

Improving Health Education: An Investigation on VOC in UTHM Libraries

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Abstract

Indoor air quality (IAQ) has been a concern in the library since 1990s, when several employees working in the building reported occasional discomforts that may have been attributable to poor air quality. In the education world, library has been an important venue for students for various reasons no other than to enhance knowledge for the importance of their education. The purpose of this study is to measure the volatile organic compounds (VOC) in two libraries located at Universiti Tun Hussein Onn Malaysia (UTHM). Benzene, phenol, furfural, isobutene and toluene were five VOC gasses measured using the Photo Ionization Detector (PID) for eight working hours in two months. The results indicate that benzene and furfural gasses occurred as the highest VOC gasses detected in both libraries. The causes were due to the appearance of several equipments and tools frequently used in libraries such as papers, copying machines, carpets and book shelves. Moreover, the concentration of gasses detected was above the standard limit as accordance to the Environmental Protection Energy (EPA) and Occupational Safety and Health Act (OSHA). As a whole, several actions should be taken due to prevent unsafe environment in libraries as the existence of libraries play important role in education.

Keywords: Library - IAQ – VOC gasses – PID

1. Introduction

With the high development in Asia, air quality has been decreased due to vehicles and factories that produce smokes containing poison gasses and can be destructive to the health of people. In order to uphold the air quality that stays in good state and safe, lots of agencies were set up for instance Environmental Protection Agency (EPA), National Institute of Occupational Safety and Health (NIOSH) and World Health Organization (WHO). These agencies have been produced air sample system for known and unknown chemistry material in order to identify the level of IAQ [1]. This shows how serious they are in controlling IAQ so that it would not be a hazard to safety and health workers and users.

IAQ is a natural nature about air that can affect human life and health in indoor environment. If IAQ does not achieve a satisfactory level, human health will be affected. Indoor air pollution has been associated with a wide range of health outcomes, and the evidence for these associations has been classified as strong, moderate or tentative in a recent systematic review [1].

Indoor smoke contains a range of health-damaging pollutants, such as small particles and carbon monoxide, and particulate pollution levels may be 20 times higher than accepted guidelines value [2]. Studies have indicated that indoor air is often dirtier and contains 2 to 5 times higher levels of contaminants than outdoor air. In addition, the average person spends approximately 90% of their time indoors [1],[3],[4]. In reality, IAQ are not clean and fresh enough especially in buildings with processing job which consist lots of chemistry elements. According to The world health report 2002, indoor air pollution is responsible for 2.7% of the global burden of disease [2].

In the education world, IAQ has been a concern in the library since 1990s, when several employees working in the building reported occasional discomforts that may have been attributable to poor air quality. Because of this and increased awareness regarding poor IAQ, it is not surprising that the number of reported employee complaints of discomfort and illness in non-industrial workplaces is increasing [3]. This investigation is a way of improving health education towards the awareness of occupational safety and health to the librarians, staff members and students.

2. Volatile Organic Compound

The IAQ contamination is not far caused by volatile organic compounds (VOCs) [1],[5],[7] and NIOSH confirmed that with 17% of research place has been effected by VOCs [1]. According to Burroughs and Hansen (2004), the VOCs contamination will not vanished in IAQ environment. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors [4].

VOC are emitted as gases from certain solids or liquids and it does include a variety of chemicals, some of which may have short- and long-term adverse health effects [4]. VOCs are emitted by a wide array of products including paints and lacquers, paint strippers, cleaning supplies, air fresheners, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions [4],[10].

VOC is an organic compound that has a boiling point between 50°C until 260°C including other form chemical such as aldehyd, alcohol, aromatic hydrocarbon, terrapin, ketene and ester [6]. With this feature, these VOCs will eventually evaporate in room temperature. According to Godish (2004), VOC contain hydrocarbon elements that have atom arrangement with a ring chain shape where it easily spread through an oxidation process in room temperature.

High rate VOC in IAQ will cause symptoms disorder such as headache, sore throat, eye irritation, sinus, allergic skin reaction, itchy nose, nausea, fatigue, dizziness and loss of concentration [3],[4],[6],[8],[10]. Moreover, many organic compounds such as VOC are known to cause cancer, liver and kidney damage in humans [4],[8],[10].

2.1. Level of VOC

Clean Air Act Amendments (1990) has come out with a chart show the level of VOC and predicted that it will increase yearly. Table 1 demonstrate the level of VOC starting from 1993 till 2010 of projection.

Table 1: Level of VOC freely in the air surrounding

Designation	Ozone design value (ppmv)	Emission (tons/year)	Attainment deadline
Marginal	0.121-0.137	100	1993
Moderate	0.138-0.159	100	1996
Serious	0.160-0.179	50	1999
Severe	0.180-0.190	25	2005
	0.191-0.279		2007
Extreme	>0.280	10	2010

Besides, there is another chart show the standard level of air for IAQ namely Threshold Limit Values (TLVs) [9]. TLVs explains regarding on air pollutant concentration and human that exposed daily without thinking of the effect on their health. There are three types of table that available; Time-Weight Average (TLV-TWA), Short-Term Exposure Limit (TLV-STEL) and Ceiling (TLV-C) [7].

2.2. Types of VOC

In simple, VOC is a chemical that evaporate easily at room temperature. The term "organic" indicates that the compounds contain carbon. VOC exposures are often associated with an odor while other time there is no odor. Both can be harmful. There are thousands of different VOCs produced and used in our daily lives. Some examples are Benzene, Toluene, Furfural, Phenol, Methylene, Chloride, Isobutene, Naphthalene, Formaldehyde, Xylene, Ethylene glycol, Texanol, 1,3-butadiene and etc. [10].

4. Results and Discussions

The study was conducted in two places. Place 1 located at main campus library where it is a two-storey building which could accommodate about 200 seats. Place 2 located at city campus library with a seating capacity of 150 at ground floor shop houses. These libraries has acquired about 110,000 copies of books, 4,000 titles of thesis, 500 titles of journal, 50 titles of magazine and 10,000 copies of audio-visual materials.

Indoor air quality monitoring for indicators of Volatile Organic Compounds (VOCs) gases has been carried out using Photo Ionization Detector (PID). Benzene, phenol, furfural, isobutene and toluene were five VOC gasses measured using the PID. The measurement had done twice for eight working hours in two months continuously in order to have consistent and persist in reading.

The results indicate that benzene and furfural gasses occurred as the highest VOC gasses at city campus and main campus library respectively. Benzene gas with concentration of 18.92ppm had achieved above the standard limit of 0.5ppm as accordance to the EPA and OSHA. This is due to the used of fully carpet at city campus library differently from bare floor at main campus library. Moreover, there are two photostat machine available at city campus library. This research finding is parallel with the result undertaken by Godish (2001) and Steve (1995) where photostat machine, machine copier, printers and carpets would spread the VOC gasses such as benzene, ammonia, benzaldehyd and strin.

At main campus library, furfural gasses with concentration of 36.49ppm had achieved above the standard limit of 2.00ppm set by the EPA and OSHA. This is due to books and wooden bookshelves that were very much available rather than city campus library. This agrees with the research findings by Gesa Kolbe (2004) and Neevel (1999) where wooden bookshelves and also ink from the books would release VOC gasses such as furfural.

The extent and nature of the health effect on humans will depend on many factors including level of exposure and length of time exposed. For furfural gasses, irritant of the skin (TLVs chart, [7]), eyes, mucous membranes, and respiratory tract, itching, burning, redness and taring of the eyes, and nasal stuffiness, dryness, soreness, or bloody discharge are signs and symptoms of exposure. Concentrations of 1.9 to 14ppm produced headache, itching of the throat, and redness and tearing of the eyes in some exposed workers [9],[13]. As for benzene gasses, it will cause cancer to humans which refer to TLVs chart [9].

In order to reduce the concentration of these gasses, several actions should be taken due to prevent unsafe environment in libraries as the existence of libraries play important role in education. First, minimize the use of carpets especially at city campus library. Second, replace the old wooden bookshelves to new aluminium/metal bookshelves. Third, place all photostat machines and copier machine far from the area where students doing their learning activities. Lastly, maintenance on air ventilation system should always sustain fully to facilitate good IAQ throughout.

5. Conclusion

In the education world, library has been an important venue for students for various reasons no other than to enhance knowledge for the importance of their education. Its aim is to develop in them a sense of responsibility for health conditions, as librarians and as members of staffs and students. Through these research experiments, they would to know the health effects through high level of exposure to a VOC gasses in long period of time exposed. With this inputs to them, they will learn to behave in a manner conducive to the promotion, maintenance or restoration of health. As a whole, renovation of both libraries are very much welcome with the intention of having a pleasure and comfortable place besides having a good health guaranteed.

6. References

- [1] Kathleen Hess-Kosa, "Indoor Air Quality: Sampling Methodologies", USA: Lewis Publishers, 2002.
- [2] Internet source: <http://www.who.int/indoorair>
- [3] Richard J. Codey, "Indoor Air Quality", Public Employees Occupational Safety and Health Program, 2004
- [4] Internet source: <http://www.epa.gov/iaq>
- [5] Burroughs H.E. and Shirkey Hansen, "Managing Indoor Air Quality", 3rd. Ed. USA: Marcel Dekker, 2004.
- [6] Godish T., "Indoor Environment Quality", USA: Lewis Publishers, 2004.
- [7] Zhang Y., "Indoor Air Quality Engineering", USA: CRC Press, 2005.
- [8] Steve M. Hays, R.V. Gobbell and N.R. Ganick, "Indoor Air Quality", USA: McGraw-Hill, 1995.
- [9] Internet source: <http://www.acgih.org>
- [10] The Minnesota Department of Health, "Volatile Organic Compounds – VOCs", Fact sheet, 2007.
- [11] Gesa Kolbe, "Gelatine in Historical Paper Production and as Inhibiting Agent for Iron-Gall Ink Corrosion on Paper", *Restaurator*, Vol. 25, No.1, 2005, pp. 26-39.
- [12] Neevel JG, "Iron Gall Ink Corrosion: Development and Analysis of the Conservation Treatment with Phytate", In: Mosk J & Tennent NH eds. *Contributions of the Netherlands Institute for Cultural Heritage to the field of conservation and research*, Amsterdam: ICN: in press, 1999.
- [13] Internet source: <http://www.osha.gov>