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Evaluating a Chemical/Biological Laboratory to Promote Safety Measures

WEDAD H. AL-DAHHAN[1], ALI ABD ALI[1], AMMAR JASIM[2], FALAH H. HUSSEIN[3] and EMAD YOUSIF*[1]

[1]Department of Chemistry, College of Science, Al-Nahrain University, Baghdad, Iraq.
[2]Department of Chemical and Biological Engineering, Al-Khwarizmi College of Engineering, Baghdad University, Baghdad, Iraq.
[3]College of Pharmacy, Babylon University, Babylon, Iraq.

Abstract

The Department of Chemical and Biological Engineering, Al-Khwarizmi College of Engineering at Baghdad University has lately renovated its own research laboratories to comply with international safety measures and conduct undergraduate and postgraduate research. In this regard, the department has harnessed some amenities within the college to establish these laboratories taking into accounts creating a convenient, safe, and developed working environment for both researchers and students. A precise procedure was followed to establish this laboratory which includes providing new bench tops which offer spacious working places for workers. These benches were supplied with power points, gas, water, and compressed air outlets. In addition, the laboratories were provided with fume hoods, fire extinguishers, and other auxiliary safety tools. For all that, an inspection conducted by experts to these laboratories showed some major and minor faults which need to be taken into considerations to ensure safety for all workers within these amenities.

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Introduction

Developing research laboratories has been one of the most crucial factors in maintaining research and academic capabilities within application based disciplines[1-2]. However, there might be some other important measures need to be considered before initiating such projects which includes selecting locations, and providing the facility with general and special equipment[3-7]. In compliance with our previous case studies on safety rules within

CONTACT Emad Yousif emad_yousif@hotmail.com Department of Chemistry, College of Science, Al-Nahrain University, Baghdad, Iraq.

research laboratories[1-2], we present here a detailed evaluation for a chemical/ biological laboratory at Al-Khwarizmi College of Engineering revealed the following report:

New bench tops were installed and provided with all necessary services to perform research as depicted in Figure 1, and 2.

Fig. 1: Newly installed benches.

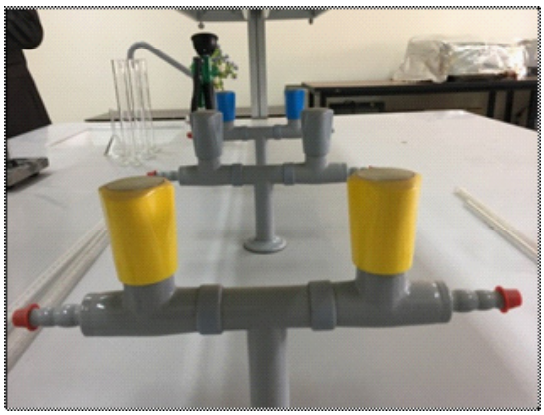

Fig. 2: The bench is provided with various outlets.

Adjusting the air flow in this manner creates negative pressure ventilation, allowing sufficient air flow into the room while minimizing the possibility of health effects due to the presence of chemical hazards8-11.

Installing new fume hoods (Figure-3) and biological cabinet (Figure-4).

Fig. 3: A safe and spacious fume hood

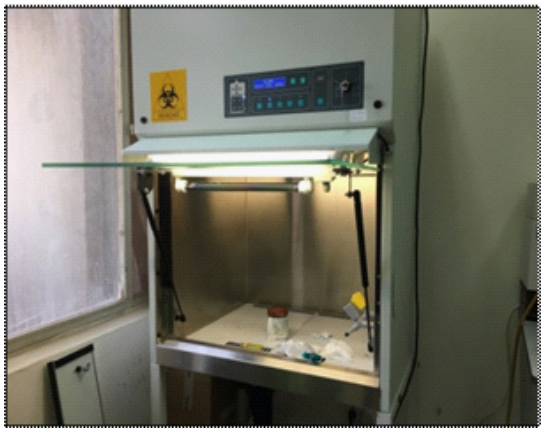

Fig. 4: A modern biological cabinet

Allocating a place for putting gas cylinders as shown in Figure-5.

Fig. 5: Gas cylinders in a safe place

Supplying the laboratory with a fridge and cabinets to keep chemicals and samples as demonstrated in Figure-6, and 7 respectively.

Fig. 6: A refrigerator to keep chemicals

Fig. 7: A cabinet for chemicals

Fire extinguishers (dry powder ABCE) were placed in the laboratory along with some additional sand in buckets as shown in Figure-8, and 9 respectively.

Fig. 8: Fire extinguisher (dry powder)

Fig. 9: Sand buckets

Mounting a first aid box on the wall (Figure-10) and providing an eye washer (Figure-11).

Fig. 10: First aid kit

Fig. 11: Eye washing unit

Using safety and hazard instructions in the laboratory as displayed in Figure-12, and 13.

Fig. 12: Hazard instructions

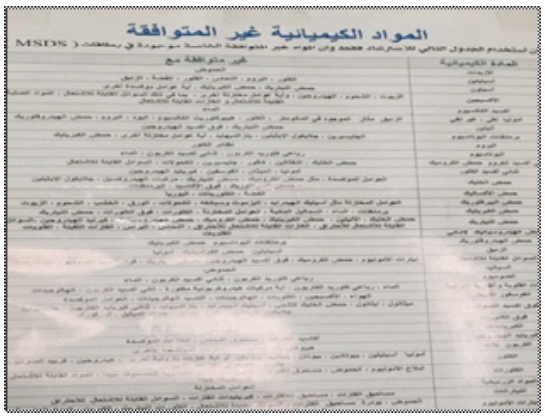

Fig. 13: Safety instructions

Up to this point, we believe that this laboratory was well renovated and equipped. Nevertheless, to the best of our knowledge and experience in the field of safety we present a detailed feedback and comments on this laboratory should be seriously and strictly considered and as follows:

There is only one door for the laboratory (Fgure-14) as there is no emergency exit. Also, this door must be open outwards not inwards and that is very valid point to consider in the first place.

In the building there are some emergency exits (Figure-15), but they were all locked for security reasons. In this case, we recommend at least keeping one of them open.

There must be an evacuation map inside and outside the laboratory to allow people in the building to know where they must be going in case of emergency. In this regard, there must be a specific assembly area outside the building which is far enough to ensure safety. We also recommend educating all students and workers on how to evacuate the building in case of emergency via performing a mock emergency accident.

Fig. 14: The only door in the lab

Fig. 15: Emergency exits.

Some electrical connections were improperly installed (Figure-16) with electrical cords exposed to chemicals or in the vicinity of water or gas outlets (Figure-17) which certainly can be a reason for many catastrophes.

The gas supplying unit (Figure-5) was not fitted in accordance with safety rules and the following feedback was made:

Firstly: gas cylinders were not secured by using secure wall mount for gas cylinders.

Secondly: there were other water supply units, pumps, and some pipes in the same place.

Thirdly: the separation distance between it and the laboratory is not big enough to prevent any damage to people or the laboratory in case of accident.

Regardless the fact that the laboratory has many safety instructions for dealing with chemicals and their storage as mentioned earlier, we observed some inconsistent and unsafe chemical storage as shown in Figure-18, and 19.

There were some cabinets contain organic solvents and strong acid together, and also some unsuitably stored chemicals with no labels. In this regard, we suggest not allowing people to bring any chemical to the lab unless they have its Safety Data Sheet (SDS) and make a risk assessment form read, understood, and signed off by student and safety officer/laboratory manager. Additionally, sufficient information must be obtained about all chemicals in the inventory of all laboratories[12-14].

Fig. 18: Improper chemical storage

Fig. 19: Poorly labeled chemicals

Safety instructions in the laboratory (Figure-20) explicitly tell people not to drink or eat in the laboratory. Nevertheless, on the spot of inspection, we found a drinking water cooler (Figure- 21), and a food rubbish in the lab bin (Figure-22)

Fig. 20: Safety instruction against eating or drinking in the laboratory

Fig. 21: Drinking water cooler

There was a hydrogen gas cylinder inside the laboratory (Figure-23) which is a colorless, odorless, and tasteless gas. That is why in case of any leakage of this gas will probably expose people in the laboratory to a serious danger. Our recommendation is that the cylinder should be outside the lab and

Fig. 22: Food rubbish in the laboratory

Fig. 23:A hydrogen cylinder in the lab

securely mounted. Also, we suggest installing oxygen sensors inside the laboratory in order to check the oxygen levels regularly.

Fig. 24: A chemical in a soft drink bottle in the fridge

The fridge in the laboratory is essential to store some chemicals. However, these chemicals must be properly stored in neat vials/jars with a clear labels on and not in a soft drink bottle as depicted in Figure-24

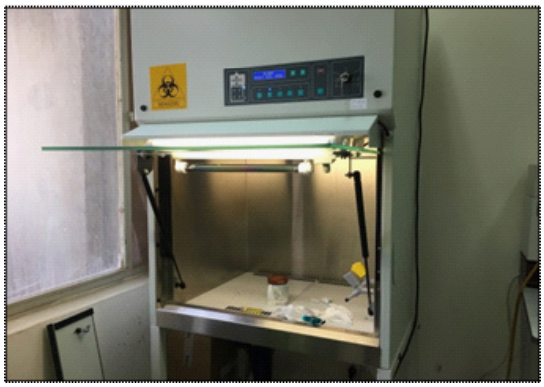

Fig. 25: A biological cabinet

The laboratory has a biological cabinet (Figure-25) which includes a ventilating fan. It is customary to sterilize the cabinet prior to do any work inside it and the sterilization involves using ethanol (Figure-26). The ventilation of fumes of ethanol will not reduce the danger if there was a naked flame in the vicinity. In this laboratory, we noticed that there was Bunsen burner used for specific purposes, but there should be a much safer handling of ethanol and this burner when in use as shown in Figure-27.

Fig. 26: Ethanol used for sterilization

It was also noted that the cabinet filters (Figure- 28) had some molten plastic materials (Figure-29) seem to be burned before using the Bunsen burner. In a

prolonged exposure to these materials, the filters will be blocked and no more suction to harmful fumes in the cabinet.

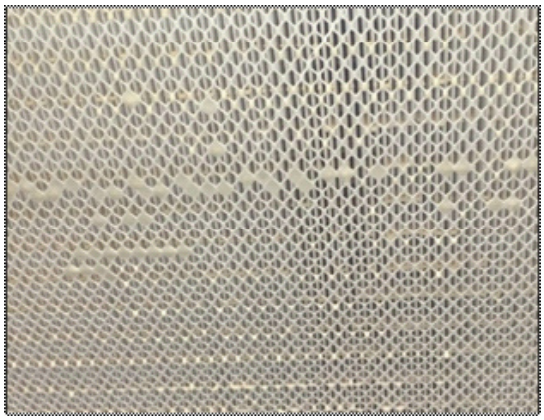

Fig. 28: plastic materials on filters

Fig. 29: molten plastic materials on a tap

10. One of the fume hood cabinets was not functional as the cabinet was not connected to the ventilation. On the contrary, the other completely functional fume hood has a giant incubator inside as shown in Figures 30 and 31.

This research spans a series of research specialized in safety aspects to lay the groundwork for work in a secure workplace environment[15-19].

Conclusion

In the light of the present case study, it is mandatory to follow safety measures in this laboratory as we suggested and as internationally advised for working in chemical or biological laboratories. This study might be beneficial to be as a starting point for maintaining a safe working environment for researchers and students in this laboratory.

Fig. 30: A non-functional cabinet

Fig. 31: A functional cabinet with incubator within

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