Optimization of Occupational Safety and Health Implementation in a Chemical Analytics Laboratory

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ABSTRACT

Introduction: A Laboratory room is one of the places that has the potential for the occurrence of work accidents for its users. A chemical analytics laboratory in University X Surabaya is a means for lecturers or students to conduct research using certain tools and materials, so occupational safety and health management is needed to minimize the risk of harm in the laboratory. This study aims to describe the application of occupational safety and health in the chemical analytics in University X Surabaya. **Methods:** This research used a qualitative approach. This type of research was descriptive observation, conducted by observing the safety checklist of the chemical analytics laboratory of University X Surabaya in August 2020 and observing the situation in the laboratory directly. **Results:** In the occupational safety and health checklist in the chemical analytics laboratory there are 8 indicators (laboratory rooms, storage facilities, sanitation, personnel facilities, heating and ventilation, lighting, laboratory safety, service, and fire prevention and protection), with 65 question points to be met. Based on the observations, 13 points have not been met and 49 points have met the checklist. Meanwhile, the other 3 points are still not filled out. **Conclusion:** The application of occupational safety and health in the chemistry analytics laboratory in University X Surabaya is good enough because most of the questions on the checklist have been met.

Keywords: implementation, laboratory, occupational safety and health

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INTRODUCTION

Accidents are incidents that cause injuries, poor health, or damage to facilities. Meanwhile, work accidents are events that can result in injury, pain (depending on severity), and even death, and can damage the environment. Accidents that occur in work relationships include accidents that occur on the way from home to work or vice versa (Ministry of Manpower Regulation, 2017).

National Social Security Agency for Employment (BPJSTK) said that in 2019 there were 77.295 reported work accidents (Social Security, 2019). Accidents that occur are work accidents ranging from minor cases to fatal cases. The adverse effects of work accidents and occupational diseases not only injure and harm workers, but also destroy equipment, and adversely affect the organization (Mohammadfam *et al*., 2017).

The risk of potential hazards occurring in the workplace can be controlled by the implementation of good occupational safety and health management. Occupational safety and health management system aims to protect the workforce and construction services from the risk of harm to support the improvement of effective and efficient performance (Pangkey, Malingkas and Walangitan, 2012). The application of occupational health and safety aims to obtain the highest level of health, both physical, mental, and social health for residents and users of the environment, through preventive, promotional, and curative efforts against diseases, or health and safety disorders due to work or work environment (Ferdiyana *et al*., 2020). Occupational safety and health risk control can be done through elimination, substitution, modification, administration, and PPE. If there is no occupational safety and health management system in an organization, then the potential for work accidents is greater. Thus, the role of risk control through occupational health and safety management system is highly important.

Work accidents can happen anytime and anywhere. The laboratory is one of the places that

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has the potential for workplace accidents for its users. Occupational safety and health in the laboratory is very important to pay attention to because it is related to the performance of researchers, lecturers, and students (Rahmantiyoko, Sunarmi and Rahmah, 2019). The laboratory is a means of learning, experimenting, observing, and training using certain tools. Based on previous research, the existence of biosafety facilities is also very necessary to support the implementation of activities involving groups of microorganisms with different levels of risk in the laboratory (Wisnuwardhani, 2018). A chemical analytics laboratory is one of the laboratories used by researchers or lecturers and students in University X Surabaya. Activities in laboratories often use certain chemicals and tools to support the learning process. This is evidenced by the occurrence of several work accidents that caused injuries and fatalities in academic laboratories over the last ten years around the world (Ménard and Trant, 2020).

Based on research conducted by Rahmantiyoko, Sunarmi, and Rahmah entitled Laboratory Safety and Security, the risks of accidents that have occurred in the laboratory area, among others, are slipping due to slippery floors causing bruises and abrasions, exposure to acid solution causing blisters or flaky skin, exposure to sodium or potassium metals causing blisters or flaky skin, and burns caused by hot objects causing skin blisters and peeling (Rahmantiyoko, Sunarmi and Rahmah, 2019). In addition, based on the results of research conducted by Cahyaningrum, Sari, and Iswandari (2019), the most frequent work accidents in the laboratory contact with heat are exposure to chemical spills, and complains of dizziness due to inhalation of chemicals during chemical testing. Accidents are highly likely to occur if risk control in the laboratory is not properly controlled. This is exacerbated when the laboratory users do not pay attention to the instructions and rules in the laboratory. Based on the above exposure, this study aims to describe the application of occupational safety and health in the chemical analytics laboratory in University X Surabaya.

METHODS

This research used a qualitative approach. This research was also descriptive observational because theresearchers made observations on the laboratory safety checklists provided by the Directorate of Infrastructure & Environment, University X Surabaya. The Occupational Safety and Health (OSH) list of this laboratory had 8 indicators with 65 questions; specifically there are 16 questions on laboratory room indicators, 3 questions on storage facility indicators, 9 questions on sanitation, 5 questions on heating and ventilation, 4 questions on lighting, 9 questions on laboratory security, 8 questions on services, and 11 questions on prevention and fire protection. The research was conducted in August 2020. The research location is in the chemical analytics laboratory of University X Surabaya.

In this study, the researchers obtained primary data and secondary data. The primary data were obtained through observations made based on the safety checklist of the chemical analytics laboratoryin University X Surabaya. During the observation, the conformity between the actual circumstances and the standards imposed were observed. The analysis of the observation results was carried out especially on the safety checklist point of the chemical analytics laboratory in University X Surabaya, which has not yet followed the theoretical standards or legislation applicable in Indonesia and internationally. Thus, the results of the analysis can be used as the basis for improvement. Meanwhile, the secondary data were obtained through documents in University X. Analysis of these data was also supported by literature studies such as scientific literature, occupational safety and health books, and applicable standards in University X and legislation related to the field of occupational safety and health.

RESULTS

Based on Table 1, the results of direct observation in the chemical analytics laboratory and safety checklists show that the laboratory space is in good and condition and although there are still some points that have not met the safety and health checklist. In the laboratory room indicators, 15 points have been fulfilled, and 1 point has not met the checklist.

Point 1 explains that there are guidelines and certifications of occupational safety to be a consideration in building facilities or evaluation of laboratory rooms. Point 2 explains local and national requirements and natural prevention requirements which are available in the chemical analytics laboratory. Point 3 shows that a room is free of all forms of obstruction and interference. Point 4 shows

that a clean analytical laboratory room is clean. Point 5 shows that on the floor of the laboratory room there is no structural damage.

At point 6, it can be seen that the workspace is adequate to operate safely. Point 7 shows that floors and the stairs of the building are not slippery. Point 8 points out that the turning room and corridor are spacious enough for the movement of people and large equipment. Point 9 points out that the state of the bench, and furniture are in good condition and clean. However, the dressing room is not available in the chemical analytics laboratory. At point 10, it can be seen that the surface of the bench is resistant to corrosive and flammable chemicals.

At point 11, it can be seen that the access to the laboratory area is limited to certain personnel. At point 12, it shows that in the laboratory room of chemical analytics no insects or rodents were found. Point 13shows that explosive steam can be ejected so as not to harm. In addition, hot water pipes have been isolated and protected. Point 14 shows the availability of backup power supply units. Point 15 shows that in the laboratory of chemical analytics, a place to wash hands is available. Point 16 shows that the application of risk assessment in activities carried out in the chemical analytics laboratory regarding equipment and facilities is still not optimal.

The second indicator is the storage facilities. The state of the storage facilities in the chemical analytics laboratory is in good condition. It is proven that the storage facilities in the laboratory have fulfilled the checklist. In point 1, the storage facilities, shelves, and so on are well organized and free from items that slide, collapse, or fall. In point 2, the storage facilities in the laboratory are free from the accumulation of unused waste goods. In point 3, the refrigerator and storage area in the chemical analytics laboratory can be locked.

Table 1. Recapitulation of Occupational Safety and Health Checklist Answer Results in the Chemical Analytics Laboratory in University X Surabaya in 2020

Indicators	Description	
	Yes	No
Laboratory room	Point 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,	Point 16
Storage facilities	Point 1,2, 3	-
Sanitation and personnel facilities	Point 1,2,3,5,7,9	Point 4 (N/A), 6 (N/A), 8
Heating and ventilation.	Point 1, 3, 4, 5	Point 2
Lighting in the laboratory	-	Point 1, 2 (N/A), 3, 4
Laboratory safety	Point 3, 5, 6, 7, 8	Point 1, 2, 4, 9
Service	Point 1, 3, 4, 5, 6, 7,	Point 2, 8
Fire prevention and protection	Point 1, 2, 3, 4, 5, 6, 7, 9, 10, 11	Point 8

The third indicator is sanitation and personnel facilities. In this indicator, the state of the chemical analytics laboratory has largely met the criteria in the checklist. in point 1, the laboratory room of chemical analytics is kept clean. In point 2, toilets and washing facilities (handwashing places) around the area of the chemical analytics laboratory are in a clean and separate condition between males and females. In point 3, hot water, cold water, soap, and towels are available. In point 5, accommodation for each personnel's clothes (such as lockers) is available. In point 7, the noise level is still acceptable, which is less than 85 dB. In point 9, TPS to temporarily accommodate hazard and toxic substances laboratory results have been provided.

As for point 8, the place to hold waste in the laboratory of chemical analytics has not been distinguished by its type between organic, inorganic, and hazardous toxic materials. Also, points 4 and point 8 are not filled because the chemistry analytics laboratory does not provide a locker room (point 4) and also does not provide a dining room (point 6).

The fourth indicator is heating and ventilation. In this indicator, the state of the chemical analytics laboratory has largely met the criteria in the checklist. This is proven by 4 points that have been fulfilled and 1 point that does not meet the criteria of the occupational safety and health checklist in the laboratory. In point 1, the temperature of the workspace has met standard. In point 3, ventilation in the laboratory of chemical analytics is available. In point 4, filters inside the ventilation system are available and are in good condition. In point 5, mechanical ventilation is available in acid cabinets and biomaterial storage cabinets. Meanwhile, point 2 is not fulfilled because in the laboratory of chemical analytics there are no blinds or curtains for the windows of the room, but they are replaced with plastic films.

The 5th indicator is lighting in the chemical analytics laboratory . The lighting in this laboratory is still inadequate. This is evidenced by 4 statements on lighting indicators that have not met these criteria. In point 1, lighting illumination is not adequate or less than 500 lux, which is 250 lux. In point 3, the

lighting of the entire area is still quite inadequate, but it does not blink. In point 4, the color of the lighting is still inadequate. Meanwhile, point 2 about local lighting on the work desks is not filled.

Indicator 6 is laboratory safety. In the laboratory safety indicator, five points have met the criteria in the checklist and the other four points have not been met. Point 1 has not been met because a qualitative risk assessment has not been done to detect and measure the security protection systems in the laboratory area. Point 2 has also not been met because the parameters of the draft response to accidents and risks are not yet available. Point 3 has been fulfilled because the entire room is securely locked if not used. Point 4 has not been fulfilled because the glass doors and windows are classified as non-breakable. Point 5 has been fulfilled because the entire room containing hazardous chemicals and expensive equipment is locked if not used. Point 6 has been fulfilled due to access to controlled and registered rooms, equipment, and materials. Point 7 has been fulfilled because the eyewash is available and in good condition. Point 8 is fulfilled because shower safety is available and in good condition. Meanwhile, point 9 has not been fulfilled because there are still some chemicals have not been equipped with GHS labels.

The seventh indicator is service in the laboratory. In the service indicator, six statements have met the criteria in the checklist, and two statements have not met the criteria in the checklist. In point 1, handwashing, water, electricity, and gas openings are available to help workers work safely in the laboratory. In point 2, inspection and maintenance for all fuses, lamps, cables, and pipes have not been done properly, so they have not met the criteria in the occupational safety and health checklist. In point 3, all damage repairs have been resolved and completed in a very short time. In point 4, the engineering and maintenance services by experts in their fields are available.

In point 5, experts or labors know the dangers of chemicals and work safety in the laboratory. In point 6, control and recording have been carried out for maintenance in every area of the laboratory. In point 7, cleanliness is maintained through the available cleaning services. Meanwhile, in point 8, information about technology services is not yet available because it is being prepared immediately, so it does not meet the criteria in the service checklist.

The eighth indicator is fire prevention and protection. In this indicator, most have met the criteria in the checklist. In point 1, a fire alarm system is available in the laboratory area. In point 2, fire extinguishers are already available in good condition in the area around the laboratory. In point 3, fire doors are available in good condition. In point 4, the fire detection system is in good condition and is tested periodically. In point 5, the fire alarm system is easily accessible. In points 6 and 7, emergency exit signs and evacuation routes are available and clearly visible in the area around the laboratory. In point 8, there is a pile of goods in the emergency exit area so this criterion does not meet the checklist. In point 9, the emergency exit is always locked if unused. In point 10, the evacuation route to the emergency exit is arranged so as not to pass through areas that have a high level of danger. In point 11, the emergency exit is connected to an open area outside the building.

DISCUSSION

Laboratory Room Indicators

The consideration in building construction is the existence of instructions and certifications of work so that they become a consideration for building facilities or assessment rooms. In the occupational safety and health checklist, the work instructions and certifications are complete, and the construction of a chemical analytics laboratory in the building has been licensed by the Directorate of Infrastructure & Environment.

A chemical analytics laboratory is one of the places that could potentially cause work accidents. The laboratory space should be well designed and efficient so that users will feel safe. One of the unexpected events that can occur is a natural disaster. Building requirements in efforts to prevent natural hazards must be met. This is important to minimize the risk of natural disasters that can harm laboratory users.

The laboratory is also designed to make users not only feel safe but also feel comfortable. In the observations, the layout in the chemical analytics laboratory is adequate and there are no barriers, especially in the entrances and hallways between work desks. The available hallway has a width of 2 meters. This is in accordance with the guidelines that the hallway area should be at least 1.2 meters and the exit area should be 2 meters. Moreover,

there should also no barriers along the corridor (Minister of Health Regulation, 2016)

The comfort and health of laboratory users are also determined by the hygiene factors in the laboratory room (Maharani and Sari, 2018). Cleanliness in the laboratory has been maintained, and there is no structural damage or slippery floors. The floor is made of the vinyl material that is not slippery and easy to clean in the event of a chemical spill. One of the work accidents that can occur due to slippery floors is slipping, resulting in bruises and abrasions on the victims (Rahmantiyoko, Sunarmi and Rahmah, 2019).

The workspaces in the chemistry analytics laboratory are also neatly arranged. However, it would be better if there is a floor plan that can explain the parts of the laboratory, making it easier for users to locate places (Rahmantiyoko, Sunarmi and Rahmah, 2019). Also, there are some floor parts that are more prominent, so this condition can be a barrier to laboratory users. The corridor leading to the analytics laboratory is not narrow and has exceeded the minimum requirement of more than 1.8 meters (Ministry of Health Regulation, 2010).

The condition of the benches and tables that can be found in the chemical analytic laboratory looks good and is not harmful. The tables used for the implementation of activities in the laboratory are a set of tables coated with an anti-corrosion coating and equipped with shelves and storage drawers. However, there are wood materials on the tables and chairs that are not fireproof. This certainly requires fire protection efforts as this could potentially lead to a fire risk. Fire is a pure risk or accidental risk, which in the event of an accident can cause sudden loss (Tagueha, Mangare and Tj. Arsjad, 2018). Therefore, it is important to prevent fire by paying attention to work equipment, especially in the laboratory.

The laboratory is designed using ventilation derived from the air conditioner. This certainly minimizes the entry of insects and animals when compared to the use of ventilation in the form of windows. The benefits of ventilation in the room, especially in the laboratory are for air circulation so that it is not hot for laboratory users and for laboratory equipment. Based on the findings of previous research, one of the causes of damaged laboratory equipment is humid room temperature (Nayiroh and Kusairi, 2019). Thus, it is important to maintain room temperature in the laboratory.

The risk of work accidents caused by various factors can occur suddenly. The existence of risk management is expected to reduce and even eliminate the risk of work accidents (Iryaning Handayani and Purwanto, 2014). Nevertheless, unfortunately, a risk assessment has never been done during the use of this new building because the spatial arrangement is still ongoing, and there is no definite floor plan. Thus, the layout of the items can still change.

Storage Facilities Indicators

Facilities that can be utilized by laboratory users to store laboratory equipment are lockers or storage cabinets. Based on the observations, cabinets and storage lockers are closed and neat, and there are no excessive piles of goods so the risk of being hit by goods is very low. Items stored in the cabinets are items that are temporarily not used. Meanwhile,

Figure 1. Condition of the Chemical Analytics Laboratory in University X Surabaya in August 2020

Figure 2. Condition of Storage Lockers at the Chemical Analytics Laboratory of University X Surabaya in August 2020

goods that will no longer be used will be stored in the warehouse.

This finding is similar to research conducted by Syakbania and wahyuningsih (2018), stating that equipment that is not used is stored in cabinets and laboratory storage warehouses. The existence of space and storage cabinets is a completeness of laboratory facilities and infrastructure that must be met following the standards of pharmaceutical laboratories (Syakbania and Wahyuningsih, 2018). If unused items are tubes or items that are at risk of rupture, they will be immediately thrown into the glass waste area. Also, the refrigerators and chemical storage at the back of the laboratory room are always closed and locked when not used by the laboratory personnel.

Sanitation and Personnel Facilities Indicators

Maintained cleanliness in the work area will create comfort. Based on the observation results, the laboratory room in general is clean and neatly arranged for the existing items. There are 2 sinks for handwashing on each right and left side of the laboratory table. However, toilets are available outside the laboratory area, which is a public facility on the 7th floor of the building. In addition, each floor has a separate toilet between male and female personnel. In the men's toilet, there are 3 latrines, 3 urinals, 2 sinks, 1 trash can, and 1 automatic hand dryer. Meanwhile, in the women's toilets there are facilities like in the men's toilets but there are no urinals. Completeness of toilet facilities is no less important to note. Completeness of toilet facilities includes latrines, sufficient clean water, flushing tools, trash cans, hand washers, and soap. (Ministry of Manpower Regulation, 2018). Toilet facilities in the area around the chemical analytics laboratory have adequately complied with the facilities as stipulated in the act.

Figure 3. Condition of Sinks and Toilets at the Chemical Analytics Laboratory of University X Surabaya in August 2020

Laboratory user facilities are also provided with lockers for a temporary place of student personal belongings during the practicum. However, one of the rules in the laboratory is that the laboratory users are not allowed to drink and eat indoors so that there is no room for eating. Laboratory users can drink and eat outside the laboratory.

The level of noise in the laboratory when measured using an audiometer obtained a result of 65 dB. It can still be categorized as safe because the value is less than the maximum limit of the threshold value of less than 85 dB (Ministry of Manpower Regulation, 2011). Thus, it needs to be maintained. The noise that exceeds the threshold will cause hearing loss as a result of unsafe and too loud noise exposure (Eryani, Wibowo and Saftarina, 2017).

Another personnel facility is the trash cans. Based on the observations made, the trash cans provided are not closed. This is similar to research conducted by Pertiwi, Joko, and Dangiran (2017),

Figure 4. Condition of Waste Disposal at the Chemical Analytics Laboratory of University X Surabaya in August 2020

stating that the existence of trash cans without lids can cause waste dilution if it is full. Unclosed trash can allow human contact with microbes and odors, and it is also unsightly (Pertiwi, Joko and Dangiran, 2017). Also, organic and inorganic waste cans are also found in one container. It is certainly not in accordance with the applicable regulations that the sorting of types of waste must be provided separately, labeled, and covered and made watertight (Ministry of Manpower Regulation, 2018).

In addition, the temporary shelters (TPS) of the available hazardous toxic materials are closed containers for liquid waste and containers made of iron for broken glass waste. Hazardous and toxic waste has different properties and characteristics from waste in general, mainly due to its unstable properties. In fact, the stability of hazardous toxic materials is affected by several external factors such as temperature, pressure or friction, mixed with other materials. This can trigger hazardous toxic materials material properties such as reactive, explosive, flammable, or toxic properties (Ruliana, Suroso and Supriyadi, 2016). Waste containing hazardous and toxic substances due to its properties, concentrations, and amounts can pollute or harm the environment, health, human survival, and other living things. This waste can be produced from laboratory activities (Hariyadi *et al*., 2020). If the amount of waste has sufficient shelter capacity, then the waste will be handed over to a third party for processing.

Heating and Ventilation Indicators

Based on the results of observation, the chemical analytics laboratory room temperature is 200C. The temperature is in accordance with the permissible laboratory temperature ranging from 200C to 250C (Ministry of Health Regulation, 2013). Maintained room temperature will create good humidity of the room to minimize damage to the equipment in the laboratory. This aims to reduce direct sun exposure and keep laboratory temperatures within the permissible limits. The temperature is also closely related to the metabolism of the body. Cold temperatures can reduce efficiency and cause stiff complaints or a lack of muscle coordination. Meanwhile, hot air conditions can decrease work performance and affect the comfort of the occupants of the room. Changes in blood circulation can also be caused by room temperature (Aziziyani, 2019).

In addition, maintaining air circulation in the room can be done by providing a ventilation system. The ventilation system aims to control the potential hazards that can occur (Ministry of Manpower Regulation, 2018). Indoor ventilation can be gained through air conditioning (AC) or room windows (Ministry of Health Regulation, 2013). Based on the results of observation, the movement of air in and out of the laboratory room is in accordance with the provisions because the air movement occurs through air conditioning, namely central air conditioning. Air filtration systems are available and function properly. This allows maintained air conditions to remain good and safe for laboratory personnel. If air circulation or indoor ventilation is poor, it can cause Sick Building Syndrome (SBS). SBS is a collection of non-specific symptoms including eye, nose, and throat irritation, mental fatigue, headache, nausea, dizziness, and skin irritation (Aziziyani, 2019). Also, there are acid cabinets used to mix harmful chemicals equipped with circulation disposal, so as not to harm laboratory personnel who are working.

Lighting Indicators

Lighting is an important factor to create a good working environment. A good working environment will be able to provide comfort and increase worker productivity. Lighting in the laboratory is also one of the aspects that must be considered to support the learning or research process. The good lighting quality of the room allows the users to see objects quickly and effortlessly.

Based on the observations, lighting in the chemical analytics laboratory still has not met the Indonesian national standards (SNI 03-6197-2000). The recommended minimum lighting level for educational institutions, such as for laboratory rooms is 500 lux (National Standards Agency, 2000). The chemical analytics laboratory found no abnormal lighting such as blinking or dying throughout rooms and corridors. Also, the color selection of the lamp is quite good and not too dazzling.

Figure 5. A Temperature Monitoring Tool at the Chemical Analytics Laboratory of University X Surabaya in August 2020

Based on previous research conducted by Odi, Purimahua, and Ruliati (2018), poor lighting can cause eye fatigue. Eye fatigue is a strain on the eyes which is caused by the use of the sense of vision in work that requires the ability to see for a long time and is usually accompanied by uncomfortable vision conditions (Odi, Purimahua and Ruliati, 2018). In a job that requires thoroughness without adequate lighting, the impact will be very pronounced on eye fatigue. Although it does not cause permanent damage, the occurrence of eye muscle fatigue and fatigue of the eye nerves as a result of continuous strain on the eyes adds to the workload, accelerates fatigue, demands frequent rest, and others. This can reduce the working efficiency of laboratory users.

Laboratory Safety Indicators

In the use of tools in the laboratory, it is necessary to note the importance of guaranteeing the safety of these tools. Tools must be maintained in safe working conditions (Ministry of Health Regulation, 2013). One way to maintain tools to minimize the loss or damage to laboratory equipment done by irresponsible people is to lock the laboratory door after use.

Control of laboratory safety in the chemical analytics laboratory, University X Surabaya is also done by installing the laboratory entrance doors made of fire resistant materials, namely glass and stainless. This is done because of the large number of chemicals in the laboratory that is flammable or explosive. Thus, the use of wooden objects is minimized to prevent fires or explosions.

Figure 6. Condition of an Eyewash and Safety Shower at the Chemical Analytics Laboratory of University X Surabaya in August 2020

All activities in the laboratory are controlled by laboratory pranata or staff. Laboratory pranata are nonstructural position (Ministry of Health Regulation, 2013). The event of damage or loss will soon be known and processed following existing provisions.

In addition, hazard risk control in the laboratory is carried out with complete safety equipment in the form of eyewash and safety showers in the chemical analytics laboratory. Such equipment is important for activities that use chemicals in the laboratory. The risk of chemical exposure can injure the users. If the eyes are exposed to chemicals, eye rinsing needs to be done in the eyewash section so that there are no eye injuries. Also, safety showers are used when the laboratory users spillchemicals into themselves to rinse exposed parts of the body (Stauffer *et al*., 2018). Based on observations, safety showers can be reached by laboratory users in less than 10 seconds from the laboratory.

Moreover, the completeness of the material safety data sheet has been neatly recorded and can be read by anyone who uses the laboratory. This is certainly in accordance with the regulations governing that material safety data sheets must be attached in the process of work on each chemical in the laboratory. The Material safety data sheets are used to classify and label chemicals according to their harmful nature. This is called the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) (Persson *et al*., 2017). However, based on the observations, some chemicals are still not equipped with labels or GHS. finding in the study is in line with research conducted by Syakbania and Wahyuningsih (2018), stating that there are still some chemicals that do not have chemical labels or Safty Data Sheet (MSDS) material so that laboratory users cannot identify the nature of the chemical. If the nature of the chemical hazard is unknown to the users, then it can cause the risk of danger or work accidents of.

Service Indicators

Service in the laboratory is an important factor supporting laboratory activities. Based on the observations made, electrical installations, handwashing places, and water are functioning properly. However, the arrangement of cables as laboratory equipment is still not organized, so it has the potential to pose danger of electrical circuits or

Figure 7. Condition of Cable Setup in the Chemical Analytics Laboratory of University X Surabaya in August 2020

Figure 8. Condition of Fire Hydrants and Alarms in the Chemical Analytics Laboratory of University X Surabaya in August 2020

electrocution for laboratory personnel. Based on the findings of previous research, electrical circuits can cause uncontrollable sparks due to untidy installation, which can cause a greater danger of fire (Andu, 2019). This can lead to material losses and even fatalities. Improvements to the problem must be done immediately so that the potential danger does not occur to laboratory personnel.

The facilities and infrastructure team is the party responsible for supporting facilities in the laboratory. Continuous monitoring of supporting facilities is carried out through recording after the treatment process. If there are problems in carrying out treatment, then workers with special skills will be brought in to support the treatment process. Maintenance of the equipment must be carried out in the laboratory. Thus, it is necessary to have in person in charge of the tool (Ministry of Health Regulation, 2013). In addition to being the person in charge of the equipment, a cleaning service is also very important as a provider of cleaning services in the laboratory.

Fire Prevention and Protection Indicators

Based on the classification of fire disasters, fires that have the potential to occur in the chemical analytics laboratory are fires caused by solid materials except metals such as wood, paper, etc. (class A), fires of liquid materials or flammable gases such as alcohol (class B), fires involving electrical equipment (class C), and fires in solid metal objects (class D) (National Fire Protection Association (NFPA) 10, 2018). One of the efforts to secure in an emergency is the existence of an emergency information system. An emergency is caused by a fire. Alarm systems and hydrants for emergencies are well available. Alarm checks in maintenance efforts are carried out once a month using a checklist.

Based on observations, light fire extinguishers are available and installed around the chemical analytics laboratory. The same finding in previous research showed that fire extinguishers were placed in the hallway of the laboratory room (Nayiroh and Kusairi, 2019). In this study, fire extinguisher condition examination is carried out every month periodically. The installed fire extinguishers contain powder weighing 3 kg. The available fire extinguishers comply with the existing laws and regulations. Other provisions require that the installation between fire extinguishers is 15 meters away (Ministry of Manpower and Transmigration Regulation, 1980). Fire extinguishers available in the area of the chemical analytics laboratory have also been located as required. However, fire extinguishers are installed at a height of 70 cm from the ground floor. It shows that the installation of fire extinguishers is not suitable, which is 125 cm from the floor. Also, some goods become a barrier around the fire extinguishers (Ministry of Manpower and Transmigration Regulation, 1980).

Based on the observations, the evacuation route to the emergency exit is safe and directly connected to the outside of the building which is an open area. However, there are some piles of stuff that can block the way of getting to the emergency exit. This condition is not in accordance with the regulations that should facilitate access to the emergency exit (Government Regulation, 2005).

According to the regulation of the Ministry of Public Works, the means of evacuation routes must be equipped with clear routes and signs or instructions (Ministry of Public Works Regulation, 2009). Based on observations, the emergency exit signs and evacuation routes have been properly installed and clearly visible and easily recognized. If there is no clear evacuation route, it can cause the evacuation process to be delayed, so the disaster can get worse (Indarwati, 2020).

CONCLUSION

The implementation of occupational safety and health has been carried out in the chemistry analytics laboratory of University X Surabaya. Based on 65 occupational safety and health checklist question items in the the chemistry analytics laboratory of University X Surabaya, 49 question items have met the criteria , 13 questions have not met the criteria on and 3 questions have not not answered due to laboratory conditions that are still changing. It is expected that the condition of the chemical analytics laboratory of University X Surabaya will soon meet the criteria based on the Occupational Safety and Health (OSH) checklist that has been provided with improvements to support the learning process and research conducted in the chemical analytics laboratory.

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REFERENCES

Andu, F. A. (2019) 'Kajian Pengawasan Listrik Dalam Penanggulangan Kebakaran', *Jurnal Ilmiah Media Engineering*, 9(1), pp. 1–10.

Aziziyani, D. A. (2019) *Hubungan Suhu, Kelembabab, dan Angka Kuman Dengan kejadian Sick Building Syndrome (SBS) di Kantor X jakarta Tahun 2019*. Jakarta: Public Health Faculty, Binawan University.

Eryani, Y. M., Wibowo, C. A. and Saftarina, F. (2017) 'Faktor Risiko Terjadinya Gangguan Pendengaran Akibat Bising', *Medula*, 7(4), pp. 112–117.

Ferdiyana, R. *et al*. (2020) 'Kesadaran Mahasiswa Teknik Elektronika Terhadap K3 Di Jurusan Teknik Elektro Politeknik Negeri Malang', *Integrated Lab Journal*, 08(02), pp. 50–56.

Government Regulation (2005) Number 36 Year 2005 concerning The Implementation Regulation of Law No. 28 of 2020 Concerning Building Building. Jakarta: Government Republic of Indonesian.

Hariyadi, S. *et al*. (2020) 'Penataan Rancangan Lokasi Instalasi Pengolahan Air Limbah Terpadu Kampus Institut Pertanian Bogor', *Jurnal Ilmu Pertanian Indonesia*, 25(3), pp. 449–455.

Indarwati, D. (2020) 'Identifikasi Bahaya dan Risk Assessment: Penerapan Keselamatan dan Kesehatan Kerja di Laboratorium', *Jurnal Inovasi dan Pengelolaan Laboratorium*, 2(1), pp. 51–56.

Iryaning Handayani, D. and Purwanto, A. (2014) 'Penilaian Risiko Keselamatan Dan Kesehatan Kerja', *Dinamika Rekayasa*, 10(2), pp. 68–75.

Maharani, R. I. and Sari, F. A. (2018) 'Analisis Cek List Keselamatan dan kesehatan kerja Di Laboratorium Biologi Fmipa Unnes', *Jurnal TEMAPELA*, 1(1), pp. 31–38.

Ménard, A. D. and Trant, J. F. (2020) 'A Review and Critique of Academic Lab Safety Research', *Nature Chemistry*, 12(1), pp. 17–25.

Minister of Health Regulation (2016) Minister of Health Regulation Number 48 of 2016 On Office Work Safety And Health Standards. Jakarta: Ministry of Health Republic of Indonesia.

Ministry of Health Regulation (2010) Number 411/Menkes/PER/III/2010 Concerning Clinical Laboratory. Jakarta: Ministry of Health Republic of Indonesia.

Ministry of Health Regulation (2013) Number 43 Year 2013 Concerning How to Conduct a Good Clinical Laboratory. Jakarta: Ministry of Health Republic of Indonesia.

Ministry of Manpower and Transmigration Regulation (1980) Number Per.04/Men/1980 Concerning The Terms of Installation and Maintenance of Light Fire Extinguishers. Jakarta: Ministry of Manpower and Transmigration Republic of Indonesian.

Ministry of Manpower Regulation (2011) Number Per.13/MEN/X/2011 concerning Threshold Value of Physical Factors and Chemical Factors in the Workplace. Jakarta: Ministry of Manpower Republic of Indonesia.

Ministry of Manpower Regulation (2017) Number 7 Year 2017 Concerning Social Security Program

of Indonesian Workers. Jakarta: Ministry of Manpower Republic of Indonesia.

Ministry of Manpower Regulation (2018) Number 5 Year 2018 concerning Occupational Safety and Health. Jakarta: Ministry of Manpower Republic of Indonesia.

Ministry of Public Works Regulation (2009) Number 20 Year 2009 concerning Technical Guidelines For Fire Protection Management. Jakarta: Ministry of Public Works Republic of Indonesian.

Mohammadfam, I. *et al*. (2017) 'Evaluation of the Quality of Occupational Health and Safety Management Systems Based on Key Performance Indicators in Certified Organizations', *Safety and Health at Work*, 8(2), pp. 156–161.

National Fire Protection Association (NFPA) 10 (2018) Standard for Portable Fire Extinguishers. USA: NFPA.

National Standards Agency (2000) SNI 03-6197-2000 Concerning Energy Conservation in Lighting Systems. Jakarta: National Standards Agency.

Nayiroh, N. and Kusairi (2019) 'Studi Pelaksanaan Keselamatan dan Kesehatan Kerja (K3) Pada Laboratorium Jurusan Fisika Universitas Islam Negeri (UIN) Maulana Malik Ibrahim Malang', *Jurnal Teknologi dan Manajemen Pengelolaan Laboratorium (Temapela)*, 2(2), pp. 65–74.

Odi, K. D., Purimahua, S. L. and Ruliati, L. P. (2018) 'Hubungan Sikap Kerja, Pencahayaan Dan Suhu Terhadap Kelelahan Kerja Dan Kelelahan Mata Pada Penjahit Di Kampung Solor Kupang 2017', *Ikesma*, 14(1), p. 65.

Pangkey, F., Malingkas, G. Y. and Walangitan, D. O. R. (2012) 'Penerapan Sistem Manajemen Keselamatan dan Kesehatan Kerja (SMK3) Pada Proyek Kontruksi Di Indonesia (Studi Kasus: Pembangunan Jembatan Dr. Ir. Soekarno-Manado)', *Jurnal Ilmiah Media Engineering*, 2(2), pp. 100–113.

Persson, L. *et al*. (2017) 'The Globally Harmonized System of Classification and Labelling of Chemicals-Explaining the Legal Implementation Gap', *Sustainability (Switzerland)*, 9(12), pp. 1–21.

Pertiwi, V., Joko, T. and Dangiran, H. L. (2017) 'Evaluasi Pengelolaan Limbah Bahan Berbahaya dan Beracun (B3) Di Rumah Sakit Roemani Muhammadiyah Semarang', *Jurnal Kesehatan Masyarakat (e-Journal)*, 5(3), pp. 420–430.

Rahmantiyoko, A., Sunarmi, S. and Rahmah, F. K. (2019) 'Keselamatan dan Keamanan Kerja Laboratorium', *IPTEK Journal of Proceedings Series*, 0(4), pp. 36–38.

Ruliana, T., Suroso, A. and Supriyadi, N. (2016) 'Policy of Waste Management of Hazardous Toxic (Waste B3)', *Scientific Papers-Series Management Economic Engineering in Agriculture and Rural Development*, 16(3), pp. 293–302.

Social Security (2019) Angka Kecelakaan Kerja Cenderung Meningkat, BPJS Ketenagakerjaan Bayar Santunan Rp1,2 Triliun.

Stauffer, S. *et al*. (2018) *Lab Safety*. Berlin: Springer Spektrum.

Syakbania, D. N. and Wahyuningsih, A. S. (2018) 'Program Keselamatan Dan Kesehatan Kerja Di Laboratorium Kimia', *Higeia Journal of Public Health Research and Development*, 1(3), pp. 84–94.

Tagueha, W. P., Mangare, J. B. and Tj. Arsjad, T. (2018) 'Manajemen Resiko Keselamatan dan kesehatan Kerja (K3) Pada Proyek Kontruksi (Studi Kasus: Pembangunan Gedung Laboratorium Fakultas Teknik Unsrat)', *Sipil Statik*, 6(11), pp. 907–916.

Wisnuwardhani, P. H. (2018) 'Biosafety Laboratory Practices : Pedoman Umum Keselamatan Kerja Pada Laboratorium', *BioTrends*, 9(2), pp. 1–10.