Chemical substances management system at the University of Tokyo
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Chemical substances pose various health and environmental hazards, and must be handled safely. To that end, we must collect sufficient information about the chemical substances and conduct proper storage, handling, and disposal procedures based on appropriate management, in addition to following public laws and local rules. At the University of Tokyo (UTokyo), chemical substances management is handled by three systems. The first one is an online purchasing system for commercial chemical substance products. The second one is an online chemical registration system for laboratory chemical inventories. The third one is a disposal system for chemically hazardous waste tracking the status of the waste throughout the disposal process. In addition, all university personnel who handle chemical substances may attend an environment and safety course; those who are involved in the disposal of chemically hazardous waste are required to take and pass the course. We believe this is an ideal way to consolidate chemical substances handling via the internal network from initial storage to disposal while focusing on individual usage, education, and the working environment.

Keywords: Environmental safety education, systematized education program, practical training materials, hands-on exercises.

1. Introduction

Chemical substances are one of the main causes of injuries in laboratories, alongside cuts from blaze or broken glassware, skin burns from heat or cryogenic materials. A wide variety of chemical substances is used in laboratories for various experiments, and these chemicals pose multiple hazards: Physical hazards from their ignitable, flammable, and explosive characteristics; health hazards from corrosive, irritant, and carcinogenic properties; environmental hazards through ambient pollution or by compromising the environment. Therefore, researchers must use chemical substances with a sufficient understanding of their hazards for the purpose of protecting themselves, their colleagues, and the environment. Researchers must also conduct proper storage, handling, and disposal protocols based on appropriate management, in addition to following applicable public laws and local rules for handling chemical substances.

At the University of Tokyo (UTokyo), scientists use three independent systems to manage chemical substances (Fig. 1). The first one is an online purchasing system where we can search, order, and accept chemical products. The second one is an online chemical registration system that contains data on about 800,000 reagents; we can easily register our inventories in the system. The third one is a disposal system for chemically hazardous waste, consisting of printed manifest slips and a database management program to identify the status of treatment of chemically hazardous waste, up to treatment at the final waste disposal site.

In this paper, we introduce these three systems and an environment and safety education course for all faculty, staff, students, and researchers who handle chemical substances at UTokyo. We conclude with a proposed ideal way to consolidate management of the three systems.

2. Online purchasing system

The UTokyo purchasing system for chemical substances (Fig. 2) authenticates users by personal identification numbers granted by the administration office. It exchanges information with a budget implementation management system. Students, researchers, and technical staff can browse and search for commercial chemical products by trade name, manufacturer, Chemical Abstracts Service (CAS) registry numbers, and chemical structural formula at any time. They can also order and check the inventory status of commercial chemical products. To purchase, a user requests a purchase online, and the system sends an automated e-mail to the faculty member supervising this user, requesting approval. The faculty member, who has an administration ID, can approve or send the request back to the user after review. After delivery, the faculty member can inspect and accept the products as well.

When a user requests to purchase industrial alcohol, the handling of which is exempt from Liquor Tax Act in Japan and requires a purchase license, the system alerts distributors to check the list of license-holders at UTokyo, which is provided by the administration office for...
Environment, Health and Safety (EHS admin office). A User cannot purchase narcotic and psychotropic drugs on this system.

3. Online chemical registration system

Handling chemical substances is regulated by numerous laws pertaining to preventing hazards, protecting the environment, proper handling, and transport management. Though we fully understand the importance of compliance, laws are sometimes revised according to social circumstances, while multiple laws may apply to some chemical substances. It is therefore necessary to have a computerized management system of chemical substances that is pre-programmed to take these laws into account. All chemical substances used in research experiments at UTokyo are managed with an online chemical registration system, the UTokyo Chemical Registration Information System (UTCRIS). The administrative server is linked by means of an internal network on campus, and users can easily register their inventories in the system. The hierarchy structure of the system allows the EHS admin office to inspect the inventories of each department and EHS admin office in each department to inspect the inventories of its laboratories in its department. The administrator in each laboratory must register all end users in the laboratory, and all end users must record stock, usage, and disposal actions online as they arise. The basic procedures of UTCRIS are shown in Fig. 3. The user creates a barcode for on-campus management at the time of stock registration of a reagent in the laboratory, and then registers the usage (when, who, how much) at the time of reagent use. When a reagent is used up, the user registers the information in UTCRIS, and then rinses the bottle, removes both the barcode label and the reagent bottle label, and disposes of the bottle according to university rules.

The system is also equipped with functionality to browse material safety data sheets for reagents, compile the quantities of chemical substances usage in a fiscal year, and to manage the inventory of poisonous/deleterious substances and fire-hazard materials.

By having each laboratory register its inventory in this system, administrators can conduct inventory management by department, campus, the entire university, or even by building.

4. Disposal system for chemically hazardous waste

Every entity, including universities, is required to treat wastes properly. Solid and liquid waste materials containing hazardous chemicals are centrally controlled by the Environmental Science Center (ESC) at UTokyo. The disposal of chemically hazardous waste is as follows: Separation and storage according to a separation reference chart by waste generator at the experimental site, collection, inspection and preparation for outsourcing by ESC, followed by intermediate treatment and final disposal by an external contractor.

The manifest slip (Fig. 4) is the only information transfer medium that connects the waste generator with the waste handler. Waste generator writes a complete and accurate list of the waste’s composition, including the substance names and concentrations for all contents. The manifest slip is printed in five copies: One each for attaching to the waste container, keeping at the waste-generating laboratory for five years, the division office,
After collecting chemically hazardous waste, information such as the manifest slip identification number, the generating division, the date of disposal, and the waste classification is registered by ESC officers in the system. The status of the chemically hazardous waste, as identified by the manifest slip number, is published on the ESC website in Japanese.

5. Safety education course for chemical substances users

It is essential that universities train people to be knowledgeable of and have an ethical outlook towards environmental safety, and teach them to translate knowledge into action. Chemical substances users should be trained with a combination of lectures and practical training, experiential learning, and hands-on exercises.

The Environment and Safety course is a classroom lecture held by ESC, and is suggested for all faculty, staff, students, and researchers who handle chemical substances at UTokyo. The course covers the fundamentals of environmental safety, the basics of laboratory safety and management, safe handling of chemical substances, and the rules concerning laboratory wastes. ESC also holds an Environment and Safety excursion, offering practical training for the disposal of chemically hazardous waste, a tour of inspection to understand waste management, and hands-on exercises for chemical substances users.

The ESC issues an Environment and Safety Course certificate to those who attend the course and excursion and pass the examination given at the end. Persons requesting the disposal of chemically hazardous waste are obligated to acquire the certificate. The certificate is valid for only three years, because the laws, regulations, and university rules related to environmental safety are subject to frequent revision.

6. An ideal management system for chemical users

In research and education in universities, the topics are widely varied, and originality and expertise are high. New technologies and chemical substances make it easier to cross over disciplines, and experimental research is becoming more and more individualized by laboratory. It is important to ensure that chemical substances management in university laboratories work in tandem with education for chemical substances users, and should take into account the users, materials, and working environment comprehensively. Since three separate systems have been introduced to adapt to each purpose at different time at UTokyo, they have not linked each other and integrated system is expected for total management of chemical substances. When user information is controlled by identification numbers, and materials are controlled by radio-frequency identification tags, it is possible to establish an intelligent, effective, and concrete management system where education management, materials storage and disposal management, and working environment/health checkup management can be combined.

References
1) Environment and Safety Guideline 2015, 1st edition of English Version, Frontispiece Figure II-4-3, Published by Environmental Science Center, The University of Tokyo, 2016.