

Health and Safety Fact File - Chemical Safety

Carcinogens

A substance which can cause uncontrolled cell growth to give rise to a cancer is called a carcinogen. The uncontrolled cell growth produces tumours and the term cancer is applied when a tumour invades and destroys other tissues in the body. There is no single mechanism of carcinogenesis and carcinogenic substances do not have a common chemical structure. The action of some, but not all, carcinogens involves direct reaction with nuclear DNA or they are metabolised in the body to substances which have this ability. The toxicity of asbestos may involve fibre length, substances released by the incomplete phagocytosis of long fibres and substances generated by reactions catalysed at the fibre surface.

Co-carcinogens

Substances which can enhance the activity of other compounds are called cocarcinogens, e.g., asbestos is believed to act synergistically with cigarette smoke. Yet further compounds, whilst not carcinogenic themselves may promote the carcinogenic action of other compounds.

Human Carcinogens

The smaller number of confirmed human carcinogens (see below for listing) have been identified as a result of human experience. The first material to be identified as a human carcinogen, over 200 years ago, was soot which was the cause of cancer of the scrotum in chimney sweeps. However, only 50 years ago were the polycyclic aromatic hydrocarbons, which are present in soot, recognised as carcinogens.

Carcinogenic chemicals present an exceptional health risk because the outward signs of a potentially fatal cancer may not show until many years even decades after first exposure and so there may be no early warning of the disease. It is also usually not possible to assign no-risk exposure thresholds to carcinogenic chemicals. Moreover, the level of exposure to a carcinogen only affects the probability of cancers occurring in any exposed population, not the severity of the disease in individuals.

Young persons may be more at risk from exposure to potential carcinogenic agents because the rate of tumour growth can be related to age. The foetus and babies are especially vulnerable and at high risk from harmful chemicals that have been absorbed by the mother. Special care is needed to ensure nursing mothers and women who are pregnant, or who may become pregnant are not exposed to carcinogens and other harmful chemicals.

Because of the exceptional health risks, [The Control of Substances Health Regulations](#) impose stricter and additional requirements for work with carcinogens. See also [University Hazardous Substances Policy on Carcinogens](#)

Carcinogenicity Testing

The majority of known carcinogens have been identified as a result of tests on animals. Although it does not automatically follow that these substances are also carcinogenic in man, a prudent precautionary policy has been adopted in the absence of evidence to the contrary. It is interesting to note that some human carcinogens are water-insoluble, unreactive hydrocarbons which are metabolised to carcinogenic species in the body.

Substances are now subjected to rapid screening for carcinogenic potential, by e.g., the Ames Test, which assumes that carcinogens have mutagenic activity. Although many of the known carcinogens have given a positive result with the Ames Test, there are some notable exceptions: arsenic, nickel and its salts, asbestos, benzene, DDT, all of which are non-mutagenic carcinogens.

Other Sources of Exposure to Carcinogens

In addition to occupational exposure to carcinogens, exposure can also result from atmospheric pollution, cigarette smoking, diet, radiation and drugs. A number of carcinogens occur naturally, including aflatoxin B1, one of the most potent carcinogens known which is produced by the fungus *Aspergillus flavus*. Bracken fern is a source of other carcinogenic substances.

Which Substances are Carcinogens?

The *Control of Substances Hazardous to Health Regulations (COSHH)* require further precautions and other arrangements for work involving carcinogens so it is important to know which substances are carcinogens. The COSHH regulations contain two definitions of carcinogen:

a substance classified as a category 1 or 2 carcinogen under the The Chemicals (Hazard Information and Packaging for Supply) Regulations (CHIP); or

a substance listed in or arising from a process specified in Schedule 1 of the COSHH regulations.

Substances Classified under CHIP as Carcinogens

The *Chemicals (Hazard Information and Packaging for Supply) Regulations (CHIP)* specify three categories of carcinogenic substance :

1. known to cause cancer in humans (assigned a "may cause cancer" risk phrase)
2. sufficient evidence, e.g. from long-term animal studies or other information , to presume may cause cancer in humans (assigned a "may cause cancer" risk phrase)
3. some evidence from appropriate animal studies but insufficient to place in category 2 either because full investigation inconclusive or further investigation required. (assigned "Limited evidence of a carcinogenic effect" risk phrase)

The lists below contain category 1 and 2 substances. Chemical carcinogens in all categories may also be identified from the University's [HAZDAT](#) hazardous substances database.

Substances that may cause cancer by all routes of exposure, assigned risk phrase "May cause cancer"

Category	Name	CAS No.
C2	Acrylamide	79-06-1
C2	Acrylonitrile	107-13-1
C2	p-Aminoazobenzene	60-09-3
C1	Ammonium arsenate	7784-44-3
C2	o-Anisidine	90-04-0
C2	Aromatic hydrocarbons, C8-10	90989-39-2
C1	Arsenic acid	7778-39-4
C1	Arsenic trioxide	1327-53-3
C1	Asbestos	1332-21-4
C1	Asbestos, Actinolite	77536-66-4
C1	Asbestos, amosite	12172-73-5
C1	Asbestos, anthophyllite	77536-67-5

C1	Asbestos, chrysotile	12001-29-5
C1	Asbestos, Crocidolite	12001-28-4
C1	Asbestos, tremolite	77536-68-6
C2	Aziridine	151-56-4
C2	Azobenzene	103-33-3
C2	Benz(a)anthracene	56-55-3
C1	Benzene	71-43-2
C1	Benzidine	92-87-5
C1	Benzidine acetate	36341-27-2
C1	Benzidine sulphate (1:1)	531-86-2
C1	Benzidine sulphate (1:x)	21136-70-9
C1	Benzidine, dihydrochloride	531-85-1
C2	Benzo(a)Pyrene	50-32-8
C2	Benzo(b)fluoranthene	205-99-2
C2	Benzo(j)fluoranthene	205-82-3
C2	Benzo[e]pyrene	91-76-9
C2	Benzo[k]fluoranthene	207-08-9
C2	Benzotrichloride	98-07-7
C2	4,4'-Bi-o-Toluidine sulphate	74753-18-7
C1	4-Biphenylamine	92-67-1
C1	Bis(chloromethyl)ether	542-88-1
C2	Bromoethylene	593-60-2
C1	1,3-Butadiene	106-99-0
C1	Butane (containing => 0.1% butadiene)	
C2	C.I. Basic Red 9	560-61-9
C2	C.I. Direct Black 38	1937-37-7
C2	C.I. Direct Blue 6	2602-46-2
C2	C.I. Direct Brown 95	16071-86-6
C2	C.I. Disperse Blue 1	2475-45-8
C2	Cadmium chloride	10108-64-2
C2	Cadmium chloride monohydrate	35658-65-2
C2	Cadmium fluoride	7790-79-6
C1	Calcium arsenate	7778-44-1
C2	Calcium chromate	13765-19-0
C2	Captafol (ISO)	2425-06-1
C2	1-Chloro-2,3-epoxypropane	106-89-8
C2	(R)-1-Chloro-2,3-epoxypropane	51594-55-9
C2	4-Chloroaniline	106-47-8
C1	Chloromethyl methyl ether	107-30-2
C2	alpha-Chlorotoluene	100-44-7

C2	Chromium(III) chromate	24613-89-6
C2	Chrysene	218-01-9
C2	Coal tar	8007-45-2
C2	Creosote, coal tar	8001-58-9
C2	4,4'-Diaminodiphenylmethane	101-77-9
C2	Diaminotoluene	25376-45-8
C2	2,4-Diaminotoluene	95-80-7
C2	o-Dianisidine	119-90-4
C1	Diarsenic pentaoxide	1303-28-2
C2	Diazomethane	334-88-3
C2	Dibenz(a,h)anthracene	53-70-3
C2	2,3-Dibromo-1-propanol	96-13-9
C2	1,2-Dibromo-3-chloropropane	96-12-8
C2	1,2-Dibromoethane	106-93-4
C2	1,4-Dichloro-2-butene	764-41-0
C2	1,3-Dichloro-2-propanol	96-23-1
C2	3,3'-Dichloro-4,4'-diaminobiphenyl dihydrochloride	612-83-9
C2	3,3'-Dichlorobenzidine	91-94-1
C2	3,3'-Dichlorobenzidine dihydrogen bis(sulphate)	64969-34-2
C2	3,3'-Dichlorobenzidine sulphate	74332-73-3
C2	1,2-Dichloroethane	107-06-2
C2	1,2:3,4-Diepoxybutane	1464-53-5
C2	Diethyl sulphate	64-67-5
C2	Dimethyl sulphate	77-78-1
C2	[3,3'-Dimethyl[1,1'-biphenyl]-4,4'-diyl]diammonium bis (hydrogensulphate)	64969-36-4
C2	Dimethylaminosulfonyl-chloride	13360-57-1
C2	3,3'-Dimethylbenzidine dihydrochloride	612-82-8
C2	N,N-Dimethylcarbonyl Chloride	79-44-7
C2	1,2-Dimethylhydrazine	540-73-8
C2	1,1-Dimethylhydrazine	57-14-7
C2	3,5-Dinitrotoluene	618-85-9
C2	3,4-Dinitrotoluene	610-39-9
C2	Dinitrotoluene	25321-14-6
C2	2,4-Dinitrotoluene	121-14-2
C2	2,3-Dinitrotoluene	602-01-7
C2	2,6-Dinitrotoluene	606-20-2
C2	2,5-Dinitrotoluene	619-15-8
C2	Dinitrotoluene, technical grade	
C2	1,2-Diphenylhydrazine	122-66-7
C2	Epichlorohydrin	106-89-8
C2	R-2,3-Epoxy-1-propanol	57044-25-4
C2	1,2-Epoxypropane	75-56-9

C1	Erionite	66733-21-9
C2	Ethylene Oxide	75-21-8
C2	Furan	110-00-9
C2	Gasoline	8006-61-9
C2	Glycidol	556-52-5
C2	Hexachlorobenzene	118-74-1
C2	Hexamethylphosphoramide	680-31-9
C2	Hydrazine	302-01-2
C2	Hydrazine sulphate	10034-93-2
C2	Hydrazine trinitromethane	
C2	6-Hydroxy-1-(3-isopropoxypropyl)-4-methyl-2-oxo-5-[4-(phenylazo)phenylazo]-1,2-dihydro-3-pyridinecarbonitrile	85136-74-9
C2	(6-(4-Hydroxy-3-(2-methoxyphenylazo)-2-sulfonato-7-naphthylamino)-1,3,5-triazin-2,4-diyl)bis[(amino-1-methylethyl)ammonium]formate	108225-03-2
C1	Isobutane (containing => 0.1% butadiene)	
C1	Lead arsenate	7784-40-9
C2	LPG	68476-85-7
C1	Magnesium arsenate	10103-50-1
C2	Methylazoxymethanol, acetate	592-62-1
C2	4,4'-Methylenebis(2-chloroaniline)	101-14-4
C2	4,4'-Methylenebis[2-methylaniline]	838-88-0
C2	4,4'-Methylenedianiline dihydrochloride	13552-44-8
C2	Naphtha solvent	8030-30-6
C1	2-Naphthylamine	91-59-8
C1	2-Naphthylammonium acetate	553-00-4
C1	2-Naphthylammonium chloride	612-52-2
C2	5-Nitroacenaphthene	602-87-9
C2	o-Nitroanisole	91-23-6
C2	p-Nitrobiphenyl	92-93-3
C2	Nitrofen	1836-75-5
C2	2-Nitronaphthalene	581-89-5
C2	2-Nitropropane	79-46-9
C2	N-Nitroso-N-methyl-N'-nitroguanidine	70-25-7
C2	N-Nitrosodiethanolamine	1116-54-7
C2	N-Nitrosodimethylamine	62-75-9
C2	N-Nitrosodipropylamine	621-64-7
C2	Petroleum roofing tar	8052-42-4
C2	Phenyl glycidyl ether	122-60-1
C2	Phenylhydrazine	100-63-0
C2	Phenylhydrazine hydrochloride	59-88-1
C2	Phenylhydrazinium sulphate	52033-74-6
C2	1,3-Propane sultone	1120-71-4
C2	beta-Propiolactone	57-57-8
C2	Propylene imine	75-55-8

C2	Safrole	94-59-7
C1	Sodium arsenate	7631-89-2
C2	Stoddard solvent	8052-41-3
C2	Strontium chromate	7789-06-2
C2	Styrene oxide	96-09-3
C2	Sulfallate	95-06-7
C2	Thioacetamide	62-55-5
C2	o-Tolidine	119-93-7
C2	Toluene-2,4-diammonium sulphate	65321-67-7
C2	o-Toluidine	95-53-4
C2	Trichloroethylene	79-01-6
C2	Trisodium [4'-(8-acetylamino-3,6-disulfonato-2-naphthylazo)-4''-(6-benzoylamino-3-sulfonato-2-naphthylazo)-biphenyl-1,3',3'',1'''-tetraolato-O,O',O'',O''']copper(II)	
C2	Urethane	51-79-6
C1	Vinyl chloride	75-01-4
C1	Zinc chromate(VI)	13530-65-9

Substances that may cause cancer only from exposure by inhalation, assigned risk phrase "May cause cancer by inhalation"

Category	Name	CAS No.
C2	Ammonium chromate	7788-98-9
C2	Ammonium dichromate	7789-09-5
C2	Beryllium	7440-41-7
C2	Beryllium chloride	7787-47-5
C2	Beryllium fluoride	7787-49-7
C2	Beryllium nitrate	13597-99-4
C2	Beryllium oxide	1304-56-9
C2	Beryllium sulphate	13510-49-1
C2	tert-Butyl chromate	1189-85-1
C2	Cadmium oxide	1306-19-0
C2	Cadmium sulphate	7790-84-3
C1	Chromic acid	7738-94-5
C1	Chromium trioxide	1333-82-0
C2	Chromium(VI)	18540-29-9
C2	Chromyl chloride	14977-61-8
C2	Cobalt chloride	7646-79-9
C2	Cobalt sulphate	10124-43-3
C1	Dinickel trioxide	1314-06-3
C1	Nickel dioxide	12035-36-8
C1	Nickel monoxide	1313-99-1
C1	Nickel subsulphide	12035-72-

		2
C1	Nickel sulphide	16812-54-7
C2	Potassium chromate	7789-00-6
C2	Potassium dichromate	7778-50-9
C2	Refractory Ceramic Fibres NOS	
C2	Sodium chromate	7775-11-3
C2	Sodium dichromate	10588-01-9
C2	Sodium dichromate dihydrate	7789-12-0

Substances Listed as Carcinogens in COSHH Schedule 1

Name	CAS No.
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9
Aflatoxin B1	1162-65-8
Aflatoxin B2	7220-81-7
Aflatoxin G2	7241-98-7
Aflatoxin M1	6795-23-9
Arsenic	7440-38-2
Coal soot	
Dibenzo-p-dioxin, 2,3,7,8-tetrachloro	1746-01-6
Hardwood dust	
1,2,3,4,6,7,8-Heptachlorodibenzo(b,e)(1,4)dioxin	35822-46-9
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4
1,2,3,7,8,9-Hexachlorodibenzo(b,e)(1,4)dioxin	19408-74-3
1,2,3,4,7,8-Hexachlorodibenzo(b,e)(1,4)dioxin	39227-28-6
1,2,3,6,7,8-Hexachlorodibenzodioxin	57653-85-7
1,2,3,6,7,8-Hexachlorodibenzodioxin	57653-85-7
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5
Mustard gas	505-60-2
Octachlorodibenzo-4-dioxin	3268-87-9
Octachlorodibenzofuran	39001-02-0
Pentachlorodibenzodioxin	40321-76-4
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6
2,3,7,8-Tetrachlorodibenzo(b,e)(1,4)dioxin	1746-01-6
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9
Used engine oil	