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Study on the Improvement of MSDS Awareness among University Laboratory Workers

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Abstract

Purpose: This study is to improve awareness of MSDS in order to prevent university accidents and protect university laboratory workers. In order to improve awareness, measures to increase accessibility through auxiliary means (warning signs, One Page Sheet MSDS, etc) and ways to strengthen safety training (improvement and strengthen MSDS training). **Research design, data and methodology:** A questionnaire survey was adopted as a research method for this study. Question items were selected, modified, and supplemented by referring to the previous paper. **Results:** As a result of the survey, MSDS found that it was difficult to find the information they wanted and that there were many technical terms and limitations in using it. In addition, MSDS training is underway, but few university laboratory workers felt that training was helping. This shows that the effectiveness of training is virtually insignificant. Therefore, it seems that improvement measures are needed to solve this. **Conclusions:** One Sheet MSDS, an effective way for university laboratory workers to communicate information, and MSDS information should be provided with warning signs with large phrases and good visibility. In addition, this study proposes a One Sheet MSDS that prioritizes important MSDS items over all items in the MSDS, and in the field of education, several improvements are proposed, such as "To prevent problems and answers from being shared on the Internet" and "To improve the difficulty of checking the online curriculum".

Keywords: MSDS, Survey, One Sheet MSDS

JEL Classification Codes : I30, I31, I38

1. Introduction

As chemicals were used for various purposes, the demand for various harmful chemicals increased.

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Accordingly, the possibility of chemical accidents occurring at chemical substances handling sites is also increasing. As a way to prevent accidents and occupational diseases related to chemical handling, Korea has introduced and implemented the Material Safety Data Sheets (MSDS) system since 1996. MSDS is a data that contains information such as chemical hazards and risks, handling methods, and emergency measures. MSDS allows you to recognize and manage harmful and dangerous information about chemicals you handle.

However, MSDS currently consists of professional and technical terms, making it difficult to communicate chemical toxicity information (Lee et al., 2017). Therefore, a continuous training and training system is needed, but it is still lacking, so the effect on preventing and mitigating casualties is minimal.

According to statistics from the Chemicals Comprehensive Information System, the types of chemical accidents that occur in schools were the most common. In addition, accidents that failed to comply with safety standards were the most common causes of accidents (Chemical Substance Safety Agency Chemical Substance Information System, 2019~2022). Therefore, efforts should be made to improve awareness of MSDS through strengthening safety training (improvement and strengthening of MSDS training) to prevent accidents at universities and protect research workers (Choi, 2021). At the same time, it is necessary to increase accessibility through auxiliary means (Warning signs, One Page Sheet MSDS, etc.)

2. Theoretical Backgrounds

2.1. MSDS and Other Relevant Theoretical Backgrounds

Material safety and health data are data that explain 16 items of chemicals in detail. Any person who intends to manufacture, import, use, store or transport a chemical substance shall prepare, install or post an MSDS.

Safety and health signs are designed to ensure the safety and health of workers. A sign is displayed in a place where an operator is likely to make mistakes in judgment or behavior in a workshop or where there is a risk of causing a disaster.

The Global Harmonized System of Classification and Domestic of Chemicals (GHS) is a system that aims to easily and consistently deliver different classifications and warning signs through internationally unified classification labeling and MSDS.

2.2. Points We Can See Through Prior Study

Of the 30 chemical accidents that occurred in the laboratory, 25 occurred in the school laboratory. In order to prevent laboratory accidents and protect research workers, various policy efforts such as strengthening on-site inspections, strengthening supervision of hazardous chemicals management and safety training are needed (Lee et al., 2016).

It was found that the higher the research workers' awareness of MSDS, the higher their awareness of hazardous chemicals (Choi, 2021). In addition, workers with MSDS training experience showed relatively higher awareness of MSDS than workers without training experience (Kim et al., 2018). This difference in perception due to training was also found in a survey conducted before and after MSDS training for students. As a result of the survey, only two students, or 3% of all students, said they heard or understood the term MSDS at least once. However, after the lecture, 63 students, or 90% of the students, said they became aware of the importance of MSDS training. Through this, it was confirmed that training on the safety management of harmful chemicals is continuously needed (Choi, 2015).

To sum up these prior studies, strengthening training on MSDS is necessary to improve university laboratory workers' awareness of MSDS. In addition, it seems necessary to consider reorganizing MSDS so that university laboratory workers can easily recognize it. Therefore, this study focused on these parts.

3. Research Contents and Methods

A questionnaire survey was adopted as a research method for this study. From July 1 to July 31, 2023, university laboratory workers handling chemicals at five universities in the Seoul metropolitan area distributed questionnaires and collected opinions. The questionnaire consisted of 13 questions, with a total of 86 people answering. Question items were selected, modified, and supplemented by referring to previous papers. Before conducting the questionnaire, the purpose of the study and confidentiality were explained to the subject. The data were collected only for those who agreed.

4. Research Results

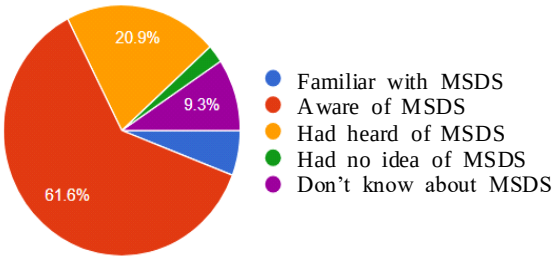

Figure 1: MSDS awareness (unit: Number, %)

As shown in Figure 1, 5 people (5.8%) were familiar with MSDS, 53 people (61.6%) were aware of it, 18 people (20.9%) had heard of it, and 8 people (9.3%) had no idea about MSDS. There were 2 people (2.3%) who did not know. The number of people who responded that they were aware of the level of awareness was 58 (67.4%).

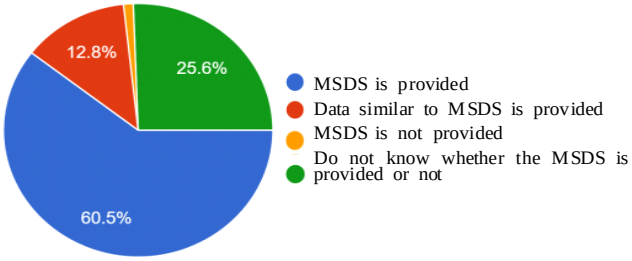

Figure 2: Whether MSDS is provided in the laboratory

As shown in Figure 2, regarding whether the MSDS is provided in the laboratory, 52 people (60.5%) said that the MSDS is provided, 22 people (25.6%) said that they did not know whether the MSDS was provided or not, and 11 people (12.8%) said that data similar to the MSDS were provided. %), it was not provided for 1 person (1.2%).

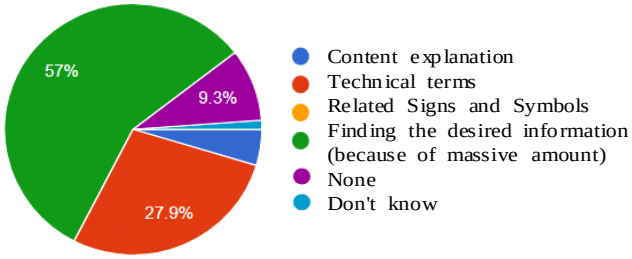

Figure 3: The difficulty of using MSDS

In Figure 3, we can find out that among the difficulties in using the MSDS, finding the desired information was the most common (49 people (57%)), followed by technical terms (24 people (27.9%)), none (8 people (9.3%)), and content explanation (4 people (4.7%)), and 1 person (1.2%) did not know.

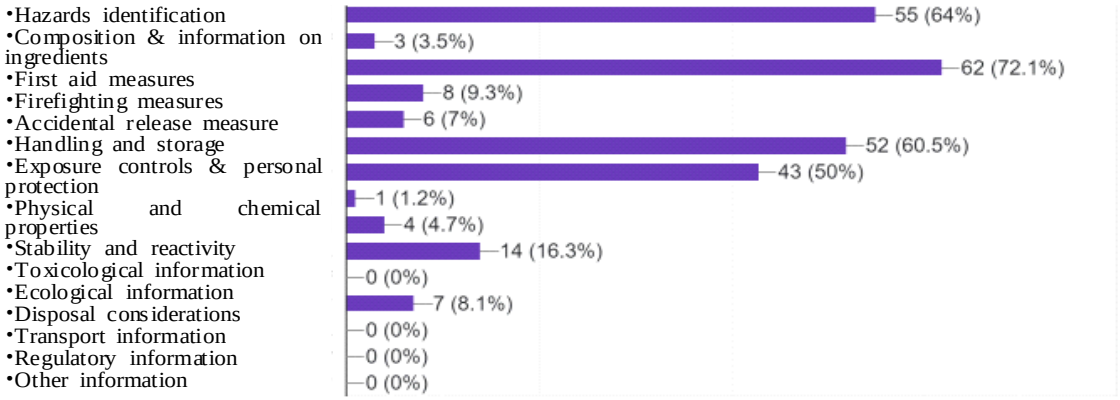

Figure 4: Importance of MSDS items

As shown in Figure 4, the importance of MSDS items was highest at 62 people (72.1%) for First aid measures, followed by Hazards identification at 55 people (64%), Handling and storage methods at 52 people (60.5%), Exposure controls and personal protection for 43 people (50%), Toxicological information for 14 people (16.3%), Firefighting measures for 8 people (9.3%), Disposal considerations for 7 people (8.1%), and 6 people (7%) for Accidental release measure. 4 people (4.7%) responded for Stability and reactivity, 3 people (3.5%) said Identification of the substance, and 3 people (3.5%) said the Composition and information on ingredients. Lastly, 1 person (1.2%) for Physical and chemical properties.

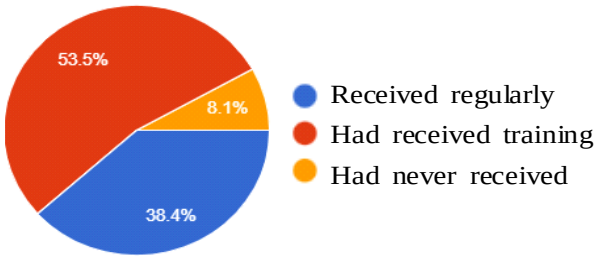

Figure 5: MSDS training status

As shown in Figure 5, 46 people (53.5%) had received MSDS-related safety and health training at school, 33 people (38.4%) had received it regularly, and 7 people (8.1%) had never received it. The number of people who received safety and health training related to MSDS was 79 (91.9%).

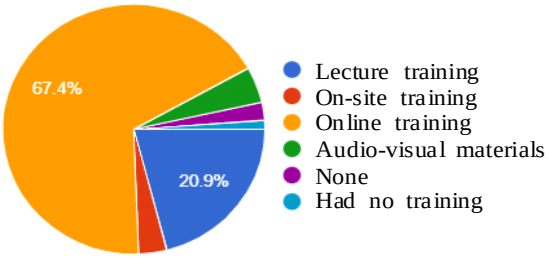

Figure 6: MSDS training method

In Figure 6, the MSDS training method was online training for 58 people (67.4%), lecture style for 18 people (20.9%), audio-visual materials for 4 people (4.7%), on-site training for 3 people (3.5%), and other training methods. There were 3 people (3.5%) who answered that they had no training.

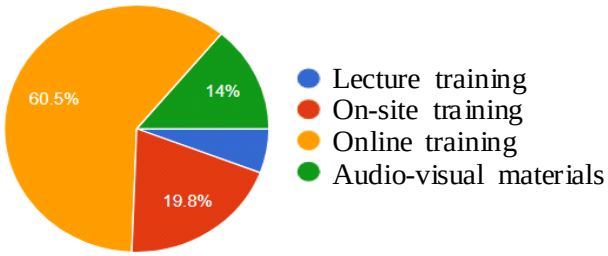

Figure 7: Preferred MSDS training method

As shown in Figure 7, the preferred MSDS training method was online training for 52 people (60.5%), on-site training for 17 people (19.8%), audio-visual materials for 12 people (14%), and lecture style for 5 people (5.8%).

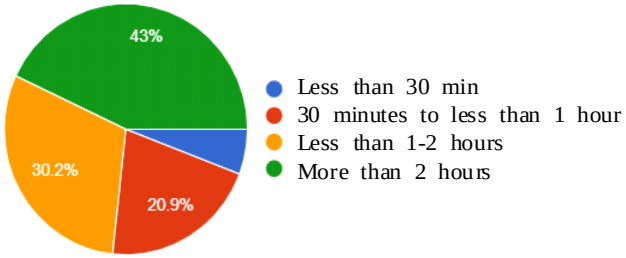

Figure 8: MSDS training time

Subsequently in Figure 8, the training time for one MSDS was more than 2 hours for 37 people (43%), 1 hour to less than 2 hours for 26 people (30.2%), and 30 minutes to less than 1 hour for 18 people (20.9%). Those who have received less than 30 minutes of training was 5 people (5.8%).

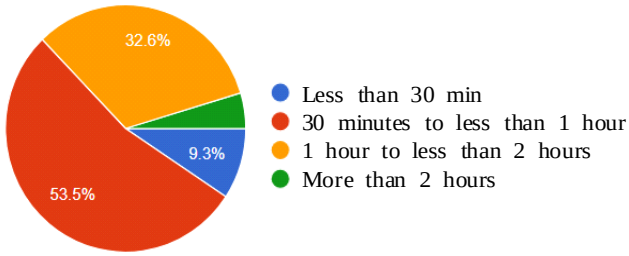

Figure 9: Preferred MSDS training time

In Figure 9, we can find out that the most preferred MSDS training time was 30 minutes to less than 1 hour for 46 people (53.5%), 1 hour to less than 2 hours for 28 people (32.6%), and less than 30 minutes for 8 people (9.3%). There were 4 people (4.7%) who had chose more than 1 hour.

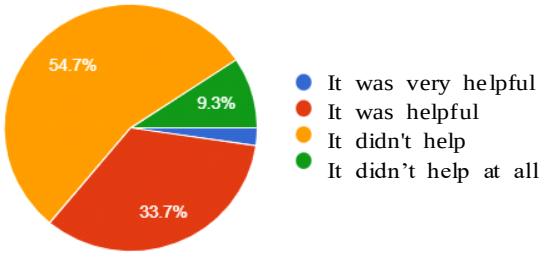

Figure 10: Whether MSDS training was helpful

As shown in Figure 10, regarding whether MSDS training was helpful, 47 people (54.7%) said it was not helpful, 29 people (33.7%) said it was helpful, 8 people (9.3%) said it was not helpful at all, and 2 people (2.3%) said it was a lot of help.

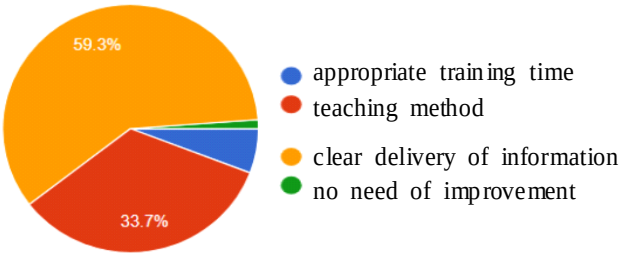

Figure 11: Direction of improvement in MSDS

As shown in Figure 11, the areas that are considered to need improvement in included MSDS was the clear delivery of information (51 people) (59.3%), which accounted for the highest percentage, followed by the teaching method (29 people) (33.7%), appropriate training time (5 people) (5.8%), and There was 1 person (1.2%)

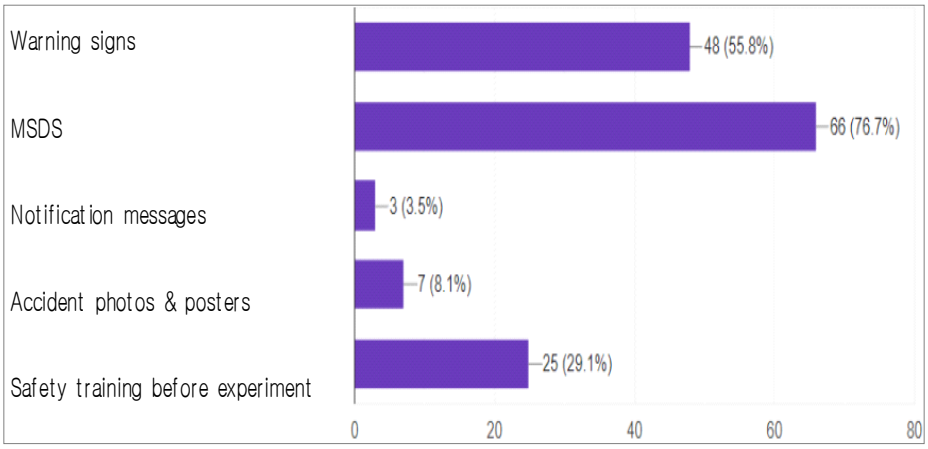

Figure 12: How risk information has been received so far

Figure 12 shows us the most common method of receiving risk information about chemicals currently handled in the laboratory is MSDS 66 (76.7%), followed by warning signs 48 (55.8%) and safety training before experiment 25 (29.1%), followed by accident photos/posters 7 (8.1%), and notification messages 3 (3.5%).

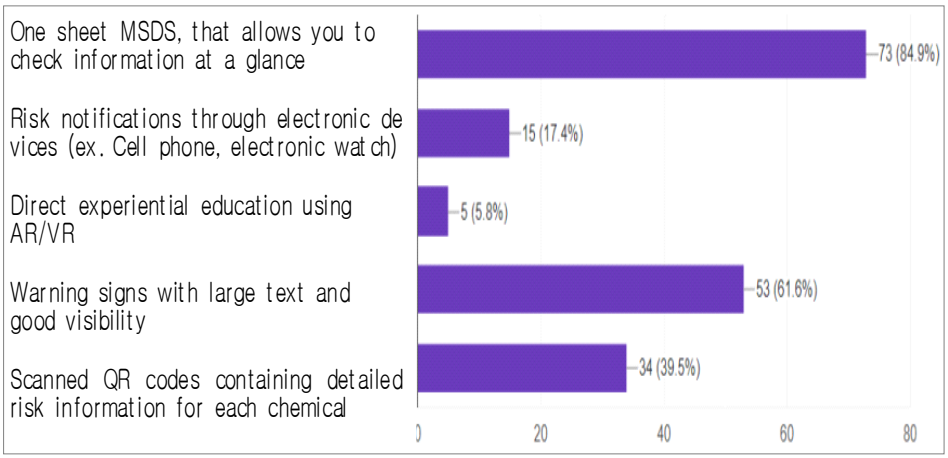

Figure 13: Directions to improve the delivery of risk information

Lastly in Figure 13, the majority of people (73(84.9%) thought that One Sheet MSDS, which allows information to be checked at a glance, is the best way to obtain chemical risk information more effectively, with large text and visibility. 53 people (61.6%) chose good warning signs, 34 people (39.5%) chose scanned QR codes containing detailed risk information for each chemical. 15 people (17.4%) said risk notifications through electronic devices will help, and 5 people (5.8%) thought that direct experiential training using AR/VR will help.

5. Discussions

5.1. Study Results Review

MSDS is data that explains Hazard identification, first-aid measures, and handling methods for chemicals. In other words, it is a data that allows university laboratory workers to recognize harm and danger and conduct experiments safely. However, there is a problem that it is difficult to convey information easily and clearly because it is described in professional content or terms and the amount is vast (Kim & Park, 2012). Accordingly, difficulties in using MSDS have been frequently reported (Meninger & Margolies, 1994).

In addition, according to the results of this study, the most difficult part for university laboratory workers to use MSDS is 49 people (57%) who 'Find the information they want(Vast amount)'. It was followed 'Technical terminology' 24 people (27.9%), 'None' 8 people (9.3%), 'Content explanations' 4 people (4.7%), and 'I don't know' 1 people (1.2%). Through this, it was found that it was difficult to find the desired information due to the vast amount, and there were many Technical terminology, so there was a limit to the understanding and use of university laboratory workers. Although training is underway (91.9%) to solve these limitations, only 36% of university laboratory workers felt that training was helpful. This shows that the effect of training is not significant, and it seems that improvement measures are needed to solve this problem.

In addition, measures are needed to solve the difficulties caused by vast amount and technical terminology. Therefore, it seems necessary to provide MSDS information by One Sheet MSDS (84.9%), an effective information delivery method that university laboratory workers think, and attaching warning signs (61.6%), which have large phrases and good visibility.

5.2. Limitations of Research

First, Reliability is low and there is a limit to generalization. The reason is that the scope and subjects of the study are limited to the five major universities in the Seoul metropolitan area, and the response rate is low with 86 respondents.

Second, there seems to be a difference between the practically important MSDS item and the MSDS item that students think is important. According to previous papers and statistics, most of the accidents that occur in university laboratories are related to leakage. Therefore, it can be said that among MSDS items, the most important part is 'Accidental release measures'. However, as a result of the survey, 'Accidental release measures' is 7% (6 people) were evaluated to be of low importance.

6. Conclusions

This study collected data through a survey of a total of 86 university laboratory workers. As a result, in order to reduce chemical accidents that occur in university laboratories, there was a need to improve MSDS awareness explaining chemicals. The following conclusions were obtained on how to improve MSDS awareness and how to improve MSDS training.

6.1. MSDS Training Improvement Plan

MSDS was the highest at 76.7% in the way university laboratory workers currently receive risk information. In addition, the awareness of MSDS itself and whether MSDS was provided were high at 67.4% and 60.5%, respectively. However, through the survey, it was found that MSDS was difficult to find the desired information (57%) due to the vast amount of information and there were many technical terms (27.9%), so there was a limit to the understanding and use of university laboratory workers. Training is underway (91.9%) to solve these limitations, but only 36% of university laboratory workers felt that training was helpful. This shows that the effect of training is not significant. It seems necessary to improve the training method so that information on MSDS can be delivered and understood more effectively.

As a result of the survey, the online training method was the most common with 67.4% and the field training method was relatively low at 3.5%. However, the most preferred method of training for university laboratory workers was online training (60.5%) and on-site training (19.8%). It is true that many people prefer convenient and accessible online training, but they think it is also important to receive on-site training directly at the site before the experiment. Therefore, it is necessary to come up with a plan to allow university laboratory workers to voluntarily participate in online training and field training that they believe to be conducted formally. At the same time, it is necessary to find ways to improve the problems of current training.

In the case of online training currently being conducted, there is a problem that it is difficult to determine whether the majority of the students taking the course concentrated on listening or understanding it properly. To improve this,

quizzes to help understand learning and final exams after online training have been introduced in the middle of online training. However, the difficulty level of the problem is easy and the questions and answers are leaked on the Internet, so they are not having much effect. Therefore, improvement measures such as further increasing the difficulty of quizzes and randomly setting questions are needed. In addition, measures should be prepared to prevent fast forwarding of lectures and to prevent them from moving to other screens during classes so that they can properly take online lectures.

6.2. Improvement Plan to Raise Awareness of MSDS

There is a limit to the understanding and use of existing MSDS by university laboratory workers. In order to improve this problem, many previous studies believe that it is necessary to use large and visible warning signs and One Page Sheet MSDS as auxiliary means to increase the readability and understandability of existing warning signs and MSDS provided (Hwang, 2022). As a result of the survey of this study, One Sheet MSDS (84.9%) and warning signs with large phrases and good visibility (61.6%) were the highest as effective information delivery methods considered by university laboratory workers.

Accordingly, One Sheet MSDS and warning signs should be utilized to the fullest extent in order to improve the awareness of MSDS. In order to increase utilization, it was judged that it would be good to organize MSDS items that university laboratory workers think are important. Accordingly, a survey was conducted on the importance of MSDS items. According to the results on the importance of MSDS items, 'First-aid measures' 62 people (72.1%) had the most first. Next, 'Hazard(s) identification' 55 people (64%) , 'Handling and storage' 52 people (60.5%) , 'Exposure controls / Personal protection' 43 people (50%), 'Toxicological information' 14 people (16.3%) , 'Fire-fighting measures' 8 people (9.3%). And 'Disposal considerations' 7 people (8.1%), 'Accidental release measures' 6 people (7%), 'Stability and reactivity' 4 people (4.7%), 'Identification' 3 people (3.5%), 'Composition / Information on ingredients' 3 people (3.5%), and 'Physical and chemical properties' 1 person (1.2%). No one chose ‘Ecological information’, ‘Transport information’, ‘Regulatory information’. These results can be understood to be important only for items related to the areas that university laboratory workers should pay attention to during experiments. Therefore, it seems necessary to think of a way to organize the One Sheet MSDS for university laboratory workers so that they can see at a glance by putting about five items in order of importance shown in the survey results of this study.

As such, it is judged that the items constituting the One Sheet MSDS should be configured according to the user. That is, it is necessary to configure important MSDS items first, not all MSDS items. For example, for workers engaged in transporting chemicals, the information needed for transportation is an important item. Therefore, it is necessary to think about the first way to write the information necessary for transportation in the One Sheet MSDS.

6.3. Conclusions

It is important to improve training and organize One Sheet MSDS in this way. However, it is also important for the school to pay more attention to ensure that training can be conducted regularly through periodic inspections. In addition, publicity is needed so that university laboratory workers can actively use One Sheet MSDS, which is easier and simpler to understand than existing MSDS.

Accidents caused by chemicals can cause enormous damage not only to university laboratory workers but also to the surrounding environment. Therefore, it is necessary to actively seek and continue to develop ways to raise safety awareness.

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