



## Measurements and modelling of PM<sub>2.5</sub> level in summertime period in Novada main shopping centre Konya, Turkey

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### Abstract

The people are spending most more the daily time in closed environments in their life. The living atmospheric air quality is important because of this long contact time. Air pollution is the presence of particles in the atmosphere because of the interaction of dust, gas, smoke, water vapor, odor and many chemicals in amounts that can harm living things and other things. This pollution, which is an environmental health problem affecting all countries of the world in recent years, causes the death of 3 million people every year in the world. In another definition, air pollution occurs because of fossil fuel burning, that is, anthropogenic activities such as natural gas, coal, and oil, to power industrial processes and motor vehicles. Industrialized countries expect a modern living place in modern life and living spaces. Their vehicle demands bring along motor vehicles and industrialization close to city centers and this effects a damage the human and environmental health. Konya city center is one of the most crowded plan sections of Turkey, and to finish our preparations together with central planning and industrial planning. People also prefer to spend their spare time doing great shopping that Novada Shopping Centre is one of them. It turns out that the forecasts of this weather arise if it is for the air pollution of the air from the people who come from shoppers and visitors. The basic organization for a good material for obtained air quality preparations. Improvement planning in the current situation achieves the goal of the air quality specialist so that the results obtained can be achieved.

### Introduction

Looking at the main causes of air pollution, the increasing population, urbanization, and the need for energy from industrialization have led to an increase in the need for fossil fuels [1]. As a result of the excessive use of fossil fuels, changes occur in the structure of the atmosphere day by day. People are constantly breathing the air around them all the time. Gases and particles in the air are exhaled together with the inhaled air. These pollutants damage people's heart, lungs, and other organs. When we look at the death cases caused by air pollution in the past, approximately 20 people died in Pennsylvania in 1948, while this event killed 63, 3000 people in Belgium in 1930 and in London in 1952 due to air pollution. Although different pollutants are released into the atmosphere because of natural physical events (volcanoes, fires), anthropogenic (human) activities have been determined as the primary source of air pollution in the environment.

The energy saving policies of recent times in countries and the construction of insulated buildings with insufficient ventilation, minimum indoor air circulation, no windows that can be opened to the outside, and air conditioners have had a significant impact on the air quality of these indoor environments. It is a known fact that human performance is affected by indoor air quality. For human comfort and productivity, the indoor environment must be at 19-20°C and the humidity of the air he breathes must be 30-50% [2]. To achieve this aim, PM<sub>2.5</sub> particulate matter measurements were made in the Novada shopping center in Konya city, which is called one of the most industrial cities. Modelling was done by mapping the obtained data. The results obtained were interpreted according to all levels and then compared with each other.

## Material and Method

### Study area

The variation of the levels of air pollutant concentrations between regions in big cities is shaped depending on the characteristics of the regions [3]. In this study, which was started based on the shopping centers in the Selçuklu district of Konya, were selected for measurements. The first of these places, which were chosen by paying attention to the fact that they are closed environments, is the Novada shopping center located in the new development area of the bay that was chosen as the second place for data collection.

Novada outlet shopping and living center located near the bus station area, which is known as the new development area of the city, opened for use in 2015. This shopping center, with a total area of 33000 m<sup>2</sup>, has 2 outdoor and one indoor parking lots, 51 stores, 12 restaurants and 3 playgrounds. Consisting of 4 floors, this building looks like the letter L when viewed from the satellite image, and 3 of the 4 entrance doors are located on the front of the building facing the main street. Sampling points were determined for the measurements to be made in the Novada.

For this reason, it is directly exposed to air pollution caused by traffic. The other entrance door is used as a parking garage entrance on the -1 floor and there is no direct exposure to outdoor air pollution. There are cash machines, travel agency and tailor shops on this floor. The first measurement point was chosen right in front of the entrance door.

The ground floor (0 in order) has two entrance doors at the same level on the north and south facades. On this floor, there are mostly household goods, electronic goods stores, cosmetics, a small number of cafes and clothing stores. The possible source of pollution was mostly thought of as the exhaust fumes carried in from the open parking lot located at the front of the shopping mall and where both doors open directly there. The first floor consists entirely of clothing stores, and the possible source of pollutants is considered as fabric types and store perfumes. The fourth entrance door is located at the back of this floor. There is a ventilation system on the ceiling and the floor in the entire building is covered with ceramic porcelain.

### Modelling and graphics program Surfer-16

This software, produced by Golden software company, consists of a 3D graphics system. It is used for gridding scattered data recorded in different environments, creating contour maps, and obtaining 3D images (Polat, 2002). Since 1984, more than 100,000 scientists and engineers worldwide have benefited from Surfer. The program's exceptional shaping capabilities make it the preferred software for working with X,Y,Z data. It shows high performance to visualize X,Y,Z data with stunning clarity and accuracy [4]. This program, which transforms the collected data into information, visualizes the data in high quality while preserving its accuracy and precision. 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 [5].

It consists of map types such as contour, calculation, 3D surfaces, color relief *etc.*, and provides tools to visualize and model all types of data. The type of map obtained in this study is contour map. After making all the statistical calculations by turning the 3D data loaded on the worksheet into a grid, the map is created by selecting the desired map type. To make the map more meaningful and readable, the map can be personalized with various customization options, thanks to the window in the lower left corner of the screen. These options include sections, magnifiers, scale bars and edits such as multi-axis, linear or logarithmic color scales, combining multiple maps, text, line, fill, and symbol properties [6].

### Results and Discussion

In the research carried out to determine the particulate matter concentrations, the pollutant sources in the external environment were examined. By comparison, there is little information on indoor particulate matter pollution, its concentrations, sources, and exposure levels to people who spend most of their time in various indoor environments [7]. In this study, which was started to determine the effect of seasonal changes on particulate matter, summer, autumn, and winter seasons were selected to take measurements. In summer and autumn seasons, measurements were made for one week at Novada shopping center, and during the summer season, weekday and weekend measurements were made in both locations. The total measurement period was completed as 4 days in the sampling period.

In seasons when the measurements were made, the daily measurement program lasted for 10 hours depending on the working hours of the places, and the measurements were repeated 6 times a day at 2-hour intervals. After taking the coordinates of the measurement points, the data collected at the end of each season are listed in the Excel program in a way that daily, weekly, and hourly averages will be taken. Besides the X and Y coordinates, the Z coordinate represented the measured PM<sub>2.5</sub> values. A worksheet was created by transferring X Y coordinates and measurement values to the SURFER 16 program. All statistical calculations were made by making the prepared data into a grid. Then, contour map was selected from the map options to show the contour lines, and the

customization window was used to clearly show the high and low concentrations and the distribution lines on the map.

**Table 1.** Seasonal weekday and weekend averages of particulate matter PM<sub>2.5</sub> in Novada shopping center

| Sampling period | Weekday average PM <sub>2.5</sub> µg/m <sup>3</sup> | Weekend average PM <sub>2.5</sub> µg/m <sup>3</sup> |
|-----------------|---|---|
| Summer          | 336.97  | 322.55  |

## Conclusions and Recommendations

Lower concentrations were obtained in all three seasons in Novada shopping center. Measurements were made on the minus one level, entrance, first and second floors of the shopping mall. The highest concentrations were seen in this mall minus one and the first floor. Opening the only door on this floor where there is no ventilation to the parking garage caused the emissions from the vehicles to spread indoors. The fact that the measurements made in the summer season coincide with the month of Ramadan caused the results to be lower than the weekend values compared to the weekdays. In the autumn and winter measurements, the situation differed, and the weekend averages were generally higher than the weekday results. The fact that the concentrations found in Novada AVM are lower than that of Rainbow is due to the presence of a clean air plant operating here. These power plants, operating on the entrance, first and second floors, changed the indoor air of the building and helped to breathe quality air. In addition, cleaning activities continue throughout the day. High concentrations are mostly in the food layer; It has been found in areas where restaurants and playgrounds are located. This building, which was put into use in 2015, has less pollution reflected in the environment due to the building material and the age of the building.

## References

- [1] Karakaş, B., (2015). İç ve Dış Hava Ortamlarında Partiküler Madde (Pm10, Pm2. 5 ve Pm1) Konsantrasyonlarının Değerlendirilmesi.
- [2] Alyüz, B., & Sevil, V. (2006). İç ortam havasında bulunan uçucu organik bileşikler ve sağlık üzerine etkileri, Trakya Üniversitesi Fen Bilimleri Dergisi, 7 (2), 109-116.
- [3] Cindoruk, S. S., (2018). Havadaki NO ve NO<sub>2</sub> parametrelerinin marmara temiz hava merkezi ölçümleri kapsamında incelenmesi, Ömer Halisdemir Üniversitesi Mühendislik Bilimleri Dergisi, 7 (2), 600-611.
- [4] Bresnahan, T., Dickenson, K. (2002). Surfer 8 self-paced training guide, Golden Software Inc. <http://www.fca.unesp.br>
- [5] URL-1, Golden software products, <https://www.goldensoftware.com/products:> [2-12-20218].
- [6] URL-2, <https://earth.google.com/>
- [7] Challoner, A. & Gill, L. (2014). Indoor/outdoor air pollution relationships in ten commercial buildings: PM2. 5 and NO<sub>2</sub>, Building and Environment, 80, 159-173.ASHRAE., (2003), Indoor Environmental Health, p. chapter 9.