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INDOOR QUALITY ANALYSIS OF CO_2 FOR KASTAMONU UNIVERSITY

Mehmet Cetin and Hakan Sevik

Kastamonu University, Turkey

Today in the world there are people who go through life largely confined to urban areas, that human health and performance is directly affected by air quality in places. One of the fastest changing gas inside is one of the components can be installed indoor air quality was off the CO_2 is caused by human activity. Many international organizations identified to air quality. In particular, EPA determined the amount of CO_2 is 800 ppm, sometimes in spite of the fact that these values into the community in the area of 1000 ppm maximum level in the internal environment. The amount of CO_2 in the atmosphere constantly above this level can cause serious harm to human health. To educate young people who are particularly adversely affected by age and exposure in Daily life where high concentrations of CO_2. Therefore, knowing the amount of CO_2 inside is of great importance for children and young people's lives. This study aimed to determine the amount of indoor CO_2 of Kastamonu University. For this purpose, Kastamonu classes in university, canteens, cafeterias, hallways, meeting rooms, instructor rooms and laboratories. According to EPA this study results is not suitable for standart values. The results exceed limit values of CO_2 concentration. This situation pose an obstacle for teenages students.

Keywords: Air quality, Indoor, Student, Carbon dioxide (CO_2), Kastamonu University.

Introduction

According to the data provided by the Turkish Statistical Institute, the 2014-2015 academic year was completed in 53,574 schools with 889,695 teachers and 16,403,328 students. Of these schools, 27,544 were primary schools with 295,252 teachers and 5,434,150 students; 16,969 were junior high schools with 296,065 teachers and 5,278,107 students; and 9061 were secondary education institutions with 298,378 teachers and 5,691,071 students (URL1). During the 2014-2015 academic year, educational activities were carried out in formal education with a total of (including pre-primary education) 59,509 schools, 919,393, teachers and 17,559,989 students (URL2). The number of students attending universities is over 2 million (URL3). Each student breathes within school buildings for 20,000 hours from primary school to university. This figure corresponds to nearly 23% of average life span (Bulgurcu et al., 2006).

Human activities can change rapidly depending on the CO_2 concentration. 0.033% CO_2 and 21% O_2 in the breathing process, is taken up by people from the atmosphere and converted 16-17% O_2 and 4% CO_2 was discharged from the lungs. The oxygen sublimit is 17% to 18% during working conditions. The Hazardous limit of the oxygen level is under 15%. The oxygen level changes, especially in schools, shopping malls and crowded seems likely to reveal itself in the hospitals (Bulgurcu,2005).

As a result, indoor air, constant fatigue, and sleepiness occurs as people sense the absence of rising CO_2 levels may cause some of the symptoms (Sevik and Kanter, 2012). The causing loss of performance of CO_2 will cause many side effects even if the reasons are not easily detected. While CO_2 levels above 1000 ppm, dizziness, fatigue, headache and smell like symptoms get annoyed observed; 1500 ppm, cough, runny nose, nasal irritation, throat irritation and eye discharge will take place during (Ercan, 2012). Where people spend most of the time these symptoms are adversely affected and people manifests itself, especially in closed environments with performance and health indoor air quality decline (Sevik and Kanter, 2012). According to the EPA, indoor permissible maximum CO_2 level of 800 ppm. Conference rooms and public areas such as schools are allowed a maximum of 1000 ppm this level (Sevik and Belkayalı, 2012).

This study aimed to determine the amount of indoor CO_2 of Kastamonu University. For this purpose, Kastamonu classes in university, canteens, cafeterias, hallways, meeting rooms, instructor rooms and laboratories.

Material and Method

In this study, she worked with Kastamonu University Faculty of Engineering and Architecture building. Faculty of Engineering and Architecture building, but also for education and training, 24 classrooms, 4 laboratories used the same faculty and a canteen on the ground floor has two computer labs used various engineering department. Altogether, the capacity is 40 students per class (Isinkaralar et al., 2015).

Portable indoor air quality due to experimental measurements of CO_2 meter for today is done. These measurements were made at different times, each different classrooms and laboratories at least 4-5 times. The results were obtained by considering the number of students in each class. In conclusion, this analysis is done by specifying the current situation in such an environment.

Carbon dioxide measurements were performed via "Extech Desktop Indoor Air Quality CO_2 Datalogger". The device is capable of measuring at a precision of 1 ppm with a data logger feature. The device was programmed to make measurements once in 5 minutes, and the data was transferred to a computer for evaluation.

Findings

According to measurements which are conducted in classrooms, workshop, canteen, library, refectory, laboratories, and computer laboratories, Table 1 is created and all measurements are shown in this table. These measurements are assumed to be calculated in surroundings involving students. If these surroundings are deaerated, CO_2 level will be equal to the outdoor air. After aeration, CO_2 level is expected to be lower than 400 ppm. Yet, in this study these values are not taken into consideration.

Table 1. CO_2 levels measurements in the surrounding involving students

Environment	Lowest (ppm)	Highest (ppm)	Average (ppm)
Classroom	698	4297	2298
Canteen	649	1476	1125
Cafeteria	601	1112	769
Laboratory	682	1694	1273
Hallways	598	1579	998
Meeting rooms	651	1496	1214
Instructor rooms	704	1908	1457

The lowest rates in the table refer to the measurements made in the early hours of mornings when there was no human activity. With the start of human activities, CO_2 amount rapidly increased and exceeded the threshold on average in all the areas except for cafeteria and hallways. CO_2 amount is much higher than the threshold especially in classrooms and reaches up to 4297 ppm in these spaces. The areas where the average rate is the highest are classrooms (2298 ppm) and laboratory (1273 ppm). Student activities are the most intense and size is limited in these areas. The average value detected in instructor rooms is 1457 ppm. High values of CO_2 in instructor rooms may stem from their small sizes and numerous entries-exits made by students. Instructor rooms are connected to a long hall that does not have air-conditioning. The windows are not opened as frequently as needed especially in cold winter months. Therefore, these rooms are not ventilated adequately, which leads to high values of CO_2 in these places.

The lowest average CO_2 values are observed in canteen, cafeteria, and hallways, which have something in common: ceiling is very high, and there is a constant entry-exit to and from these areas, which increases air circulation compared to other areas.

All in all, it is possible to say that in areas where people are intensely active, but ventilation is inadequate, the amount of CO_2 is much higher than the threshold; however, in areas where ceiling is very high and ventilation is constant (even if it is for short intervals), the amount of CO_2 is lower.

Discussion

The results of this study indicate that the amount of CO_2 in areas which are frequently used by students and where educational activities take place is much higher than the threshold values specified by EPA. Especially classrooms have a CO_2 value as high as 4297 ppm. However, EPA states that the acceptable carbon dioxide rate in indoor areas is 800 ppm at most. For crowded areas such as schools and conferences halls where people stay together, it is 1000 ppm at most (Favvcett, 1988). However, CO_2 rate in classrooms is much higher than the specified value. Bulgurcu (2005) reports that average amount of carbon dioxide in classrooms in Turkey reaches up to 5475 ppm in January, and carbon dioxide values are drastically higher than the threshold value in almost all classrooms, particularly during winter. Previous studies conducted in Turkey found out similar results as well. Isınkaralar et al. (2015) report that the amount of CO_2 reaches up to 4318 ppm in classrooms, 2159 ppm in computer laboratories, and 1568 ppm in student laboratories. Sevik et al. (2015a) state that the amount of CO_2 reaches up to 3918 ppm in classrooms, 2699 ppm in workshops, and 1897 ppm in computer labs.

Similar studies were conducted in various countries all around the world. Similar results are reported by Lee and Chang (2000) for Hong Kong, Ahman et al. (2000) for Stockholm, Lundin (1999) for Sweden, Fuji et al. (2002) for Japan, Zhang et al. (2006) for Australia, and Godwin and Batterman (2007) for the United States.

The results of the present study indicate that the amount of CO_2 is lower in the areas where ceiling is very high and ventilation is constant. Previous studies suggest that the most efficient way to decrease the amount of CO_2 in such environments is to ventilate them (Sevik et al., 2015a). This is because CO_2 in outdoor environments is 5 to 100 times as clean as CO_2 in indoor environments (Cetin et al., 2015). The lowest values detected in this study are thanks to the air quality in outdoor environments. The lowest values were detected to be in the range of 598 to 704 ppm. Sevik et al. (2015b) states that the amount of CO_2 in the central district of Kastamonu province ranges from 517 to 720 ppm in winter months. The lowest values obtained in the present study are generally close to these values, and they are the values in newly ventilated environments.

Conclusion

The results of the study can be summarized as follows: in areas where there is intense human activity and which are not adequately ventilated, the amount of CO_2 exceeds the threshold value to a great extent. On the other hand, the areas where ceiling is very high and ventilation is constant have lower CO_2 values. In addition, it is possible to say that the amount of CO_2 can be reduced most efficiently by ventilating the environment, and low CO_2 values depend on the outdoor environment. Therefore, each phase of school construction, from the selection of place to architectural plans, should take into account indoor air quality. Indoor CO_2 level rapidly changes depending on human activities. It influences people's and especially children's health and performance to a great extent. It should be kept in mind that capacity of classrooms, ventilation, outdoor air quality, and the size of the place are the main factors determining the increase in the amount of CO_2 within the environment. These are remarkable points to be considered while planning schools.

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References

1. Ahman, M., Lundin, A., Musabasic, V., Soderman, E. 2000. Improved health after intervention in a school with moisture problems, Indoor Air, 10, 57-62. (in Turkish)
2. Bulgurcu, H., İlten, N., Coşgun, A. 2006. Okullarda iç hava kalitesi problemleri ve çözümler, Tesisat Mühendisliği Dergisi, 96, 59-72. (in Turkish)
3. Bulgurcu, H. 2005. Okullarda iç hava kalitesi problemleri ve çözümler, VII. Ulusal Tesisat Mühendisliği Kongresi ve Sergisi, Bildiriler Kitabı, 601-616. (in Turkish)
4. Cetin, M., Sevik, H., Ozturk, S. 2015. The Effect on The Amount of CO_2 of Indoor in some indoor Plants" The international conference on science, Ecology and technology I (Iconsete'2015 – Vienna) Abstract Book pp:124, August 25-28, 2015, Vienna, Austria
5. Ercan, M.S. 2012. Yeşile pusulanız çevre göstergesi, X. Uluslararası Yapıda Tesisat Teknolojisi Sempozyumu, 169-175, 30 Nisan- Mayıs, 2012, İstanbul – Türkiye.
6. Favvcett, H.H. 1988. Respiration: systemand protection favvcett, H.H.(ed.) Hazardousand Toxic Materials: SafeHandling and Disposal VViley, Bildiriler Kitabı, 145-173.
7. Fuji, Y., Shima, M., Ando, M., Adachi, M., Tsunetoshi, Y. 2002. Effect of air pollution and environmental tobacco smoke on serum hyaluronate concentration in school children, Occup Environ Med, 59, 124-8.
8. Godwin, C., Batterman, S. 2007. Indoor air quality in Michigan schools, Indoor Air, 17(2), 109-121.
9. Isınkaralar K., Cetin M., İçen H.B., Sevik H. 2015. Indoor quality analysis of CO_2 for student living areas. The international conference on science, Ecology and technology I (Iconsete'2015 – Vienna) Abstract Book pp:123, August 25-28, 2015, Vienna, Austria
10. Lee, S.C., Chang, M. 2000. Indoor and outdoor air quality investigation at schools in Hong Kong, Chemosphere, 41, 109-113.
11. Lundin, L. 1999. Allergic and non-allergic students, perception of the Same high school environment, Indoor Air, 9, 92-102.
12. Sevik H., Kanter I. 2012. The effect of indoor plants on indoor air quality, X. International HVAC-R Technology Symposyum, p.517-521, 30 April-2 May 2012, Istanbul, 2012.
13. Sevik, H., Belkayalı, N. 2012. Kastamonu ili hava kalitesinin karbondioksit miktari açisindan değerlendirilmesi, Kastamonu'nun Doğal Zenginlikleri Sempozyumu, Bildiriler Kitabı, 83-86, Kastamonu Üniversitesi Su Ürünleri Fakültesi, 16-17 Ekim 2012, Kastamonu

14. Sevik H., Belkayalı N., Sakıcı Ç., Ayan E., Şenöz E., Karakaş H. 2015a. Possibilities of Improving Indoor Air Quality in Classrooms Through Plants", Journal of Chemical, Biological and Physical Sciences, Section D, 5(2), 2115-2121.
15. Sevik H., Cetin M., Belkayali N. 2015b. Effects of forests on amounts of CO_2: case study of Kastamonu and Ilgaz Mountain National Parks, Pol.J.Environ.Stud., 24(1), 253-256
16. URL1: accessed on 08/06/2015 from: http://www.tuik.gov.tr/PreIstatistikTablo.do?istab_id=1606
17. URL2: accessed on 08/06/2015 from:

    sgb.meb.gov.tr/istatistik/meb_istatistikleri_orgun_egitim_2014_2015.pdf
18. URL3: accessed on 08/06/2015 from: http://osym.gov.tr/dosya/1-58207/h/1ogrencisayozettablosu.pdf?ret=0
19. Zhang, G., Spickett, J., Rumchev, K., Lee, A.H., Stick, S. 2006. Indoor environmental quality in a low alerjen school and three standard primary schools in Western Australia, Indoor and Built Environment, 16(1), 74-80.