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From Students' Questions of Safety Education in a Chemistry Laboratory

Takashiro Akitsu*

Affiliation: Department of Chemistry, Faculty of Science, Tokyo University of Science, Japan

***Corresponding author:** Takashiro Akitsu, Department of Chemistry, Faculty of Science, Tokyo University of Science, 1-3 Kagurazaka, Shinjuku-ku, Tokyo 162-8601, Japan, E-mail: akitsu2@rs.tus.ac.jp

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Abstract

Chemists operate fairly scary chemicals with their bare hands, but drug injuries and addiction is very rare. This is because we are familiar with what is dangerous and what is not dangerous, and for that reason, the experimental curriculum is designed with the idea of gaining sufficient experience of failure in the undergraduate years in the chemistry classroom of the university. From the experience of safety education in the author's laboratory, this article will describe some points that are easy to overlook (metal powder), fire extinguishers, and the opinions are divided (cyanide). Beside general viewpoints of chemical aspects fire safety and chemistry experiments similar to that I have written for high-school and college students and teachers, this Editorial focused on "Question" that my (under) graduate students have practically.

Keywords: Safety of experiments, Metal powder, XRD, Cyanide

Abbreviations: SDS-Safety Data Sheet, XRD-X-ray Powder Diffraction

Introduction

Chemistry students can handle substances safely by knowing what is dangerous and what is not dangerous. There was education rather than reprimand, and students were imbued with the lessons of failure [1]. In my laboratory, when dealing with a new substance for myself, when ordering reagents other than replenishment, I am supposed to grasp the properties of the substance with the Safety Data Sheet (SDS) as well as the usage method (reaction scheme etc.). Other than that, when reconfirming how to handle particularly dangerous reagents (Note: there is no safe reagent in a laboratory!), refer to manual books such as "To conduct experiments safely" series and SDS to handle them properly [2-4].

Case 1: Easy to overlook (metal powder).

When a solid metal that does not react with a solid metal becomes a powder, a catalyst having a low ionization tendency can be a strong catalyst. The finer the powder, the higher the reactivity and it is necessary to pay attention to the dust explosion. For example, in platinum, the bullion is a nonflammable type, and the fine powder is a catalyst, and there is a risk of fire or explosion due to many reactions. That is, the shape of the metal, its surface condition, and the particle size. Attention should be paid to the reaction scale, impurities and reagent purity. There are many accidents of dust explosion caused by metal powder. Indeed, conditions of powder samples cannot be constant (**Figure 1**).

Moreover, in the cases of accidents that could not be predicted from the Japanese Fire Service Act or SDS (namely, properties of chemicals), two cases in the lecture were due to static electricity in different situations. One of them was caused by poor maintenance of apparatus, so it could be prevented with good care. However, in the other case, the static electricity of the spatula and the container caused the organic solvent to explode, and it would be impossible to prevent this (without conditions or details of handling in which it was used).

[**Question**] It was stated that the properties of substances are often related to metal lumps, but SDS, which provides information on toxic substances, is in a different state, such as the danger of not only the state of metal lumps but also the state of powder. Is it possible to confirm the danger in? I think it would be ideal to be aware of it with knowledge, but I would be alert to the dangers not mentioned in the SDS.

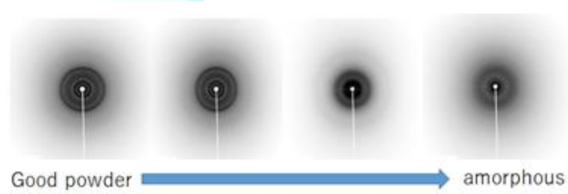

Figure 1: Some examples of powder XRD patterns of metal complexes.

Case 2: Opinions are divided (cyanide).

Accidents of accidental ingestion of chemicals are quite rare, but they are still not completely preventable, and as described in the "To conduct experiments safely" series, mistakes in potassium cyanide there is also a fatal thing called drinking. When a man drank tea with only hot water during a break between experiments using Potassium Cyanide (KCN), my vision became dark and I fainted. He was taken to the emergency room because he shouted "Potassium cyanide!" [2]. On the verge of fainting, and he survived. The accident was caused by not washing hands after the experiment.

[Question] I received some advice from an assistant professor to teach undergraduate student experiments, but potassium cyanide becomes highly toxic hydrogen cyanide when deliquescent, and it is very dangerous and difficult to handle, so it is better not to use it in undergraduate student experiments as much as possible. It seems that some graduate students are reluctant to use it, so it would be better to change the reagent.

Case 3: About fire extinguisher in chemical laboratory

In the material of the lecture, there were various fire extinguishers for the chemistry laboratory. In the example of a French university, there were as many as three types of fire extinguishers (**Figure 2**). However, in our university, we only have common powder (ABC) fire extinguishers. Certainly, it seems to be able to handle all three types of fires A, B, and C. [**Type A fire (ordinary fire):** Fire burning wood, paper, clothing, etc. **Type B fire (oil fire):** A fire that burns petroleum, gasoline (flammable liquid), oils and fats, etc. **Type C fire (electric fire):** Fires involving electrical facilities such as electrical equipment and appliances that may cause electric shock].

[Question] But is it okay if there is no fire extinguisher with other characteristics? Also, are there not only fire extinguishers but also sand buckets? In the first place, which fire is classified as a fire caused by a chemical substance (reagent)?

Figure 2: Fire extinguishers of a French university.

Conclusion

Since it is a chemistry laboratory, please be able to handle such substances safely, which is another opinion for the Question of Case 2. First, check the SDS for general properties and figure out what you shouldn't do in the experiments. Gloves are a must, of course (**Figure 3**). Solids should be weighed quickly and treated as a basic solution. I think the four-sided transparent cell that measures fluorescence had a lid. There is also a draft in the room. Check with a universal test strip and be careful so that the waste liquid tank becomes basic Hydrogen Cyanide (HCN) gas can be generated if it is acidic.

Figure 3: Wearing gloves for cleaning, and the waste liquid tank prevents the risk of poisoning and ignition.

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