) assay as biological indicators of non ionizing radiation exposure. In the present study totally 70 subjects were selected including 50 exposed and 20 controls. Informed written consent was obtained from all participants and the study was performed in accordance with the Declaration of Helsinki and the approval of the local ethical committee. A higher degree of CA and MN was observed in exposed subjects compared to controls, the frequency of CA being significantly enhanced with long years of exposure ($P<0.05$). Moreover increase in CA and MN with age was noted in both exposed subjects and controls, but was significantly greater in the former. The results of this study demonstrated that a significant induction of cytogenetic damage in peripheral lymphocytes of workers occupationally exposed to EMFs in electric transformer and distribution stations. In conclusion, these findings suggest that EMFs possess genotoxic capability, as measured by CA and MN assays; CA analysis appeared more sensitive than other cytogenetic end-points. It can be concluded that chronic occupational exposure to EMFs may lead to an increased risk of genetic damage among electrical workers.

Asian Pac J Cancer Prev. 2012; 13(6):2961-6.

Monitoring of oxidative stress in nurses occupationally exposed to antineoplastic drugs.

Antineoplastic drugs (ANDs) have been in clinical usage for more than five decades. The nonselective mechanism of action of ANDs between cancerous and noncancerous cells had well documented side effects such as acute symptoms, reproductive health issues, and potential cancer development in healthcare workers as a result of occupational exposure. The anticancer mechanism of ANDs is the generation of reactive oxygen species (ROS) which are responsible for various side effects in patients undergoing chemotherapy

and the healthcare personnel occupationally exposed to them. ROS have potential to damage lipids, DNA, proteins, and so on leading to oxidative stress condition. The aim of this study was to evaluate the possible oxidative stress effect of antineoplastic drugs in nurses who routinely handle ANDs in an oncology hospital in south India. Malondialdehyde levels, reduced glutathione content, and glutathione S-transferase activity were analyzed in serum collected from 60 female nurses handling ANDs and compared with equal number of healthy volunteers matched by age and sex except AND exposure. The results showed statistically significant ($P < 0.05$) increase in malondialdehyde levels in the serum of exposed nurses. However, glutathione content and glutathione S-transferase activity was significantly decreased in these nurses. This study suggests that the nurses occupationally exposed to ANDs were susceptible to the oxidative stress and emphasizes the need for a harmonized safe handling approach that assures minimal risk to the working nurses.

Toxicol Int. 2012 Jan;19(1):20-4.

Cytogenetic biomonitoring in petrol station attendants: A micronucleus study.

Benzene, which is a major organic product, on chronic exposure can result in many malignant disorders, and therefore exposure to gasoline vapors is classified by the International Agency for Research of Cancer as possible carcinogenic to humans. Petrol station attendants are chronically exposed to petroleum derivatives through inhalation of petrol during vehicle refuelling. This study is aimed to investigate cytogenotoxic damage in exfoliated buccal cells obtained from petrol station workers and control subjects using micronucleus (MN) test. This study was carried out on 30 petrol station attendants working at different petrol stations located in Indore. The control group consisted of 30 healthy subjects who were not exposed to benzene. Buccal cell samples were collected at the end of the work shift. Slides were stained and were evaluated to determine the MN frequencies. Exposure monitoring was performed by the detection of phenol excreted in the urine. Urinary phenol measurements were performed following the colorimetric quantitative determination method of Yamaguchi and Hayashi. Variations in MN frequencies were seen in control and petrol bunk attendants. The MN test in exfoliated epithelial cells seems to be a useful biomarker of occupational exposure to genotoxic chemicals. Phenol is the principal metabolite of benzene. Therefore, phenol concentration in the urine of exposed workers can be used as a biomarker of external exposure.

J Cytol. 2012 Jan; 29(1):1-5.

Anti-genotoxic potential of casein phosphopeptides (CPPs): a class of fermented milk peptides against low background radiation and prevention of cancer in radiation workers.

Radiation workers are constantly exposed to low background radiation which is their occupational hazard. This continuous and prolonged exposure produces genotoxicity and cancerous condition in many workers. The authors have tested casein phosphopeptides (CPP) as a radioprotectant against low background radiation using animal models. Fermented milk was produced by addition of a bacterial culture, *Lactobacillus acidophilus* to a commercially available milk brand. After the fermentation process is completed in the milk, CPP is isolated from fermented milk by enzymatic hydrolysis-based method. The radioprotective role of CPP was proved using albino mice and Catla catla fish. The micronucleus assay showed higher level of cell deformation and micronucleus formation in the control animal cells than the test animal cells. CPP has found to be having radioprotective activity potential. This radioprotective potential of CPP can be harnessed to produce formulations which can be used by radiation workers and personnel exposed to low ionization background as an occupational hazard, thus reducing the risk and preventing any type of cancer.

Toxicol Ind Health. 2011 Nov; 27(10):867-72.

A comprehensive analysis of plausible genotoxic covariates among workers of a polyvinyl chloride plant exposed to vinyl chloride monomer.

The aim of this study was to assess the frequency of chromosomal aberrations-including chromatid type aberrations (CTAs), chromosomal type aberrations, micronucleus (MN) comet assay, and XRCC1 399 Arg/Gln polymorphism-in peripheral blood lymphocytes of workers occupationally exposed to vinyl chloride monomer (VCM). A total of 52 workers and an equal number of controls were recruited into the study to explore the potential cytogenetic risk of occupational exposure to VCM. Questionnaires were administered to obtain details of habitual cigarette-smoking, alcohol-consumption pattern, and occupation, etc. The exposed subjects and controls were classified into two groups based on age (group I <40 years; group II ≥40 years), and exposed subjects were further classified based on exposure duration (>8 and ≥8 years). CTA, MN, and comet assay frequency were significantly greater in polyvinyl chloride (PVC) factory workers ($p < 0.05$) with long-duration work. CTA, MN, and comet assay values were found to be increased with age in exposed subjects as well as in controls, with exposed subjects showing a statistically greater degree. An extensively greater MN frequency was observed in smokers exposed to VCM than in the control group ($P < 0.05$). The mean tail length of exposed subjects was greater compared with controls. The study on XRCC1 399 Arg/gln polymorphism in PVC factory workers showed less significant

difference in allele frequency compared with controls. In conclusion, this result of work provides evidence for an apparent genotoxic effect associated with VCM exposure. Results reinforce the greater sensitivity of cytogenetic assays for biomonitoring of occupationally exposed populations. Statistics indicate that workers exposed to VCM are at carcinogenic risk and should be monitored for long-term adverse effects from their exposure.

Arch Environ Conta Toxicol. 2013; 64(4):652-658.

Association of gene polymorphism in detoxification enzymes and urinary 8-OHdG levels in traffic policemen exposed to vehicular exhaust

With rapid economic growth and massive development of transportation, the number of automobiles has greatly increased. Traffic police are the one of the vulnerable groups predominantly exposed to vehicular exhaust during traffic control. The present study is aimed to study the relation between occupational exposure to vehicular exhaust and oxidative stress (OS) in traffic police. Authors investigated the levels of 8-hydroxydeoxy-guanosine (8-OHdG), one of the most sensitive biomarkers for measuring OS and the association between polymorphisms in Cytochrome P450 (CYP) and Glutathione S-Transferase (GST) genes that are known to play a significant role in the activation and detoxification of xenobiotics. 148 non smoking male traffic policemen and 135 control subjects were selected for this study. The 8-OHdG levels were analyzed by liquid chromato-graphy with electrochemical detection method. Gene polymorphism was detected by multiplex PCR and RFLP method. 8-OHdG levels were found to be increased in traffic police with increase in the years of service in traffic control ($p = 0.02$) when compare to the controls. The results showed a significant increase in urinary 8-OHdG levels in mutated CYP1A1m1 ($p < 0.007$) and null GSTM1 ($p < 0.01$) genotypes. However the genotype frequencies of CYP1A1 m2 and GSTT1 genes did not vary in both exposed and control groups. This study suggests that exposure to vehicular exhaust over a period of time increases oxidative stress and subsequently induces oxidative DNA damage in traffic policemen. Preventive and therapeutic strategies may be considered for traffic policemen to minimize the adverse effects due to vehicular exposure.

Inhalation Toxicol. 2013; 25(1):1-8.

Genotoxicity in agricultural farmers from Guntur district of South India-A case study

Pesticides play an important role in controlling the pests on agricultural crops and thereby to increase the yield of agricultural produce. Farmers occupationally exposed to pesticides during spraying activities are more prone to genotoxicity than unexposed. To assess the genotoxicity in farmers, engaged in spraying complex mixture of pesticides in the cultivation of cotton crops. A total number of 152 male subjects were selected randomly from Guntur district of Andhra Pradesh (AP), South India. The demographic particulars viz., personal habits, duration of exposure to pesticides, types of pesticides used were collected from the study subjects using an interview schedule. Among them 76 subjects were farmers and the remaining individuals served as unexposed or controls. Blood samples from these subjects were collected for assessing the genetic damage by chromosomal aberrations (CAs) test and micronucleus test (MNT). The results of the study indicated that CA was significantly higher with 2.8% in farmers who were exposed to pesticides when compared to unexposed (0.72%). However, there was a minor difference in MN with 0.13% and 0.12% between exposed and unexposed which was not statistically significant ($p < 0.05$). A correlation between CA frequency and exposure to benzene hexachloride (BHC) pesticide residue was observed.

Human & Exp Toxicol. 2012; 31(7): 741-747.

Effect of nickel and chromium exposure on buccal cells of electroplaters.

The electroplating industry commonly involves the use of nickel and chromium. An assessment of the genotoxic effects of these metals can be carried out by micronucleus (MN) test in buccal cells. Other nuclear anomalies (NA) observed in buccal cells viz., karyorrhexis, pyknosis and karyolysis are also the indicators of genotoxicity. The current study aims at determining the extent of genotoxic damage in relation to the duration of exposure to nickel and hexavalent chromium via micronuclei induction and other nuclear anomalies. The present investigation included 150 subjects of which 50 individuals with no history of nickel/chromium exposure (Group I) were taken as control, 50 electroplaters exposed to nickel and hexavalent chromium for duration of less than 10 years (Group II) and 50 electroplaters exposed for >=10 years (Group III) were included. Slides of buccal cells were prepared and the frequency of MN (parts per thousand) and NA (parts per thousand) were calculated. ANOVA was applied to test significance. Results were considered significant at $p < 0.05$ and $p < 0.001$. Group III showed the highest MN frequency (1.08 +/- 0.54 parts per thousand, $p < 0.05$), karyorrhexis (20.75 +/- 6.29, $p < 0.05$), karyolysis (3.50 +/- 1.91, $p < 0.001$), binucleate (4.75 +/- 2.75, $p < 0.05$) and enucleated cells (5.75 +/- 1.70, $p < 0.05$). Significant increase in frequencies between Group II and III was found as duration of exposure

increased. Plasma nickel and chromium levels were also determined which showed a positive correlation with frequency MN and other nuclear abnormalities ($p < 0.01$).

Toxicol Ind Hlth. 2012; 28 (1): 74-82.

Influence of GSTM1 and GSTT1 genotypes and confounding factors on the frequency of sister chromatid exchange and micronucleus among road construction workers.

In the present study, authors have investigated the influence of polymorphism of GSTM1 and GSTT1 genes and confounding factors such as age, sex, exposure duration and consumption habits on cytogenetic biomarkers. Frequency of sister chromatid exchanges (SCEs), high frequency cell (HFC) and cytokinesis blocked micronuclei (CBMN) were evaluated in peripheral blood lymphocytes of 115 occupationally exposed road construction workers and 105 unexposed individuals. The distribution of null and positive genotypes of glutathione-S transferase gene was evaluated by multiplex PCR among control and exposed subjects. An increased frequency of CBMN (7.03 +/- 2.08); SCE (6.95 +/- 1.76) and HFC (6.28 +/- 1.69) were found in exposed subjects when compared to referent (CBMN - 3.35 +/- 1.10; SCE - 4.13 +/- 1.30 and HFC - 3.98 +/- 1.56). These results were found statistically significant at $p < 0.05$. When the effect of confounding factors on the frequency of studied biomarkers was evaluated, a strong positive interaction was found. The individuals having GSTM1 and GSTT1 null genotypes had higher frequency of CBMN, SCE and HFC. The association between GSTM1 and GSTT1 genotypes and studied biomarkers was found statistically significant at $p < 0.05$. Findings suggest that individuals having null type of CST are more susceptible to cytogenetic damage by occupational exposure regardless of confounding factors. There is a significant effect of polymorphism of these genes on cytogenetic biomarkers which are considered as early effects of genotoxic carcinogens.

Chemosphere. 2011; 84 (5): 564-570.

DNA damage and cholinesterase activity in occupational workers exposed to pesticides.

The present study was designed to evaluate genotoxicity, acetyl cholinesterase (AChE) activity, hepatic and renal toxicity in occupational workers exposed to mixture of pesticides (n = 70) with same number of healthy subjects as controls. The mean comet tail DNA % (TD %) and tail moment (TM) were used to measure DNA damage, while AChE activity and other biochemical parameters such as markers of nephrotoxicity (urea and creatinine) and hepatotoxicity (AST, ALT and ALP) were measured as biomarkers for toxicity due to exposure of pesticides. The occupational workers were continuously exposed to mixture of pirimiphos methyl, chlorpyrifos, temephos and malathion on a regular interval as per usage and activity. The comet assay using lymphocytes of exposed workers showed significantly higher TD percentage value (60.43% vs. 31.86%, $p < 0.001$) and TM value (14.48 mu m vs. 6.42 mu m, $p < 0.001$) in occupational workers as compared to controls. AChE activity in erythrocytes was found to be decreased (3.45 KAU/L vs. 9.55 KAU/L in controls, $p < 0.001$) and associated with the duration of exposure to pesticides used by the workers. Enzyme levels for hepatic and renal functions were also found significantly different in occupational workers than healthy controls ($p < 0.001$). These results suggest that the exposure to mixture of pirimiphos methyl, chlorpyrifos, temephos and malathion may induce DNA damage, decrease in AChE activity, hepatotoxicity as well as nephrotoxicity. Periodic biomonitoring of these biomarkers along with imparting education and training to occupational workers for safe application of pesticides is recommended for its potential hazards.

Environ Toxicol Pharmacol. 2011; 31 (2): 278-285.

Cytogenetic biomonitoring of road paving workers occupationally exposed to polycyclic aromatic hydrocarbons.

Road pavement workers are exposed to many known carcinogens in their complex occupational environment. The study makes an attempt to investigate exposure to polycyclic aromatic hydrocarbons (PAH) from the bitumen fumes among the road pavement workers engaged in different pavement sites at Coimbatore, Tamil Nadu and to thereby determine the genotoxic effects associated with it. The study included 36 road pavers and 37control subjects with similar mean ages, smoking prevalence and alcohol consumption was analyzed for DNA damage in blood leucocytes by Micronucleus assay (MN) and the Comet assay. The mean urinary 1-OHP concentration in road pavers (1.68 +/- 0.93) was significantly higher than in controls (0.55 +/- 0.42). The results of MN test and comet assay showed that the mean micronuclei rate in workers was significantly higher than those in controls ($P < 0.05$). The results of this study indicated that the genetic damage was detectable in road paving workers occupationally exposed to bitumen and also demonstrate the high sensitivity of comet assay to assess early oxidative effects induced by exposure to bitumen fumes at low doses and confirm the suitability of urinary 1-OHP as a biomarker of PAH exposure.

Asian Pac J Cancer Prev. 2011; 12(3): 713-717.

DID YOU KNOW

Cancer is a leading cause of death worldwide, millions of new cases coming up every year. Globally, one fifth of all reported cancers cases are attributable to the environment, both working and living.. WHO has classified 107 agents, mixtures, and exposure situations as carcinogenic to humans. Environmental causes of cancer are air pollution (indoor as well as outdoor both), UV radiation and radon. It has been estimated that every tenth lung cancer death is closely related to risks in the workplace. Lung cancer, mesothelioma, and bladder cancer are among the most common types of occupational cancers. Long lists of agents found in the workplace are known or probable causes of cancer. IARC has classified as human carcinogens 29 chemicals or physical agents, groups of agents or mixtures, to which exposure is mainly occupational and 15 industrial processes or occupations. Solvents such as benzene used in shoe production or the pharmaceutical and chemical industries are associated with acute non-lymphocytic leukaemia, aromatic amines used in the rubber industry were found to cause cancer of the urinary bladder, cadmium and chromium (VI) found in dye and pigments production cause lung cancer, and formaldehyde used in textile and plastic industries is related to nasopharyngeal cancer. Mineral oils, used as a lubricant by metal workers, in pharmaceutical and cosmetic preparations, and in the printing industry (ink formulation) are associated with skin cancer. Nickel refining and smelting and welding is associated with cancer of the lung, nasal cavity and paranasal sinuses. Exposure to arsenic in smelting nonferrous metals and metallurgical industries are also associated with lung, skin and urinary bladder cancer. Various PAH-related industries and -containing mixtures are also described as carcinogenic to humans by IARC: aluminium production, coal gasification, coke production, etc. Endocrine disrupting chemicals and carcinogens, some of which may not yet have been classified as such, are present in many occupational environments and could increase breast cancer risk.

CURRENT CONCERN

The types of cancer that have most commonly been linked with occupational exposures and for which evidence is strong, are those of the lung, urinary bladder, mesothelioma, larynx, leukaemia, angiosarcoma of the liver, nose and nasal cavity and skin.

Occupational exposures are avoidable hazards to which individuals are involuntarily exposed. Though occupational cancer represents only a small portion of the total number of cancer cases, but probably it may represent the majority of cancer cases among certain groups of workers exposed to some specific occupational hazards.

The prevention of occupational cancer in the formal sector relies heavily on legislation, here the population exposed to risk can be easily identified.

Occupational diseases- including cancers caused by various materials in the workplace, including asbestos, carcinogenic (cancer-causing) chemicals, silica, cotton, dust, and radiation, job stress and work shifts - usually take a long time to develop (from a few months to more than 10 years). And given changing work practices, most industries tend to hire workers on short-term contract. By the time they develop a disease, therefore, it is almost impossible to link it to their work. Not many doctors are able to correctly diagnose an occupational disease. In fact, certain occupational diseases like byssinosis (a lung disease caused by cotton dust) and silicosis (a lung disease caused by silica dust) are often wrongly diagnosed as tuberculosis. In a socity where very few doctors are available finding, an OSH specialist is simply out of the question. In most places, occupational safety and health invariably means prevention of accidents; very little attention is paid to occupational diseases. An accident-free workplace by no means implies a safe workplace.

REGULATORY TREND

The Factories Act, 1948, the Mines Act, 1952, The Dock Workers (Safety, Health & Welfare) Act, 1986 are the laws, which have provisions for safeguarding and regulating the workers health in any working environment and establishment. The Employees State Insurance Act, 1948 along with Workmen's Compensation Act, 1923 are taking care of compensatory requirement of the workforce.

CARCINOGEN LIST

The following is a list of substances NIOSH considers to be potential occupational carcinogens.

- Acetaldehyde
- 2-Acetylaminofluorene
- Acrylamide
- Acrylonitrile
- Aldrin
- 4-Aminodiphenyl
- Amitrole
- Aniline and homologs
- *o*-Anisidine
- *p*-Anisidine
- Arsenic and inorganic arsenic compounds
- Arsine
- Asbestos
- Asphalt fumes
- Benzene
- Benzidine
- Benzidine-based dyes
- Beryllium
- Butadiene
- *tert*-Butyl chromate;
- Cadmium dust and fume
- Captafol
- Captan
- Carbon black (exceeding 0.1% PAHs)
- Carbon tetrachloride
- Chlordane
- Chlorinated camphene
- Chlorodiphenyl (42% chlorine); class polychlorinated biphenyls
- Chlorodiphenyl (54% chlorine); class polychlorinated biphenyls
- Chloroform
- Chloromethyl methyl ether
- bis(Chloromethyl) ether
- *B*-Chloroprene
- Chromium, hexavalent [Cr(VI)]
- Chromyl chloride;
- Chrysene
- Coal tar pitch volatiles; class, coal tar products
- Coke oven emissions
- DDT (dichlorodiphenyl trichloroethane)
- Di-2-ethylhexyl phthalate (DEHP)
- 2,4-Diaminoanisoleo
- *o*-Dianisidine-based dyes
- 1,2-Dibromo-3-chloropropane (DBCP)
- Dichloroacetylene
- *p*-Dichlorobenzene
- 3,3'-Dichlorobenzidine
- Dichloroethyl ether
- 1,3-Dichloropropene
- Dieldrin
- Diesel exhaust
- Diglycidyl ether (DGE)
- 4-Dimethylaminoazobenzene
- Dimethyl carbomoyl chloride
- 1,1-Dimethylhydrazine
- Dimethyl sulfate
- Dinitrotoluene
- Dioxane
- Environmental tobacco smoke
- Epichlorohydrin
- Ethyl acrylate
- Ethylene dibromide
- Ehtylene dichloride
- Ethylene oxide
- Ethyleneimine
- Ethylene thiourea
- Formaldehyde
- Gallium arsenide
- Gasoline
- Heptachlor
- Hexachlorobutadiene
- Hexachloroethane
- Hexamethyl phosphoric triamide (HMPA)
- Hydrazine
- Kepone
- Malonaldehyde
- Methoxychlor
- Methyl bromide
- Methyl chloride
- Methyl iodide
- Methyl hydrazine
- 4,4'-Methylenebis(2-chloroaniline) (MBOCA)
- Methylene chloride
- 4,4-Methylenedianiline (MDA)
- *a*-Naphylamine
- *B*-Naphylamine
- Nickel, metal, soluble, insoluble
- Nickel carbonyl
- Nickel sulfide roasting
- 4-Nitrobiphenyl
- *p*-Nitrochlorobenzene
- 2-Nitronaphthalene
- 2-Nitropropane
- *N*-Nitrosodimethylamine
- Pentachloroethane
- *N*-Phenyl-*b*-naphthylamine
- Phenyl glycidyl ether
- Phenylhydrazine
- Propane Sultone
- *B*-Propiolactone
- Propylene dichloride
- Proplyene imine
- Propylene oxide

- Radon
- Rosin core solder, pyrolysis products (containing formaldehyde)
- Silica, crystalline cristobalite
- Silica, crystalline quartz
- Silica, crystalline tripoli
- Silica, crystalline tridymite
- silica, fused
- Soapstone, total dust silicates
- Tremolite silicates
- 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) (dioxin)
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethylene
- Titanium dioxide
- *o*-Tolidine-based dyes
- *o*-Tolidine
- Toluene diisocyanate (TDI)
- Toluene diamine (TDA)
- *o*-Toluidine
- *p*-Toluidine
- 1,1,2-Trichloroethane
- Trichloroethylene
- 1,2,3-Trichloropropane
- Uranium, insoluble compounds and soluble compounds
- Vinyl bromide
- Vinyl chloride
- Vinyl cyclohexene dioxide
- Vinylidene chloride (1,1-dichloroethylene)
- Welding fumes, total particulates
- Wood dust
- Zinc chromate

ON THE LIGHTER SIDE

- "So many people spend their health gaining wealth, and then have to spend their wealth to regain their health"
- The difference between engineers and mathematicians: An engineer was given the problem of removing two nails from a piece of wood. One of the nails had been hammered all the way in, while the other was slightly protruding. So the engineer first pulled out the protruding nail without much difficulty. Then, he dug in with his fingernails and slowly pulled out the second nail, taking far longer.

  Next, a mathematician was given the same problem. The mathematician started with the nail that was pressed all the way into the wood, similarly digging in and slowly making progress until the nail was removed. He then looked at the protruding nail, and said "Oh, that's easy-- I can reduce this to a problem I've already solved!" and started by pushing the protruding nail all the way into the wood.
- Chemists are the cleanest people you'll ever meet...they wash their hands even before they go to the rest room!

CONFERENCES

Building Design and Engineering Approaches to Airborne Infection Control

Boston, United States, 05 Aug 2013-16 Aug 2013

A significant bottleneck in the implementation of precautions against airborne transmission of infections around the world is the lack of technically qualified consultants. This two week, multidisciplinary program provides a unique opportunity to build the global engineering capacity to help control airborne infections of all types. Building Design and Engineering Approaches to Airborne Infection Control brings together a body of technical expertise common to the control of human airborne infections including tuberculosis (including drug resistant strains), H1N1 virus, pandemic influenza, SARS, and selected bioterrorism agents.

https://ecpe.sph.harvard.edu/programs.cfm.CSID=AIRO813

International Conference and Exhibition on Physical Medicine & Rehabilitation

Las Vegas, United States, 19 Aug 2013-21 Aug 2013

Physical Medicine-2013 is a unique event which brings together a unique and International mix of health concerned research institutions, leading universities, government organizations, treatment, and rehabilitation centers across the globe making the conference a perfect platform to share novel therapeutic innovations and challenges in the field of Physical Medicine & Rehabilitation. http://www.omicsgroup.com/conferences/physical-medicine-rehabilitation-2013/index.php

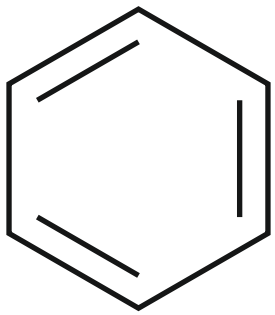
MINI PROFILE OF BENZENE

SYNONYMS : Annulene, Benzeen, Benzen, Benzol, Benzol 90, Benzole, Benzolo, Coal Naphtha, Cyclohexatriene, Phenyl Hydride

CAS RN : 71-43-2

MOLECULAR FORMULA : C_6H_6

MOLECULAR STRUCTURE:



MOLECULAR WEIGHT: 78.11

PROPERTIES: Clear, colourless liq; aromatic odour; BP: 80.1°C; MP: 5.5 °C; Miscible with alcohol, chloroform, ether, carbon disulfide, acetone, oils, carbon tetrachloride, & glacial acetic acid; Density/Specific Gravity: 0.8787. HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames. Vapours may form explosive mixtures with air. Vapours may travel to source of ignition and flash back. Most vapours are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks). Vapour explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated.

USES: Manufacture of industrial chemicals such as polymers, detergents, pesticides pharmaceuticals, dyes, plastics, resins. Solvent for waxes, resins, oils, natural rubber, etc, Used for printing and lithography, paint, rubber, dry cleaning, adhesives and coatings and Gasoline additive.

TOXICITY DATA:

LD_{50} Rat oral 3306 mg/kg

LC_{50} Rat ihl 10,000 ppm/7 hr

LD_{50} Rat ip 2890 ug/kg

LD_{50} Mouse oral 4700 mg/kg

LC_{50} Mouse ihl 9980 ppm

LD_{50} Mouse ip 340 mg/kg

PERSONAL PROTECTION: NIOSH has recommended that benzene be treated as a potential human carcinogen. Protective clothing consisting of coveralls or other full body clothing should be worn and changed at least twice weekly. Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Do not get in eyes, on skin, or on clothing.

Route	Symptoms	First Aid	Target Organ
Inhalation/ Ingestion	Ingestion or by breathing concentrated vapors, the major toxic effect is on the CNS symptoms from mild exposure including dizziness, weakness, euphoria, headache, nausea, vomiting, tightness in chest, & staggering. If exposure is more severe, symptoms progress to blurred vision, tremors, shallow & rapid respiratory, ventricular irregularities, paralysis, & unconsciousness.	First, Move the patient to fresh air. Administer supplemental oxygen and assist ventilation as required. Monitor closely for respiratory distress or cough Treatment is symptomatic and supportive. Correct any significant fluid and/or electrolyte abnormalities in patients with severe vomiting.	CNS, Respiratory
Contact Eye/Skin	A severe eye and moderate skin irritant.	Irrigate exposed eyes with copious amounts of room temperature water or normal saline for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen by an ophthalmologist. Remove contaminated clothing and wash exposed and wash exposed area thoroughly with soap and water.	Eyes, Skin

MAY WE HELP YOU

To keep abreast with the effects of chemicals on environment and health, the ENVIS Centre of
Indian Institute of Toxicology Research, deals with :

Maintenance of Toxicology Information Database on Chemicals

Information collection, collation and dissemination

Toxic Chemical related query response service

Preparation of monograph on specified chemicals of current concern

Publishing Abstract of Current Literature in Toxicology

for further details do write to

Scientist In-Charge

ENVIS CENTRE

CSIR-INDIAN INSTITUTE OF TOXICOLOGY RESEARCH

Post Box# 80, Mahatma Gandhi Marg, Lucknow-226 001 India.
Phone : (0522) 2284 591, Fax : (0522) 2628227
E-mail : itrc@envis.nic.in
Website : http://www.itrcenvis.nic.in