INDOOR AIR QUALITY ASSESSMENT FOR A MULTI-STOREY UNIVERSITY OFFICE BUILDING IN MALAYSIA

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ABSTRACT

The indoor air quality (IAQ) in office buildings should be assessed for public health concerns as it relates to work performance and productivity. Therefore, this paper aims to assess the IAQ in a university office building. From this investigation, the level of contaminated indoor air is examined, the significant causes and contributing factors of contaminated indoor air are determined and a recommendation to improve the existing condition has been proposed. The physical parameters measured include air temperature, air velocity, relative humidity, and concentrations of carbon dioxide (CO_2), carbon monoxide (CO), sulphur dioxide (SO_2), and also air particles. It was found that the number of air particles of 0.5 μm in diameter is about 197,748 particles/m^3, while air particles of 5.0 μm in diameter is around 534 particles/m^3. The collected data were then compared with a questionnaire and IAQ standards. In conclusion, the indoor air quality within the multi-storey central office building of Universiti Tun Hussein Onn Malaysia (UTHM) is acceptable and suitable for occupation even though there were countable symptoms of Sick Building Syndrome (SBS) among its occupants.

KEYWORDS

air particles, indoor air quality, university office building, Sick Building Syndrome, carbon dioxide, carbon monoxide, sulphur dioxide

1.0 INTRODUCTION

Recently, there has been a rapid growth in urbanisation and industrialization in Malaysia. This has led to a dramatic rise in the number of residences, office buildings and manufacturing facilities, together with increases in both the number and density of motor vehicles and population. Outdoor air quality has been widely examined since pollution would directly cause many adverse health effects to the population (Zhang, 2004). However, Fisk et al. (1987) claimed that

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most people spend 10% to 15% of their time outdoors and the remaining time is in indoor environment, which means the indoor air quality is predominant in daily life. Besides that, the industrialization/urbanization process also exhibits both positive and negative effects on indoor air quality (Baek et al., 1997).

As a result, acceptable indoor air quality (IAQ) is one of the critical components of green building design (Xiong et al., 2015). The topic of green building has been expanded outside the environmental community and has become a critical issue among mainstream building industry professionals to counter the negative health impacts brought about by IAQ problems in buildings. As referenced in the Green Building Index in Malaysia, IAQ has been included as one of the default elements in green building assessment and certification. Green buildings require indoor air quality measures that are in compliance with minimum indoor air quality (IAQ) performance to enhance indoor air quality indoors, thus contributing to the comfort and well-being of the occupants. Previous studies have indicated that the majority of available measurements in green buildings do show that IAQ, as perceived by green building occupants, is improved as compared to the responses from occupants in conventional buildings (Stenemann et al., 2017). However, the relationship between energy consumption and IAQ, and tenant education on the pollutant levels and exposures towards health effects, as well as the thermal condition may need more attention in IAQ investigations in green buildings. Therefore, there is a clear need for studies evaluating IAQ in buildings for public health and indoor environment quality as it impacts workplace performance and productivity.

Environmental quality for residential buildings has been calculated using measured data for air temperatures, relative humidity and carbon dioxide concentration (Laskari et al., 2017). According to the Environmental Protection Agency (EPA) (EPA, 1997), pollutant levels are two to five times higher inside the home than outside. These pollutants include airborne particles and particulate matters such as allergens, lung irritants, gases, toxic chemicals and volatile organic compounds (VOCs). However, indoor air quality (IAQ) problems are not limited to homes. In fact, many office buildings have significant sources of air pollution, possibly due to inadequate provision of the ventilation system. Research also focuses on computing acceptability limits for IAQ at workplace (Freda et al., 2017).

The findings discussed earlier have demonstrated that indoor air has a tendency to be more polluted than outdoor air (albeit with different pollutants) although it might not affect the common understanding of air pollution. This may be due to how indoor air pollutant levels reflect the sum of contributions from indoor sources as well as from outdoor pollutants that enter a building through openings and ventilation air (Nazaroff, 2013). In fact, indoor air generally provides a greater health hazard than the corresponding outdoor setting. IAQ is the most important issue in the occupation of office buildings, as a poor IAQ in the office space will affect the work performance of occupants and loss of productivity. Measuring workers' productivity is important in a workplace where performance measures provide detailed information about worker productivity. Based on the studies by both Clements-Croome (2008) and Wyon (2004), the performance of simulated office work would increase by removing the common sources of indoor air pollution. In contrast, the performance in carrying out or accomplishing an action, task, or function in office work would deteriorate when occupants in the office are suffering from Sick Building syndrome (SBS) due to the impacts of poor IAQ. This may reduce the ability of workers to accomplish the expectations of the company. Besides that, the occupants in offices may also be affected by the illness related to SBS, such as a headache, which may cause difficulty in thinking. Thus, this would indirectly lead to low