The Chemical and Physical Parameters as Indicator of Office Air Quality at PT X Coal Mining Company

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Abstract

Background: Coal still ranks the second largest source of total global energy demand, which is complemented by the high-risk nature of coal mining activity. Therefore, it is important to discuss the health issues of coal workers. One of the risks associated with coal mining activities is poor indoor air quality (IAQ) due to the high concentration of airborne pollutants. **Methods:** This study aims to evaluate the results of air quality measurements in the PT X office, and the method used was a descriptive approach with quantitative secondary data. Furthermore, the measured variables are NO2, SO2, CO2, CO, Pb, PM10, temperature, humidity, and noise. **Conclusion:** The results showed that there was an IAQ problem, namely noise, temperature, and humidity which exceed the recommendations. Therefore, the IAQ management implemented by PT X was still systematically and comprehensively developing.

Key Words: *Coal mining, office air quality, chemical parameter, physical parameter.*

Introduction

Coal mines air are well known for its air pollutant namely sulfur dioxide (SO2), nitrogen dioxide (NO2), VOC (volatile organic compound), PM10, and PM2.5 [1–3]. Various health impacts arise due to the risks contained in mining air, one of which is pneumoconiosis, which includes both black lung and silicosis[4]. Meanwhile, in America, it was noted that black lung is the latent killer for 4,118 mining workers from 2007-2016[5].

Significance of the problem of air health risks in the coal mine is greater in the indoor and outdoor work areas. However, the number of indoor air pollutants is 2-5x greater than outdoor air[6]. In addition, it was reported in the late '80s that humans spent 90% of their time indoors[6]. As a result, people that work in offices', as well as perform their main work indoors are at the highest risk of being exposed to air pollutants.

These pollutants cause poor indoor air quality and also have various impacts, which include, affecting the cognitive performance of workers and subclinical disturbances that leads to a decrease in work productivity[7]. Furthermore, health problems such as eye irritation, headaches, and allergies, as well as discomfort effect results in high absenteeism[8].

In addition to disrupting cognitive performance, worker productivity, and a high rate of absenteeism, poor air quality causes the 'typical' disease of this problem, which includes, SBS (Sick Building Syndrome) and BRI (Building Related Illness). SBS is a term used to describe a situation where the occupants of a building experience acute health problems and discomfort associated with the length of time spent in the building, but no disease was identified and the complaint disappears once someone leaves the building[8]. Meanwhile, BRI is a condition in

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which symptoms of health problems are diagnosed and are known to be related to indoor air contaminants[8].

PT X is inseparable from the health risks caused by poor indoor air quality. In an office located in the middle of the mine site, it is possible to infiltrate mine air into the room. PT X performs four main business processes, namely mining operations, hauling operations, coal processing, and barge loading (CPBL) Kelanis, as well as supporting facilities. Meanwhile, there are more than 155 contractors who work to assist PT X in its business processes in Kalimantan (Borneo). Therefore, the discussion of managing health risk control due to indoor air quality in PT X's coal mine needs attention.

Materials and Method

The method used was a quantitative data with a descriptive approach to evaluate the results of air quality measurement in the office rooms at the PT X coal mining location. Furthermore, the data were collected by reviewing secondary data in the form of documents on the results of air measurements for the work environment at the Kalimantan office PT X site in 2019 and primary data in the form of interviews with informants, such as OHS managers and environmental staff. The variables studied consisted of two parameters, namely chemical parameters such as NO2, SO2, CO, CO2, Pb, and PM10, as well as physical parameters such as noise, temperature, and humidity. Secondary data for the measurement of chemical and physical parameters at the PT X offices were collected from July-December 2019.

Result and Discussion

All the rooms measured have the similarity, namely their main function as office room to manage administration. However, the characteristics of each building and room are varies depending on its location and the presence of other factors that affect the IAQ. The SM, Plant and Main Office are located in the SEG III work area, namely in the CPBL (Coal Processing & Barge Loading) area, which is located close to the coal crushing work process as well as in the stockpiling and loading of coal into the barge. The Main Office is a building that is the center of administrative activities at SEG III and uses split AC. There is an Office Plant not far from the main office, which also has administrative activities and is very close to the equipment maintenance process that involves welding. In addition, the Office Plant is also located not far from the landfill (TPS) and uses split AC. Office SM has similar characteristics to other rooms in the SEG III work area.

The KM 69 Office, Mine Office, and the MIA Logistics Office on the first floor are located in the SEG II work area, namely hauling or coal transportation routes using trucks/trailers. Furthermore, the KM 69 Office room serves as a checkpoint for the 80 km coal haulage route. Therefore, there is a parking area around this building that can accommodate up to 10-15 trailers. This building is located in the middle of a tree-free field which consists of two floors with a generator, landfill (TPS), and a smoking area. The characteristics of Mine Office are similar to KM 69 Office, because of its location in the middle of a transportation route, which is a field without trees. However, this building is made of a container that has only one room with an air conditioner without ventilation. In addition, this room is only for administrative activities and is used by officers responsible for transporting coal. The logistic office on the first floor of the MIA is located close to a heavy equipment repair workshop, and the building only has one room with administrative activities as well as spare parts inside and outside. Also, the type of air conditioner used is split.

The result shows that the highest NO2 concentration is in the Main Office room at 0.01 ppm, but this result is still below the TLV of Permenaker No. 5 of 2018. The highest SO2 concentration is in the Office Plant room at 0.03 mg/m3, and the highest CO concentration in the KM 69 Office room is 8 ppm, which is close to the 10 ppm requirement regulated in Permenkes No. 48 of 2016. Furthermore, the highest Pb concentration is 1.3 µg/m3 at the main office, and the highest PM10 concentration is reported in the Office Plant room with 0.016 mg/m3, while the highest CO2 concentration in the Mine Office room is 327 ppm, but these two values are still below the requirements of Permenkes No. 48 of 2016.

The measurement results of physical factor variables reported that several variables exceed the requirements of Permenkes No. 48 of 2016. The temperature variables in all rooms, namely Office SM is at 31.6°C, Plant at 31.9°C, Main Office at 29.8°C, KM 69 is at 29.1°C, Mine Office is at 29.6°C, and the MIA 1st Floor Logistics

Office is at 28.4°C, which exceeds the requirements of Permenkes No. 48 of 2016, namely 23-26°C. The humidity problems only occur in the Main Office by 61-67%, exceeding the requirements of 40-60%. Also, the highest noise occurs in the MIA 1st Floor Logistics Office by 65.8 dBA, which exceeds the standard of 55-65 dBA for office activities.

The measurement results for Office SM of 31.6°C and Plant of 31.9°C were included in the hot category. Furthermore, the measurement results for the Main Office at 29.8°C, Office KM 69 at 29.1°C, Mine Office at 29.8°C, and the MIA 1st Floor Logistics Office at 29.8°C are included in the warm category. This heat source is estimated to be derived from the characteristics of all measured buildings located in the middle of the mine area with few or no trees. Therefore, there is a need to identify the source of the problem in further research, such as AC.

Offices that are too hot causes residents to feel tired[9]. Therefore, it is necessary to take corrective measures to control the IAQ issue related to temperature to achieve thermal comfort which is important for worker productivity. Thermal comfort is a condition where a person wears normal clothes without feeling too cold or too hot, and it is important to a person's well-being and productivity. Although everyone's temperature preferences are different, the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 55 - 2013 recommends a temperature of 23-26°C, with thermal Environmental Conditions for Human Occupancy that satisfies 80% of building occupants[9].

The 61-67% humidity in the Main Office room is categorized as high because it exceeds the requirements. The estimated source is the use of the building which is the center of administrative activity in SEG III. Also, there is the possibility of workers to enter and exit the hot mine area in sweaty conditions. However, the identification of a source with high humidity content needs to be conducted more deeply in further research. High humidity makes the room stuffy, increases the perception of heat felt in the room, and supports the development of microorganisms[9,10]. Therefore, the humidity of the Main Office also needs to be controlled because humidity with temperature (air and radians), clothing, and body metabolic rate are factors that affect thermal comfort[9].

The results of noise measurements at the MIA Logistics Office on the 1st floor show a value of 65.8 dBA which exceeds the Permenkes No. 48 of 2016. The source of this noise may be from an office located near a heavy equipment repair workshop. Furthermore, the impact caused by noise that exceeds the requirements in the office is distracting concentration at work because of divided auditory attention. This disruption in concentration also causes an increase in annoyance which in the long term will result to stress[11].

Office KM 69 which shows the highest CO measurement results has a trailer parking area, a smoking area, and a generator. The existence of these facilities and equipment is thought to be the source of the high CO concentration in this room. Although the CO at Office Km 69 does not reach the highest recommended concentration, the exposure of low CO concentration causes fatigue and heaviness in the chest for people with heart disease, while the impact on moderate concentration exposure is angina, reduced vision ability, and reduced brainpower[12].

Townsend, Robert, and Maynard reported that CO exposure of 9 ppm causes the formation of 2.5% COHb (carboxyhemoglobin) in the blood. A total of 2-20% COhb content in the blood causes subtle effects on visual perception, hearing, motor and sensorimotor performance, alertness, and other measures of neurobehavioral performance[13]. Therefore, the measurement result in the KM 69 Office room of 8 ppm is already a number that needs to be considered and controlled.

Conclusion

The measurement of air quality in PT X offices shows the result of the evaluation results of several variables that exceed the standard. Furthermore, the variables that exceed the standard, however, are based solely on the physical parameters, such as noise, temperature, and humidity. The temperature that exceeds the requirements is reported in the six examined rooms. Meanwhile, humidity that exceeds the requirements is only in one room, namely the Main Office. Also, noise that exceeds the requirements only occurs in the MIA 1st

floor Logistics Office. Despite being in the middle of a coal mining process area, there are no chemical factors that exceed the standard.

Ethical Clearance – The study protocol was approved by The Research and Community Engagement Ethical Committee, Faculty of Public Health, Universitas Indonesia with approval letter number Ket- 314/UN2. F10.D11/PPM.00.02/2020.

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Conflict of Interest - Nil

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