Available online at www.joac.info

ISSN: 2278-1862

Journal of Applicable Chemistry

2013, 2 (6): 1409-1412

(International Peer Reviewed Journal)

Basic Concepts of Chemical Toxicity for School Children

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Received on 10th November and finalized on 13th November 2013

ABSTRACT

School level education is important because it is imparted to the most impressionable minds and also because it forms the foundation on which higher education is assimilated. Therefore introducing courses which are relevant from not only information point of view but also have social utility becomes very important. Given the role that chemicals play in modern life, touching each and every aspect of activity, it becomes necessary to have a very proper understanding of their properties, including the harm they are capable of doing when they are not handled properly. This probably can be most effectively done by teaching students about chemical toxicity at the school level itself. This paper is a general article on some of the facts which school children could be taught on chemical toxicity.

Keywords: chemical toxicity, exposure, dose, hazard symbols.

INTRODUCTION

The school curriculum is usually designed to impart a plethora of information on diverse topics. The rationale behind this is that individuals, irrespective of the walk of life they choose later, have a foundation of sound and diverse knowledge which helps them assess, examine and handle various situations. Children are also introduced to courses that have relevance in day-to-day affairs. Laboratory courses in chemistry are usually an integral part of the school curriculum and students are introduced to many interesting and useful experiments. Using the doing is learning method, students learn to conduct experiments and make observations. These experiences lend utility not only in future chemistry pursuits but in many other situations. However, since it is important that individuals should have very sound knowledge on the hazards that chemicals are capable of posing when they are not handled carefully, it might be helpful to allow more emphasis to be laid on the topic of chemical toxicity. The authors, through their limited experience and understanding feel that if teaching of chemical toxicity is given more importance at the school level, to children below fourteen years for whom education is compulsory, the children who subsequently go on to become responsible citizens of any society will have a sound knowledge of the nature of chemicals and will be in a far better position to manage and protect our fragile environment.

The extent to which damage can be done to an entire organism or to a substructure of an organism by another substance is **toxicity**. The toxicity of any substance is dose-dependent and an over-dose of any substance including water can have detrimental effects. While all substances around us can become toxic above a permissible limit, however, the impact of chemicals is more pronounced and therefore needs to be

addressed as a separate issue. Chemicals which have high levels of toxicity are capable of causing severe health impairment and can even be responsible for diseases like cancer, and cause disorders of various internal organs including the nervous system. If these chemicals are not easily biodegradable, they persist in the environment and travel along the food chain, thereby effecting people who would have otherwise not come in contact with the chemical.

Chemicals also can irritate the skin, eyes, nose, and throat. Some chemicals pose significant safety hazards, such as fire or explosion risks.
The extent of poisoning caused by a chemical is influenced by the quantity that has entered and also the route of entry, in addition to the inherent toxicity of the chemical. Exposure to chemicals may be sudden and for a short duration or for prolonged periods but types of exposure are equally capable of causing harm.

With thousands of chemicals in commercial use today, it has become very important for all individuals to have some information regarding the hazards posed by chemicals. Presented below is a gist of some of the information that could be imparted to children so that they become subsequently conversant with the physical and chemical properties of chemicals, all the hazards associated with their improper use, as well as how they should be stored, handled and disposed **[1-7]**.

Categories of Chemicals:

1. Chemicals such as paint thinner; laboratory solvents (acetone, alcohols, acetic acid, hexane); and even some adhesives fall under the category of **flammable or explosive substances**. They may be liquids or gases or sometimes even solids and can catch fire rapidly and burn. They are indicated by the symbols:

 indicating flammable or  indicating explosive.

2. **Corrosive substances** are those which can destroy or living tissue or corrode materials, such as metals or even glass at times. Strong acids and bases, oxidants and dehydrating agents come under this category. They are indicated by the following symbol:

3. Some chemicals react violently or even explosively in presence of heat, light, water or even air. Examples include nitrates and nitrites, peroxide and metals such as sodium. They are usually called **oxidizers** and indicated by the symbol

4. **Poisonous substances** are those which can cause harm to body even death, when ingested. Chemicals such as cyanide, mercury, arsenic and methanol are poisonous. The symbol that is used to indicate poisonous substances is

5. **Radioactive substances** such as isotopes of cobalt and uranium which are capable of emitting radiation are indicated by the following symbol:

Before handling any chemical the details given on the label of the container should be properly read and the necessary precautions taken. Table 1 gives a list of chemicals which are commonly used and encountered in most basic chemistry laboratories and the hazards they are capable of posing.

Table 1*

Chemical	**Relevant Hazard**
Acetic Anhydride	Poison (on inhalation and ingestion), Irritant (skin, eyes, respiratory). Violent reaction with many compounds, used in illicit drug manufacturing
Acetonitrile	Toxic (on inhalation, ingestion, and absorbance through skin)
Aluminum Chloride, Anhydrous	Violent reaction with water
Ammonia, Gas	Corrosive, Irritant (skin, eyes, respiratory), used in illicit drug manufacturing
Ammonium Dichromate	Oxidizer; poison (on inhalation and absorbance through skin) carcinogen (Cr(VI))
Ammonium Nitrate	Oxidizer; forms explosive mixtures with hydrocarbons
Ammonium Vanadate	Poison (on inhalation and ingestion)
Aniline	Poison (on inhalation and absorbance through skin); Irritant (eye, skin)
Benzene	Carcinogen
Carbon Disulfide	Extremely flammable; Acute CNS/peripheral toxin; reproductive toxin
Carbon Monoxide	Toxic
Carbon Tetrachloride	Carcinogen. Acute renal hepatotoxin
Chlorine	Oxidizer, corrosive; irritant (on inhalation); poison (on inhalation).
Chloroform	Carcinogen
Chromic Acid	Carcinogen (Cr(VI))
Chromium Hexavalent Compounds	Carcinogen
Chromium Trioxide	Carcinogen
2,4-Dinitrophenylhydrazine	Explosive
Formaldehyde (Formalin)	Carcinogen
Hydrazine	Powerful reducing agent; explosive; corrosive; carcinogen

Hydrofluoric Acid and solutions containing HF	Corrosive; May be fatal if inhaled or ingested (liquid and vapor can cause severe burns not always immediately painful or visible but possibly fatal)
Hydrogen Bromide (anhydrous)	Poison (on inhalation); corrosive
Hydrogen Chloride (anhydrous)	Poison (on inhalation); corrosive
Lead Carbonate	Poison (on inhalation and ingestion)
Nitrobenzene	Poison (on inhalation, ingestion, and absorbance through skin)
Silver Nitrate	Oxidizer; corrosive; may be fatal if ingested; poison (on ingestion); incompatible with many compounds
Tetrahydrofuran	Forms explosive peroxides
Thionyl Chloride	Violent reaction with water; corrosive; poison (on ingestion, abs)
Trinitrophenol (Picric Acid)	Poison (on ingestion); irritant (skin, eye), allergen; unstable, explosive when dry

***** The contents of this table have been reproduced from Reference 7

CONCLUSIONS

There can never be any denial of the role played by chemicals in improving the quality of modern day life. However, presently the problem is that there is not much awareness and realization that chemicals can also be hazardous. If knowledge of chemical toxicity is spread among all members of society, it may be much easier to work towards pollution prevention though community mobilization, and in this effort, children may be most important.

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