How to Read a Material Safety Data Sheet (MSDS)

A Material Safety Data Sheet (MSDS) is written by the company that creates a chemical or a company that blends different chemicals into a chemical product. The MSDS provides guidance on using, storing and handling substances safely on the job and in emergencies such as fires and spills.

MSDS do not have a standard format. The Federal government requires MSDS to contain certain information; the producer of the hazardous material may present this information in their own format. Some MSDS come from manufactures in other countries. Although these documents will satisfy U.S. requirements, they may be more directed toward the requirements of another country. The Canadian WHMIS (Workplace Hazardous Materials Information System) is common as well as hazard information based on EEC (European Economic Community) Directives.

Below are the 16 sections recommended by the ANSI (American National Standard Institute):

I. Chemical Product and Company Identification: This section identifies the manufacturer and product. Other forms of identification may be noted such as a chemical family, synonyms, formula, or trade name. If the product is a mixture of several chemicals, only the trade name will be listed. There might be a product or catalog number that may be critical in distinguishing between different grades or mixes of the same chemical.

II. Composition, Information on Ingredients: This section identifies hazardous ingredients and exposure limits. Product ingredients are listed by percentage or total weight. The hazardous ingredients need to identified, down to 1% for a hazardous chemical and 0.1% for a chemical considered to cause cancer.

III. Hazards Identification: This section identifies the health hazards for the specific chemical and the route of entry. There may be numerous medical terms used in this section. Just as important are the conditional words such as “may cause” vs. “will cause”. The route of entry for an exposure will be listed in this section, as well as, the target organ that will experience adverse health affect(s) upon exposure to the specific chemical. Realize that the target organ (or part of the body) that will experience the adverse health affect may seem unconnected to the route of entry. For example, alcohols which are absorbed through the skin may damage the liver and central nervous system. The symptoms that are listed in this section, along with odor if noted, are the first warning signs that there is a problem.

IV. First Aid Measures: Directions on what to do if there is an exposure to a specific chemical.

V. Fire Fighting Measures: This section identifies what type of extinguishing media (water, fog, foam, alcohol foam, carbon dioxide, or dry chemicals) to use if the chemical should it start to burn. Also it identifies special hazards that might occur when the chemical burns, i.e., the release of toxic smoke. Special protective equipment or measures may be recommended in this section. Flash point and flammability limits will also be found in this section, and are used to determine the classification for fire hazard. The NFPA rating for the chemical can be found in this section. The majority of the information in this section is directed toward First Responders, such as the Starkville Fire Department and the Mississippi State University Police Department.

VI. Accidental Release Measures: This section identifies the proper materials needed to clean up, techniques to use, and/or precautions to be aware of during an accidental release of a specific chemical.

VII. Handling and Storage Measures: This section identifies proper handling of the specific chemical and types of containers to storage the chemical and special storage conditions.

VIII. Exposure Controls/Personal Protection: This section identifies recommended engineering controls, such as chemical fume hoods, eye protection, gloves, and other personal protective equipment. Pay attention to the specific glove material (rubber vs. nitrile, etc.) that needs to be worn while handling the specific chemical.

IX. Physical and Chemical Properties: This section identifies measurements that are obtained by standardized tests. Common parameters like color and appearance will help identify the product and bring attention to a chemical that may be decomposing. Boiling point, vapor density, and evaporation rate will indicate how easily the chemical may become an inhalation exposure. Odor then becomes a detection method for this exposure. Specific definitions for these parameters follows:

a. Boiling point: The temperature at which a liquid changes to a vapor state at a given pressure. The boiling point is usually expressed in degrees Fahrenheit at sea level pressure (760 mmHg, or one atmosphere). In general, a low boiling point means the substance will be in gas form at room temperature (unless it is pressurized), i.e., carbon monoxide (BP -191.5^{o}C).

b. Vapor Pressure: The pressure exerted by a saturated vapor above its own liquid in a closed container. Vapor pressures reported on MSDS are in milliliters of mercury (mmHg) at 68oF (20oC), unless stated otherwise. Some important facts to remember are that vapor pressure increases with temperature and the lower the boiling point of a chemical, the higher its vapor pressure.

c. Vapor Density: The weight of a vapor or gas compared to the weight of an equal volume of air is an expression of the density of the vapor or gas. Materials lighter than air have vapor densities less than 1.0. Some examples are acetylene, methane, hydrogen. Materials heavier than air, such as propane, hydrogen sulfide, ethane, butane, chlorine, and sulfur dioxide, have vapor densities greater than 1.0. All vapors and gases will mix with air, but the lighter materials will tend to rise and dissipate unless confined. Heavier vapors and gases are likely to concentrate in low places-along or under floors, in sumps, sewers, and manholes, in trenches and ditches where they may create fire or health hazards.

d. Evaporation Rate: The rate at which a material will vaporize (evaporate) when compared to the known rate of vaporization of a standard material. The evaporation rate can be useful in evaluating the health and fire hazards of a material. The designated standard material is usually normal butyl acetate (NBUAC or n-BuAc), with a vaporization rate designated is 1.0. Vaporization rates of other solvents or materials are then classified as :

i. Fast – greater than 3.0 (Methyl Ethyl Ketone = 3.8, Acetone = 5.6, Hexane = 8.3)
ii. Medium – between 0.8 to 3.0 (95% Ethyl Alcohol = 1.4)
iii. Slow – less than 0.8 (Xylene = 0.6, Water = 0.3)

e. Specific Gravity: The weight of a material compared to the weight of an equal volume of water is an expression of the density (heaviness) of a material. Insoluble materials with specific gravity of less than 1.0 will float on water. Insoluble materials with specific gravity of greater than 1.0 will sink in water. Most flammable liquids have specific gravities less than 1.0 and, if not soluble, will float on water, which is an important consideration for fire suppression.

X. Stability and Reactivity: This section describes how the substance will react under particular circumstances. Unstable chemicals will form new chemicals out of themselves and atmospheric ingredients in uninitiated reactions. This unintended reaction might generate a health risk such as the release of energy or may lead to the creation of a new chemical with very different potential hazards then the original chemical.

a. Stability: Indicated whether the substance may decompose (disintegrate) over time. It is used to help decide how and where the chemical is stored.

b. Incompatibility: Indicated chemicals that should not come into contact with this chemical. Mixing may result in fire, release of toxic gases or buildup of pressure in a container.

c. Hazardous Decomposition Products: Includes hazardous materials released during fires and created by aging of the chemical.

d. Hazardous Polymerization: Polymerization is a chemical reaction in which small molecules combine to form larger molecules. If this reaction occurs with an uncontrolled release of energy, it is a hazardous polymerization. This section should list storage procedures and the shelf life of the chemical.

XI. Toxicological Information: This section identifies the results of tests on animals or documented case studies for the chemical or for its components. This information is directed at medical or occupational health specialists. Certain thresholds in standardized toxicological tests are used to establish warning terms, i.e., Toxic vs. Extremely Toxic. Specific forms of toxicity are also identified in this section, and may include carcinogenicity (ability to cause cancer) teratogen.

XII. Ecological Information: This section indentifies the potential impacts of the chemical on the environment. Many chemicals have very different health effects on plants and other animals. Ecotoxicdity data may include information on acute and chronic toxicity to fish and invertebrates, or plants and microorganism toxicity. Characteristics that might be used to assess a spill of the chemical might be noted such as soil mobility, bioaccumulation, or photolytic stability.

XIII. Disposal Considerations: This section identifies a general reference to disposal according to local, state, or federal regulations. Many chemicals that may be hazardous will become non-hazardous with use.

XIV. Transport Information: This section identifies proper packaging and labeling requirements for the chemical based on the US DOT (Department of Transportation) shipping tables.

XV. Regulatory Information: This section provides notation if the chemical is on a list of chemicals specifically covered by and OSHA or EPA regulation. Even though a chemical may be listed, the regulation may only be in effect at a certain RQ (Reportable Quantity) or TPQ (Threshold Planning Quantity).

XVI. Other Information: This section identifies any additional information such as references or MSDS revision dates.