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Education of environmental toxicity

SHAHBANO ALI[1] and NEELOFAR IQBAL[2]

[1]Multimedia Educational Department, M.P. Bhoj (Open) University, Bhopal (India)
[2]Asian Biotech. Research Centre, Bhopal – 462 001 (India)

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ABSTRACT

With the ever increasing use of materials like soaps detergents, cosmetics, dyes and drugs etc. and with the urbanization, the use of various chemicals is increasing day by day in laboratories, industries and in domestic cleaning purposes. With the awareness of science of chemicals and the study of their harmful and toxic effects, it has become the need of time to have detailed knowledge about the various of chemicals we are using and the knowledge of their safe use, so as to minimize the risk of health hazards. Therefore, the education of environment with reference to toxic chemicals present therein is very necessary and should be included in the syllabus also.

Key words: Education, chemicals and environmental toxicity, health hazards.

INTRODUCTION

Chemicals are used increasingly in domestic and non-technical environments, where their safe handing is no longer solely the concern of qualified chemists. For instance, consider the use of domestic cleaners, solvents and detergents, weed killers and pesticides and proprietary medicines. There are a no. of chemicals in the environment, some of these are toxic and rest are non-toxic. The toxic chemicals are discharged by industries into air, water and soil. They get into the human food chain from the environment. Once they enter our biological system, they disturb the biological process leading to some causes to fatal results. Chemical toxicology is the science of the study of toxic chemicals and their mode of action. Toxicity is the science of the assessment of how substances, whether natural or synthetic, can harm life by physico-chemical reactions with living cells. It considers the relationship between toxicity and dose, and the fact that some substances are essential for life as well as toxic, while others are very toxic. Many metals are essential for good health in trace amounts. e.g., copper, zinc and iron, but are toxic in larger amounts. Other compounds, e.g. insecticides, organic solvent, etc. In both cases the toxicity is dose related.

Environmental toxicology and its impacts

Large exposures to chemicals can affect human health, directly or indirectly, by disrupting ecological systems that exist in rivers, lakes, oceans, streams, wetlands, forests and fields. The release of chemicals into the environment knows no political boundaries and can have a global impact.

Global impacts

Many examples of global impact can be cited. One is the detection of DDT and its derivatives in both the Arctic and Antarctic. It has never been used in either place but is now present in the bodies of polar bears and penguins. Another example is the man made disasters of the release of methyl isocyanate from the Union Carbide factory of Bhopal which causes more than 2000 deaths and is suppose to be one of the most famous aerial chemical disaster of the world.

Air pollution

The greatest source of air pollution is from the burning of fossil fuels with the production of sulfur and nitrogen oxides, volatile organic compounds and carbon dioxide, resulting in acid rain and global warming. There are other side effects, less well known. For example, if acid precipitation reduces the pH of waterways to below 6.0, aluminium ions become soluble and bio-available and toxic to marine life. (At a pH above 6.0 aluminium is mostly in the insoluble hydroxide form which is not bilogically available).

Ozone depletion

The depletion of Ozone in the upper stratosphere has been one of the consequences of environmental pollution through the burning of fossil fuels and the release of other volatile organic compound into the atmosphere, the most notable being chlorofluorocarbons (CFCs), which were used extensively as refrigerants.

Global warming

The release of carbon dioxide and water vapour into the atmosphere from the burning of fossil fuels does not impair solar radiation from reaching the earth, which causes continuous warming of the environment and the melting of snow from the mountains causing the alarming rise in water level of the sea, which has made certain countries and cities in danger.

Hazard and risk

Hazard is defined as the potential of a substance to cause damage while toxicity is the assessment of its ability to poison. Risk is defined as a measure of the probability that harm may result from exposure to chemical. Thus, if there is no exposure, there is no risk regardless of the magnitude of the hazard. Similarly, a chemical with a small hazard becomes toxic if the exposure is excessive.

Factors affecting risk of poisoning

This section looks at the routes and mechanisms by which toxic materials are distributed through out the environment and the body. Whereas, a more water-soluble compound is likely to have a higher concentration in water. Similarly, a substance may bind to soil or sediments and be retained there. Substances may enter the body through several routes, by inhalation or ingestion, skin absorption and eye exposure. Most substance will not be distributed evenly between different body compartments and organs. For example, iron is stored in the liver and in abnormally high amounts is hepatotoxic, many metals, e.g., gentamycin, cyclosporin. and lithium, are particularly nephrotoxic. In order to understand this in detail it is necessary to understand the toxicokinetic and toxicodynamic behaviour of the substance, and what control its absorption, distribution, metabolism and excretion. These concepts are introduced in this section.

Table -1: Some toxic chemicals and their health hazards

Chemical	Specific Example	Health Risk
Dust / Fume	Small Particles (10 mm or less)	Lung damage, Cancer
	Nanoparticles (100 nm or less)	Lung and Heart damage
Gases	Sulfur / Nitrogen oxides Carbon monoxide	Lung / Nose irritants De-oxygenated haemoglobin
	Hydrogen cyanide	Cellular respiration
Solvents	Volatile Organic Solvents	Effect many organs.
Metals	Lead	Anemia, brain / nerve function. Nervous System
	Mercury	Dermatitis, Lung Cancer.
	Nickle / Chromium	
Acid / Bases	Mineral Acids,	Corrosive, Lung Damage
	Strong Bases	Corrosive, Deep Skin Sores
Pesticides	Most Pesticides	WHO Classification defines severity

Carcinogenic and poisonous chemicals

The list of carcinogens is expanding with the addition of more number of chemicals to it based on medical research. The chemical we handle may be a potential carcinogenic and therefore, every chemical, even if it is known to be safe, should be kept in locked containers inside a fumed-hood. Every bottle containing such a chemical should have warning label. Usually a label showing a skull and two crossed bones is pasted on them.

Global risk assessment

This section introduce the concept of risk assessment. It has already been indicated that as substances enter the environment by a diversity of routes, they may become more concentrated and have a more toxic effect in different parts of the environment and in different parts of the body. These effects will be very different from one substance to another. Risk assessment requires understanding this complex process and calculating the probability of adverse effects resulting from a given exposure.
Management of toxicity

In Industrial terms, the management of chemicals is referred to as the "*Life Cycle*" of the chemical and is the management of the chemical throughout its processing from "Cradle to the grave". It is illustrated in this section. No chemical, natural or manufactures can be said to be totally without risk, and so the perception of risk is very important. This perception may be influenced by social need and understanding of the nature of toxicity. At one time lead tetra acetate was regarded as an essential ingredient of motor fuel but now is regarded as socially unacceptable because of its toxic properties.

Health & Safety

This section looks specifically and health and safety procedures within the laboratory. Laboratory safety is the responsibility of all laboratory workers. This requirement is laid down in law in many countries and even the most junior member of a laboratory team must be familiar with basic safety requirements. Good health and safety procedures are requirements of good laboratory practice.

Table -2: Toxic and poisonous chemicals

Class	Examples
Aromatic hydrocarbons	Benzene
	Toluene
	Xylenes
	Naphtholes
	Anthracene
Amines	Aliphatic amines
	Anilines
	Naphthyl amines
	Benzidines
Chlorinated aliphatic hydrocarbons	$CHCl_3$, CCl_4, CH_3CCl_3
	$CHCl_2CH_2Cl$, $Cl_2C=CHCl$, $CH_2=CHCl$
Chlorinated aromatic hydrocarbons	DDT, PCB, 2,4,5-T, 2,4-D
Hydrazines	Hydrazine
	Arylhydrazines
	Alkylhydrazines
Inorganic compounds	Compounds of the elements As, Be, Bi, Cd, Co
	Cr, Hg, Mn, Ni, P, Pb, Se, Te, Tl, Th, V
Others	N-nitroso compounds
	Nitrogen mustards, $RN(CH_2CH_2Cl)_2$
	2-Nitrobiphenyl
	Methyl fluorosulfonate

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