Improvement of workplace by reuse of the unnecessary chemical substances at the university

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Long-term bulk storage of unnecessary chemical substances increases the work needed to manage these substances in the universities. There is an increased exposure risk for staff and students to harmful gases and potential delays in dealing with emergencies such as fires. Moreover, the damage to work environments and other problems in terms of safety and hygiene management is also feared. To solve these problems, Faculty of Medicine and the university hospital in Tottori University sponsored a program for the collection of the chemical substances stored in laboratories on campus and the reuse of them. The project succeeded in making reuse of about 7% of the surplus chemical substances at our university. There have been several previous reports on the disposal and reuse of leftover reagents at universities. However, this is the first report investigating the attributes of the chemical substances used in the biomedical field laboratories specifically. It is useful as basic data on chemical substances management in this field.

Keywords: unnecessary chemicals, reuse, recycle, biomedical field, university

1. Introduction

Chemical substance management at universities level is unlike management at corporations. Small quantities and many varieties of chemicals are handled at universities. Specifically, there may be interruptions or terminations of research projects, researchers may change or retire, research locations may have to be changed, or research buildings and university hospital wards are renovated or relocated. Therefore, a large amount of unnecessary chemical substances will be generated and accumulated over time.

Relative to industrial settings, little research on laboratory safety in academic institutions has been conducted to date9. Consequently, little is known about the effectiveness of reuse and improvement of various wastes in academic laboratories. Therefore, how to build a safety system for laboratory waste disposal has become an important issue in the environmental protection, safety and hygiene of all universities. So far, several research laboratories around the world have reported on the reuse of various effluents and wastes. Taiwan university reported on risk assessment and improvement of liquid waste management7. It was reported that the improvement of waste paper deinking to enzymatic method for reuse of waste paper of school succeeded in reducing the amount of chemical substance consumption to about half with the conventional chemical method13. South Indian University reported that it collected human urine and used it as fertilizer to try to improve the environmental sustainability of wastewater management6. It was reported that the low speed filtration method was effective for removing TSS and that UV irradiation was effective for reducing BOD and COD as a result of researching a new method of reusing gray water from school5. More recently, Isfan Medical University in Iran has established a new quantitative and qualitative assessment method for organic biomedical waste8. In addition, new approaches have been developed to reuse organic medical wastes such as blood, dressing swabs, used cotton, etc. by reducing the TSS, BOD and COD by treatment of green extracts, ie extracts of tabacco, as soil fertilizers7. Mishina et al. reported the findings from the management system of University of Freiburg to promote their reuse and recycle wastes generated by academic activities8. Moreover, Zinchenco et al. reported on the reuse and recycle of valuable materials, such as minor and noble metal and their compounds in Nagoya University based on the concept named campus mine9. Recently, reuse of reagents at university has been reported at Toyama University in Japan, but not in the medical and biological fields10.

Here, Faculty of Medicine and the university hospital in Tottori University sponsored a program for the collection of unused chemical substances stored in laboratories on campus and the recycling and reuse of unused reagents.

2. Methods

First, we distributed questionnaires about unused laboratory chemicals to all 113 laboratories in faculty of medicine and the university hospital, collected questionnaire results from 33 laboratories (29.2% response) among them and then we investigated the inventory status and attributes of the surplus reagents stored at these locations as well (Fig. 1). Additionally, information about the use, reuse, and disposal of chemical substances was distributed to...
researchers campus-wide, except for such as mercury and psychotropic drugs, that require special handling and substances that could not be transferred or transported due to budget limitations. Subsequently, the reagents that were not reused were disposed of collectively by a specialized chemical disposal company. Subsidies were also offered to help researchers reduce the cost burden of disposal and recycling on each of the university laboratories.

3. Results & discussion

The project succeeded in making reuse of about 7% of the unnecessary chemical substances at laboratories on campus and in making effective use of space (Fig. 2). Figure 3 shows the breakdown of faculties where the unnecessary chemical substances were has been reused. Many of the unnecessary chemical substances used in the medical field were efficiently reused in other faculties such as engineering and agriculture.

As a result of the project investigation, an attribute classification of the surplus chemicals across the university and its subsidiary locations was created (Figs. 4,5). The attribute classification of what was reused is shown in Fig. 4, and the legal classification of each reused reagent is shown in Fig.5.

The surplus reagents comprised a large number of unopened chemicals, and there was a tendency to reuse these reagents more preferentially than ones that had already been opened (Fig.4(a)). This result is similar to reports from other faculties9) 10). The most storage period that surplus reagents had been kept was recorded as 20–30 years (Fig. 4(b)).

In addition, it was found that most of the surplus

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Fig. 1 Questionnaires on unnecessary chemical substances for all 113 laboratories. Questionnaire form that was sent to individual research laboratories for the investigation of storage conditions of unnecessary reagents at the Faculty of Medicine, Tottori University.

Fig. 2 Examples of workplace improvement. (a) A reagent shelf and (b) a drawer of the reagent shelf.

Fig. 3 A department-wise breakdown list of recipients who were provided unnecessary reagents for reuse (n=79).
reagents that come under the Industrial Safety and Health
generated due to this process. There were no reagents in frozen storage.

There are many organic solvents among the surplus
A part of surplus reagents was found to have been
the (a) sealing condition (open or unopened); (b) storage duration (years); (c) storage temperature; and
remaining surpluses of reagents. This has enabled most of
(b) storage duration (years); (c) storage temperature; and
(d) budget for purchase (budgeted for a specific purpose or without a specific purpose). All unnecessary reagents
(n=1,214) (left) and the reused reagents (n=90 (7.4%))
right).

A part of surplus reagents was found to have been purchased from specific project budgets, e.g., the Grant-in-Aid for Scientific Research. (Fig. 4(d)). Generally, the reagents obtained under such a budget are not suitable for reuse. In recent years, national universities, including Tottori University, have had increased competitive research funding. Therefore, future purchases of reagents for specific budgets are likely to increase, and it may be difficult to make use of or reuse them completely. Further consideration needs to be done on how to reduce the amount of surplus chemicals generated due to this process.

There are many organic solvents among the surplus reagents that come under the Industrial Safety and Health Act and Class 4 dangerous goods that come under the Fire
Service Act. Moreover, the reusable reagents are affected by many applications of these acts (Fig. 5). This result is similar to reports from other universities and departments.

Through the current effort, we have been able to reduce the work of handling such regulations in the management of chemical substances for researchers. Subsidies from the School of Medicine and affiliated hospitals have greatly reduced costs for bulk disposal and shipping costs for the remaining surpluses of reagents. This has enabled most of the campus laboratories to participate in the collection, disposal, and recycling of surplus reagents.

4. Conclusions

At the Tottori University Faculty of Medicine, we distributed announcements about our program to deal with

surplus and unnecessary laboratory chemicals on campus through distributing further information and free transfer for recycling them, and we succeeded in improving the work environment as a result of disposal of unnecessary reagents. Therefore, we were also able to achieve the following: (1) reduce risks such as ignition by chemical substances, explosion and expansion of damage in case of fire, (2) reduce the risk of health disorders due to volatile gas exposure and chemical substances of staff and students, (3) reduce the researchers’ labor around the legal records, (4) make effective use of space by getting rid of unnecessary chemical substance storage, and (5) save on chemical substance disposal costs, electricity bills, and other research and education expenses.

It was found that there are many chemicals commonly used among different faculties. Reusing of unnecessary reagents is an easy and effective workplace improvement activity, not only for safety and health measures, but also for environmental preservation of limited resources. This project is a novel way to gain basic data for whole reagents and reused reagents from the medical and biological departments of the university.

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References


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