328e Enhancing the Sustainability of Chemical Practices in Academic Laboratories

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MIT and various research institutes worldwide generate tremendous benefits for society in the form of technological innovation and development of new knowledge. These discoveries come at a cost, however, one element of which is the responsible management and ultimate disposal of chemical waste in order to minimize harm to human health and the environment.

Within the last several decades, science and public policy have identified that harm to human health and environment may be more proactively addressed through source reduction—selection of chemicals and processes that prevent or reduce waste upstream—than through the treatment of waste. Industry has been at the forefront of adopting these types of more sustainable chemical practices. Unfortunately, the transition has not been as smooth for academia. The array of research activities, combined with the scale of use within individual laboratories, presents a challenge to the implementation of green chemical practices in academic laboratories. In spite of this challenge, universities do have an incentive to reassess current chemical purchasing, use, and management practices. Two important examples are the potential for creating safer work environments and the opportunity to reduce hazardous waste disposal costs through source reduction. The second opportunity has served as the launching point of this project.

The purpose of this project is to improve the MIT general use of chemicals for the benefit of our health, safety, and the environment, using the Chemistry Department as the basis for the experiment. By primarily focusing on source reduction, the aim is to reduce unnecessary generation of hazardous waste while simultaneously introducing safer, less toxic alternatives. This project, initiated in late 2003, first consisted of collecting data on the amount and kinds of chemicals purchased, interviewing representatives from academic laboratories on how these chemicals are used in research, and identifying possible substitutes and less toxic chemical alternatives.

The collection of this information lays the groundwork for the design and implementation of tools to enable sustainable chemical purchasing, use, and management practices in academic and research laboratories. This involves several steps, the most significant of which is the development of a program interface within the procurement process that provides information on alternative chemical practices. If successful, the purchasing interface presents the most substantial opportunity to encourage sustainable chemical practices not only on the MIT campus, but also in other laboratory settings. To complement this effort, several other initiatives are being pursued. A website has been created for the project, which features flow charts for chemical replacement. Presently, the flow charts are accessible from a hyperlink on the MIT Ecat (procurement) home page; it is envisioned that this information ultimately will be directly incorporated into the purchasing interface.

The website also includes basic information on the project, information on green chemistry, and a list of resources in the form of web links. In addition, we are pursuing several avenues for raising student and researcher awareness, beginning with a preliminary survey, and potentially expanding to an online chemical exchange database.

In addition to developing electronic tools for green chemistry practice, we have implemented two demonstration projects that replace the use of hazardous materials andreduce chemical waste respectively. At the instructional level, in the course “Experimental Biology and Communication” (7.02) Spring 2005 offering, students conducted DNA staining using ethidium bromide and SYBR Safe®, a substantially less mutagenic alternative, in a side-by-side comparison. SYBR Safe® performance was considered as effective and it will now replace ethidium bromide for the “Recombinant DNA Methods”

module in the course. At the research level, we have established a “Sustainable Chemistry Grant” pilot program, to increase awareness of laboratory efforts that focus on green chemistry. A graduate student from the chemical engineering department is the recipient on one such grant; his work entails the use of microreactors that enable process chemistry to run on the microscale. The expected outcome of this project is a significant decrease in hazardous waste generation from reactions requiring the use of toxic substances. These projects, and additional demonstration projects, will enable analysis of barriers to implementation of sustainable practices.

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