Advanced Engineering Days

aed.mersin.edu.tr

# $PM_{2.5}$ Concentration Measurements and Mapping at Gökuşağı Mall for Autumn 2018, in Konya, Turkey

**Sukru Dursun** *[1], **Mina Naseer Qasım**[1]

[1]*Konya Technical University, Environmental engineering Department, Konya, Turkey, sdursun@ktun.edu.tr; mineenviro@gmail.com*

Cite this study: Dursun, S., & Naseer Qasım, M. (2021). PM2.5 Concentration Measurements and Mapping at Gökuşagı Mall for Summer 2018, in Konya, Turkey, 72-74

**Keywords**
Air quality
Indoors
Measuring
Modelling
Particulate matters
PM2.5
Shopping centers

**ABSTRACT**

The majority of people living in urban areas spend a significant part of their lives indoors such as homes, schools and workplaces. Therefore, the air quality of indoor or indoor environments is very important. As in Turkey, while improving the outdoor air quality first, regulations on indoor air quality have been started to be developed recently, or lower pollutant concentrations are determined by lowering the air quality standards by certain ratios for acceptable limit values for indoor environments. Ventilation systems and air quality are very important especially for Shopping Centers, which are visited by people from different walks of life and have many different business lines. Gökkuşağı Shopping Center also causes thousands of patients and their relatives to visit because of the fact that the Faculty of Medicine has more than 100 personnel, together with around 100 thousand students belonging to Selçuk University. Gökkuşağı Shopping Center, which was established to meet the needs of these people, serves around 100 people with its cafes, restaurants and many workplaces. This service is concentrated at certain hours, especially when there is a need for food. In this study, which was carried out during the university education period, the measurements of the particle size ($PM_{2.5}$) pollution reaching the human lungs and remaining there to a large extent were made at 6 different hours between the opening-closing hours of the shopping mall. The distribution of the pollutant in the space was modelled using the Surfer16 package program and the distribution map was drawn. The values obtained in the measurements were above the international standards.

## Introduction

Industrialized societies also want a modern living space in modern life and living spaces. These vehicle demands bring along motor vehicles and industrialization close to city centers and this poses a danger to human and environmental health. Gases belonging to air sources, and their life span in nature and nature are important due to their nature. Among the world climate, one of the world's weathers has been determined in relation to the world climate in 1992 (as from Uno climate, 2003). Indoor air circuit from 2 main sources. Designs consisting of interior design and design, interior designs consisting of interior designs. Indoor PM uses are affected by drinking, cooking, home, etc., first of all, outdoor-indoor atmosphere-indoor ventilation such as resuspension and ventilation, and removal from outdoor-indoor air such as hand precipitation [1-2] (Quackenboss et al., 1989; Moriske et al, 1996). In this study, $PM_{2.5}$ concentrations were measured at different times during the day in the closed environment of the closed social area Gökkuşağı Shopping Center at Selçuk University, one of the campuses with the highest number of students in Turkey, and three-dimensional pollution maps were obtained by modeling the indoor distribution.

## Material and Method

### Study area

In this study, which was started on the basis of shopping centers located in Selçuklu district of Konya province, suitable measurement points were determined for making measurements. This place, which was chosen by paying

attention to its indoor environment, was chosen as the place where people visit the most on the campus of Selçuk University.

It was carried out in the social facilities that serve students-employees and those who come to the hospital in the Alâeddin Keykubat campus of Selcuk University, and the locations for the data were determined. The details of the study area are given in Naseer Qasim (2019). There are two corridors with a width of approximately 2 m in the north, east and west parts of the shopping center. Some business entrances lead to these corridors. These corridors, which consist of a ceiling structure that cannot be high as a structure, cause the air pollutants circulating in a narrow area to be trapped in a narrow area and close to the respiratory level. Although existing workplaces have ventilation systems, they are not sufficient in common areas. In previous years, the air blowing system was out of use due to technical malfunctions. Although the Gökkuşağı Shopping Center, which was built and put into operation in the past years, has undergone simple renovations over time, there has not been sufficient improvement from its opening to the working period. 13 measurement points were determined to represent the space for your measurements in the rainbow Shopping center.

**Atmospheric Particulate Matter Measurement Method**

Atmospheric particulate matter measurement methods vary according to the size and purpose of the particles. Thanks to electronic systems, a laser particle counter and dust measuring device "Particle Counter PCE-PCO1" configured to determine the concentration of particles in the atmosphere can be determined. This device is used in non-polluted environments, indoor air quality or exposure to cigarette smoke and other harmful air pollutants, and for monitoring dust levels in the air. Detailed information for measurement can be obtained from Naseer Qasim (2019) and [3].

**Modelling and graphics program Surfer-16**

Golden software 16 is a program capable of modeling and creating a 3D graphic preparation system that includes basic statistics. It is used for creating contour maps and obtaining 3D images by processing complex data obtained from different processes and making grids [4-5]. Since the eighties, more than 100,000 scientists and engineers around the world This program, which transforms the collected data into information, visualizes the data in high quality while preserving its accuracy and precision (Bresnahan and Dickenson, 2002). Along with Surfer's extensive modeling tools, interpolation and grating parameters can be adjusted, define errors and breaks, or perform grid calculations such as volumes, transformations, smoothing or filtering [7].

**Particulate matter PM2.5 measurement method**

In the researches carried out to determine the particulate matter concentrations, the pollutant sources in the external environment were examined. By comparison, there is less information about indoor particulate matter pollution, its concentrations, sources, and exposure levels to people who spend most of their time in various indoor environments [6]. In order to determine the interaction of particulate matter values with seasonal changes, studies are carried out in different seasons to take measurements in the study. In this study, autumn was chosen as the opening period of schools, and in the study, two-day measurement intervals were determined on weekdays and weekends. The periodical measurement period was completed as 4 days.

## Results and Discussion

Particulate matter 2.5 micrometer size measurements were carried out in the autumn period in the rainbow shopping center of Selçuk University Alaeddin Keykubat campus, which is one of the important shopping centers in Konya. The sampling period, the second sampling period, was carried out between 24.09.2018 - 07.10.2018. During the measurement period, measurements were made for one week. Weekly average distributions of particulate matter $PM_{2.5}$ were prepared for Surfer 16 by measuring 6 times a day.

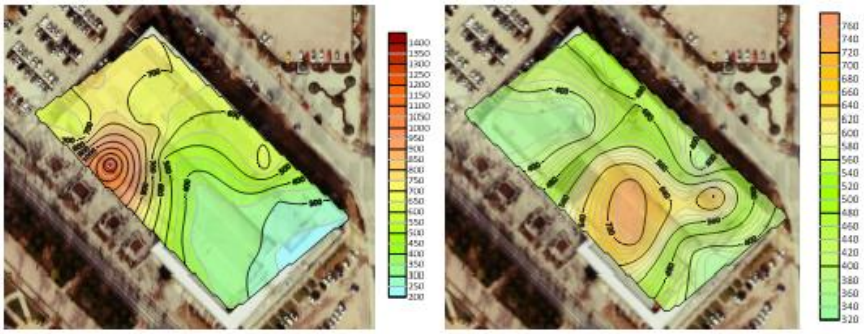
Within the scope of the research, it was arranged to cover the opening and closing hours of the shopping center between the hours of weekdays and weekends (09.00 - 19.00) at the Gökkuşağı AVM at the university. As a result of the study, the average values of $PM_{2.5}$ obtained from the examination of all data during the week and at the weekend are shown in Table 1.

Average $PM_{2.5}$ concentrations in the autumn 2018 period were found to be 693.65 µg/m$^3$ and 495.75 µg/m$^3$ on weekdays. Measurement times were made between 09.00-19.00 hours. The 7-day measurement period, which started right after the official semester registration of Selçuk University, started on 24.09.2018 and continued until 30.09.2018.

**Table 1.** Autumn season weekday and weekend particulate matter $PM_{2.5}$ averages in Rainbow shopping mall.

| Sampling period | Weekday average PM2.5µg/m3 | Weekend average PM2.5 µg/m3 |
|---|---|---|
| **autumn** | 693 | 496 |

The weekday average was found to be 1400 μg/m$^3$ even in the early hours of the day thanks to the pollution that occurred at point F (west entrance gate) and exceeded 1000. It affects the entrance point of the restaurant chimneys located on both sides of the entrance door. Values not exceeding 700 μg/m$^3$ were observed during weekdays in other parts of Gökkuşağı Shopping Center. Low $PM_{2.5}$ concentration was found to be 760 μg/m3, resulting from quieter weekends and fewer visits. The modelling results of the first average $PM_{2.5}$ concentration of the study period at 09:00 are shown in Figure 2. The values at 11:00 am found to be quite high and the $PM_{2.5}$ value was found to be 2900 μg/m$^3$. Here, the particle pollution formed at point B started from the north-eastern part of Gökkuşağı Shopping Center and spread towards the center. $PM_{2.5}$ concentration was found to be at least 1300 μg/m$^3$ at points J and K where cooking restaurants are located. Cooking activities have been ranked 2nd by EPA as the indoor $PM_{2.5}$ formation source (Lai & Ho, 2008).



(a) (b)

**Figure 2.** Gokkusagi Shopping Center at 9:00 a. Weekdays, b. Weekend average

## Conclusions

In this study, indoor $PM_{2.5}$ air quality, a breathable air pollutant, which is an important environmental problem in Turkey as in the world, has been examined. Although air pollution is a major problem in Konya, one of the most important industrial cities of Turkey, this study for indoor environment is based on shopping malls, the particulate matter $PM_{2.5}$, which carries serious risk factors on human health and is ranked second among air pollutants by the World Health Organization. measurements and modeling were done. In order to make the measurements, it was preferred to make the measurements at the Gökkuşağı Shopping Center located on the Selçuk University Alâeddin Keykubat campus. The sampling period for the measurements was carried out between 24.09.2018 and 07.10.2018. Sampling hours at Gökkuşağı Shopping Center were held between 09:00 and 19:00. How particulate matter PM2.5 affects indoor air quality throughout the period and what causes it are examined. The results were mapped and modeled using the Surfer 16 program. While modeling, the results were interpreted as weekday and weekend averages. As a result, measurement $PM_{2.5}$ values in Gökkuşağı Shopping Center did not exceed WHO's standards.

**Acknowledgement:** This paper has been prepared a part of Mina Naseer Qasım MSc.Thesis.

**Funding:** This research has been funded by Selcuk University, Scientific Research Found, Project no:18201117.

**Author contributions: Sukru Dursun:** Conceptualization, Methodology, -Reviewing and Editing; **Mina Naseer Qasım:** Investigation, Data curation, Writing-Original draft preparation, Modelling.

**Conflicts of interest:** The authors declare no conflicts of interest.

### References

[1] Quackenboss, J.J., Lebowitz, M.D., Crutchfield, C.D., (1989). Indoor-outdoor relationships for particulate matter: exposure classifications and health effects. Environment International, 15, 353–360.
[2] Moriske, H.-J., Drews, M., Ebert, G., Menk, G., Scheller, C., Schondube, M., Konieczny, L., (1996). Indoor air pollution by different heating systems: coal burning, open fire place and central heating. Toxicology Letters, 88, 349–354.
[3] URL-2 https://www.pce-instruments.com/english/measuring-instruments/test-meters/particle-counter-pce-instruments-particle-counter-pce-pco-1-det_516316.htm [Retrieved December, 2021]
[4] Polat, O., (2002), Golden software surfer v.8 kullanim ile ilgili notlar p, https://docplayer.biz.tr [04.04.2019].
[5] URL-3 https://www.goldensoftware.com/ [Retrieved December, 2021
[6] Challoner, A., Gill, L., (2014), Indoor/outdoor air pollution relationships in ten commercial buildings: PM2. 5 and NO2, Building and Environment, 80, 159-173.
[7] URL-4, Golden software products, https://www.goldensoftware.com/products: [Retrieved December, 2021].