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INDUSTRIAL CARCINOGENS

INTRODUCTION

For the last 20 to 30 years, science and technology have taken giant steps. Massive amounts of new machines, processes and products are designed, produced and marketed annually. Thousands of new previously unknown chemicals are introduced into the market every year.

Only in the last few years have we realized that the great advantages of these new chemicals may be counteracted by posing serious health hazards to the manufacturer and user of these chemicals. The most serious of these hazards, the potential for carcinogenicity (cancer) to man, has alarmed industry and the public in general.

STANDARDS

Research into the carcinogenic potential of the myriad of chemicals has been very slow and in most cases inconclusive. Identification of cancer agents is further complicated by the difficulty of correlating animal experiments with actual human epidemiological data. The Occupational Safety & Health Administration (OSHA) has produced regulations for only 21 chemicals with carcinogenic potential to man. Strict standards and regulations have been established which are included in the Code of Federal Regulations 29 CFR 1910. Even for these, only a few have established permissible exposure limits. The American Conference of Governmental Industrial Hygienists (ACGIH) further recognizes that a few more are so toxic that no exposure or contact is permissible. However, more than half of these do not have any established Threshold Limit Values (TLV) or other permissible exposure limits.

Table No. 1 shows the carcinogens listed and regulated by OSHA.

The standards established by OSHA for the chemicals in Table No. 1 are specific on the various requirements. They further include exceptions by use and by percentage of carcinogen content.

CONTROL PROGRAM

The following is a summary of the basic requirements for a good carcinogen control program. For specific details, please consult the individual standard.

1. Substitute less toxic materials for known carcinogens.
2. A written, well-defined set of procedures should be established for the storage, use, and general control of these chemicals. Strict maintenance, cleaning, spillage control, and waste disposal procedures should be established. These procedures should be approved and implemented by top management.
3. Workers and supervisors who may be engaged in the use of these chemicals should be thoroughly trained as to the recognition, use and all other aspects relating to the chemicals. Regularly scheduled retraining sessions should also be established.

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4. Establish and maintain a separate inventory on all carcinogenic products.
5. Containment of the chemicals at all stages from storage to final use is vital. Open vessel systems should not be used.
6. Areas where these materials are being used or stored should be regulated and access to and exit from them should be restricted. Posted signs and documentation should be maintained as to the names of employees entering and leaving the restricted area.
7. If possible, only one well-trained person should handle these chemicals. All operations, especially the weighing and scooping of these chemicals, should be done within an effective local exhaust ventilation system. A laboratory type hood with front doors is recommended so that only the worker's hands, properly protected by gloves or glove boxes, are required to be introduced into the hood, leaving the face behind the glass window. Intermediate transfer of these materials should always be done in closed and tightly secured containers. These chemicals should be stored in closed containers in segregated areas under lock and key.
8. Adequate, approved respiratory and skin protection should be worn as required for each type of chemical. In most cases they may involve the use of self-contained breathing apparatus, full-body airtight suits or high efficiency filter respirators.
9. The removal of the personal protective equipment and work clothes should be done in wash areas adjacent to, but separate from, the work area. Employees should wash their hands and shower thoroughly before leaving the plant. Work clothes should never be taken home.
10. All employees exposd to the chemicals should undergo periodic medical examinations and the results of which, as well as the personnel exposure history, be maintained and documented as required.

RECOGNIZED HUMAN CARCINOGENS

In addition to the OSHA listed carcinogens, the ACGIH has listed substances (as **recognized** human carcinogens) associated with industrial processes. These are shown in Table No. 2 with any applicable TLV's.

SUSPECTED HUMAN CARCINOGENS

ACGIH has also listed industrial substances **suspect** of carcinogenic potential for man. Included in this series of chemicals are substances which are associated with inducing cancer but are based on either (1) limited epidemiological evidence, exclusive of clinical reports of single cases, or (2) demonstration of carcinogenesis in one or more animal species by appropriate methods. These chemicals, as opposed to those in Table No. 1, are presently used in a large variety of industries and processes with a great number of workers being exposed to them.

For the chemicals listed in Table No. 3, worker exposure by all routes should be carefully controlled to levels consistent with the animal and human experience data including those substances with a listed TLV.

As more information becomes available, chemicals in Table No. 3 may become regulated. It is also very likely that more chemicals will be associated with human carcinogenicity.

CONCLUSION

Continuing research will surely develop significant conclusions. While the chemicals mentioned in this bulletin are the most likely to be found in the work place, many more have or will be identified in pollution breakdown chains, natural animal and vegetable food items, among others. On the other hand, media

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reports tend to implicate many other compounds as potential cancer agents. When reviewing the latter, one has to scrutinize these reports as to their actual scientific background, completeness of research, and dose-response relationship (how much consumption will actually increase the potential for cancer).

TABLE 1
OSHA LISTED AND REGULATED CARCINOGENS

Standard	Name	Use	Type of cancer	TLV
1910 1001	Asbestos (a)	Various insulation filler	Lung & liver	2 fibers/cc greater than 5 micrometers in length
1910 1002	Coal Tar Pitch Volatiles (b)	Manufacture of steel asphalt, etc	Mainly bladder	0.2 mg/m^3
1910 1003	4-Nitrobiphenyl	Intermediate in production of 4-Aminodiphenyl	Bladder as 4-Aminodiphenyl	NEOC (ACGIH)
1910 1004	alpha-Naphthylamine	Intermediate in dyes, herbicides and antioxidants	Bladder with beta-naphthylamine	No TLV
1910 1005 (Deleted)	4,4' Methylene bis (2-chloroaniline) (MOCA) (c)	Curing agent for isocyanate-containing polymer	Non conclusive data	No TLV
1910 1006	Methyl chloromethyl ether	Production of ion-exchange resins and as chloromethylating agent	Lung (oat-cell)	No TLV
1910 1007	3 3' Dichlorobenzidine (and its salts)	Production of dyes curing agent for isocyanate containing polymers	Bladder (suspected)	No TLV
1910 1008	bis-Chloromethyl ether	Intermediate in production of various textile aids	Lung	0 001 ppm (ACGIH)
1910 1009	beta-Naphthylamine	Intermediate in dyes, antioxidants	Bladder	NEOC(ACGIH)
1910 1010	Benzidine	Dye manufacture	Bladder	NEOC (ACGIH)
1910 1011	4-Aminodiphenyl	Rubber antioxidant	Bladder	NEOC (ACGIH)
1910 1012	Ethyleneimine	Used to manufacture polyethyleneimine flocculant in water treatment intermediate oil additive adhesives, surfactants	Liver-cell & pulmonary (animals)	0 5 ppm (ACGIH)
1910 1013	beta-Propiolactone	Manufacture of acrylic acid and its esters	(animals)	No TLV
1910 1014	2-Acetylaminofluorene	Initially as pesticide	Various (animals)	No TLV
1910 1015	4-Dimethylaminoazo-benzene	Manufacture of coloring polishes and other wax products	Liver & bladder (animals)	No TLV
1910 1016	n-Nitrosodimethylamine	Solvent and in manufacture of rocket fuel, antioxidants, lubricant additives, and in condensers to increase dielectric constant	Liver & kidney (animals)	No TLV
1910 1017	Vinyl chloride (monomer)	Mainly PVC manufacture	Liver	1 ppm
1910 1018	Inorganic Arsenic	Foundries & smelters Pigment glass & paint manufacture	Lung & skin	10 ug/m^3
1910 1028	Benzene	Solvents Chemical intermediate	Leukemia, bone marrow	10 ppm
1910 1029	Coke oven emissions	Coke ovens (Steel foundries)	Lung, liver & skin	150 ug/m^3
1910 1044	1,2 dibromo-3-chloro-propane (DBCP)	Pesticide	Cancer & sterility	1 ppb
1910 1045	Acrylonitrile	Plastics, pesticide	Lung & colon	2 ppm

(a) All forms Chrysotile, amosite, crocidolite, tremolite anthophyllite and actinolite

(b) Particulate Polycyclic Aromatic Hydrocarbons (Benzene soluble fraction) Anthracene, benz(a)pyrene, phenanthrene, acridine chrysene, pyrene

(c) MOCA has been deleted from the OSHA carcinogen list

TLV = Threshold Limit Value

ACGIH = American Conference of Governmental Industrial Hygienists

NEOC = No Exposure or Contact

mg/m^3 = milligrams of contaminant per cubic meter of air

ppm = parts of contaminant per million parts of air, by volume

ppb = parts of contaminant per billion parts of air, by volume

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TABLE 2

Recognized Human Carcinogens Substances or substances associated with industrial processes recognized to have carcinogenic or cocarcinogenic potential with an assigned TLV

	TLV
Chromite ore processing (chromate)	0 05 mg/m^3 (as Cr)
Nickel sulfide roasting, fume & dust	1 0 mg/m^3 (as Ni)
1 2 Dibromoethane (ethylene dibromide)	NEOC

TABLE 3

Suspected Human Carcinogens
Industrial Substances Suspect of Carcinogenic Potential for Man

	TLV
3-Amino 1 2 4-Triazole	—
Antimony trioxide production*	—
Arsenic trioxide production	—
Benzene—Skin	10 ppm
Benz(a)pyrene	—
Beryllium	2 0 ug/m^3
Cadmium oxide production	—
Carbon tetrachloride	5 ppm
Chloroform	10 ppm
Chromates of lead and zinc (as Cr)	0 05 mg/m^3
Dimethylcarbamyl chloride	—
1, 1 Dimethyl hydrazine	0 5 ppm
Dimethyl sulfate—Skin	0 1 ppm
Ethylene dibromide—Skin	—
Hexachlorobutadiene	0 02 ppm
Hexamethyl phosphoramide—Skin	—
Hydrazine	0 1 ppm
4,4'-Methylene bis (2-chloroaniline)—Skin	0 02 ppm
Methyl hydrazine	0 2 ppm
Methyl iodide	2 ppm
2-Nitropropane	25 ppm (Ceiling Value)
n-Phenyl-beta-naphthylamine	—
Propane sultone	—
Propylene imine—Skin	2 ppm
o-Tolidine	—
Vinyl bromide	5 ppm
Vinyl cyclohexene dioxide	10 ppm

* Cigarette smoking can enhance the incidence of respiratory cancers from this or others of these substances or processes

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