Using Material Safety Data Sheets to Teach Laboratory Safety

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Modern life thrives on, but is also threatened by, the constant development and use of chemical concoctions. Many are benign. Some are very dangerous. A few are deadly. But more dangerous than the chemicals we contact every day is the rampant ignorance of their hazards. It seems to be a firmly entrenched trait of human nature to ignore the risks involved in substances to which we are in constant contact, especially if those substances are provided for us by others. The millions of dollars spent to remove asbestos from our living and working environments, is evidence of what ignorance can lead to. How true it is that "Near acquaintance doth diminish reverent fear."[1] In the face of strong evidence, we ignore obvious connections between illness and even death and unprotected use of chemicals. "There is nothing more terrible than ignorance in action"[2]

Endless volumes of regulations have been written for industry about the workers' "Right-to-Know" the risk under which they work. In 1970, with passage of the Occupational Safety and Health Act, standards were set up for industry "to assure so far as possible every working man and woman in the nation safe and healthful working conditions"[3] . Two main agencies were established by the act: the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). By setting up processes for injured workers to receive due and punitive compensation for physical damages, OSHA exerted economic motivation on employers to implement preventative safety measures.

NIOSH was assigned the task of determining the toxicity of existing and newly developed chemicals as well as the concentrations at which they become toxic[4]. But even in 1992 C. Noble writes, "OSHA standards lag far behind professional recommendations and leave major hazards unaddressed."[5] Every year thousands of new chemical products are developed and turned loose on the unsuspecting and trusting public. "He who wishes to cure his ignorance must first confess it"[6]

An important part of any college education must be the realization of hazards and the means to protect oneself from them. Depending on the area of study, students handle many hazardous substances. OSHA and NIOSH have no jurisdiction in the academic community. And yet, the academic community has neglected developing their own standards for safety in the laboratory environment. Do students have any less "right-to-know?" Students, like workers in industry, deserve to know the risks to which they are subjected. They deserve to be equipped to make knowledgeable decisions concerning their personal safety. They deserve ready access to critical safety information. In the absence of standard regulations, it falls to the teachers to seek out proper resources and provide that access. The standards instituted by OSHA and NIOSH provide excellent resources for academic laboratory use, especially in the form of Material Safety Data Sheets. Knowledge of safety factors is not only important for the students, who contact substances for a short time at most, but also for the teacher who continues to work in a

chemical
rich environment over a long period of time. In fact, we tend to think that "somebody" has already provided for our safety. This is usually not so.

I discovered MSDS, by serendipity when a supplier included them in a shipment of aircraft fabric coatings I had ordered for my Federal Aviation Administration Airframe Mechanics course. The following is taken from the report on nitrate dope, a common base coating for aircraft structures.
"High concentrations may cause headaches and dizziness, are anesthetic and may have other central nervous system effects, including death [7]. Another product warned of possible liver, kidney, and brain cell damage and possible birth defects. It included a waiver stating that the "toxicological properties" of the product had not been fully studied and may cause harm.

This information struck fear in me. I had exposed both my students, including a pregnant women, and myself to strong concentrations of these and other vapors for years. "Being ignorant is not so much of a shame, as being unwilling to learn"[8]

MSDS are essential for the academic engineering educator. The MSDS format is a flexible, adaptable guide to which manufacturers can add or omit sections. Along with a manufacture's name, address and telephone number and product code number is a list of the hazardous ingredients. Acceptable tolerance limits by various standards accompany each ingredient. Suspected carcinogens must be specifically noted if they make up more than .01 percent of the product[9]

Fire and explosion hazards are provided to guide users as well as the fire department in case of spills or fires. Containment and clean up methods for spill and leaks and possible reactivity
with other substances are stated if pertinent. Types of protective equipment, for example respirators, gloves, etc can be listed and emergency first aid procedures for inhalation, ingestion , eye and skin contact are spelled out in detail. Most reports list physical data, such as appearance, weight (lighter or heavier than air) , volatility (less or greater than ether) and flash points . Telephone numbers, often toll-free, are listed for further information or for use in an emergency.

MSDS contain the following sections[10]

- Product identification
- Component data
- Precautions for safe handling and storage
- Physical data
- Personal protective equipment requirements
- Fire and explosion hazard information
- First aid
- Toxicology and health information
- Transportation information
- Spill and leak procedures

Waste disposal
Additional regulatory information
Additional information
Major references

Besides the manufacturer, good sources for reports are supply houses, repair shops, and local industries. Hospitals and fire stations maintain collections for obvious reasons. MSDS are available as an update service on CD-ROM. These are fairly expensive if only a few specific reports are needed, but they are handy for cross-referencing and searching. A growing number of institutions are becoming depositories or collection points for all MSDS. Most libraries can get access to the National Aeronautics and Space Administration (NASA) document which indexes
the reports by manufacturer.[11] With the growing ubiquity of the Internet, reports are becoming easier to locate. Cornell University maintains a large collection which can easily be printed out.

John H. Bartsch, a high school teacher from New York, in his book, School Material Safety Manual,[12] 1992 has collected MSDS for chemicals commonly used in schools. This excellent safety source also includes suggestions and recommendation on the use of materials which teachers, students and even cleaning personnel might use.

Every engineering laboratory that maintains an inventory of chemicals or chemical products should include a minimum of one unit of study on the use of Material Safety Data Sheets. Student project ideas abound. Some include:

*Locating MSDS for each product used in a specific setting i.e. the lab, a certain factory, home cleaning products, etc.
*Distributing appropriate sheets to students in notebook form
*Testing over material available on MSDS
*Making a safety notebook for specific lab including process for spill, contamination, etc.
*Finding what type of protective equipment is needed for a particular product or substance
*Setting up a first-aid center for a specific situation
*Researching incidents involving hazardous chemicals in the academic setting or the workplace
*Writing scenarios describing incidents and responses using MSDS
*Visiting a local fire station or hospital emergency facility to see their collection of MSDS and interview personnel
*Planning drills in case of accidents in the lab
*"Inventing" a chemical and creating an MSDS for it
*Research sources for protective equipment which meets specific requirements

The development of new hazardous products continues daily. Teachers in engineering education face the challenge of providing safety and health information to their students in a way that keeps up with rapid changes. As educators, our awareness of actual hazards of the materials,

chemicals and products we use will provide a strong impetus for implementing a program of MSDS usage. Including the study of Material Safety Data Sheets in the curriculum goes a long way toward making sure we are equipping our students in an efficient, timely manner.

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