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Measurements of Ambient Particle Material Level in Shopping Centers in Konya City[#]

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Abstract: Air pollution levels shows the interaction between the particles like dust, gas, smoke, water vapor, odor and many chemicals that presence in the amount of damage to living organisms and damage the materials. Various types of air pollutants in the atmosphere forms naturally or by human source activities the appearance of the air depends on the state of pollution. Particulate matter is one of these pollutants which has a significant effect on human health. It has the ability to stay in the air for a long period or even weeks, and because of its small size and lightweight, it can move to around very long distances. This study was carried out in the city center of Konya considering shopping centers as a measuring points to monitor the relationship between concentrations of PM2.5 and the change of climatic factors for different seasons. We took different points and at different location to measure PM pollution indoors. The highest values for summer season were obtained at location AB (1739 mg/m^3), (1653 mg/m^3) at location B1, for autumn the same values were observed at location AB nearby (3785 mg/m^3) while the concentrations at location B1 did not exceed (3302 mg/m^3). These two points were record the maximum values and the reasons generally were about that the places did not contain fans or ventilation areas in addition to the large number of visitors.
Keywords: Air quality, Pollution, Indoors, Measurement, PM2.5, Shopping centers.

INTRODUCTION

The last years' researches showed that the air pollution has become a focus of attention in the worldwide. Thought the air pollution is not a new problem, but its importance was observed after the industrial revolution in the previous century. Air pollution refers to mixture of organic and inorganic material existing in the atmosphere in amounts that enough to harm the living things around. Particulate matter PM is one of the most significant pollutants which forms by natural events and human actions, in terms of quality and quantity Particulate matter's size, density, chemical composition and health effects vary widely depending on their potential.

These particles are given to the atmosphere in the form of solid or liquid as a result of combustion operations [1]. In terms of mass Particulate matters classified into 2 categories according to the US Environmental Protection Agency (EPA): coarse particles with diameter ranging between (10 - 2.5 μm), fine particle with diameter less than 2.5 μm. These particles are present in the atmosphere as a smoke and turbidity state and are released directly into the atmosphere by power plants and forest fires [2]. The formation of these particles in the internal environments depends on the various sources from humans activities, these sources include smoking, cooking, wood burning, gas oil heating, air humidifiers, domestic animals and electric [3], indoor sources is the reason why people are exposed to 76 % of particulate matter [4]. In the last century, human-induced emissions that led to the formation of PM increased dramatically, resulting in negative human health effects [5]. With the Directive 2008/50 / EC prepared by the European Parliament and of the Council for outdoor air quality on 21 May 2008, the yearly and daily PM10 limit values are as follows; 40 μg / m3 and 50 μg / m3 and 17 μg / m3 for PM2.5. WHO recommended that air quality standards (25 μg / m3 and 50 μg / m3 for PM2.5 and PM10 respectively) be provided everywhere to significantly reduce the adverse health effects of pollution [6]. In Turkey, the air quality regulations that came into force on 6 June 2008, the standards for PM10 daily and annual basis, respectively; 50 μg / m3 and 40 μg / m3, but there is still no standard established about PM 2.5 [7].

Many of the people spend about 90% of their daily life in indoor environments either inside residential house, offices, shopping centers, colleges, schools, commercial or industrial buildings.

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Results of studies shows that the recorded concentration of pollutants in the internal environment is much higher than the concentration of the urban outdoor ambient [8]. However, the indoor air quality and pollution gained highly less attention than the outdoor air quality until last decade [9].

The indoor air quality varies according to the activities taking place in the ambience, at shopping centers there are several activities occurring at the same time, and this shows that there are more than one PM sources. indoor sources could be short period, seasonal, or continuous with the most significant being environmental fumes from cooking, and tobacco smoke, oil heating and wood burning stoves. Other human activities such as vacuuming, and dusting can also contribute to elevated particle concentrations levels indoors [10].

In addition to the factors shown above, the humidity in indoor air has an optimal window where it favors the formation and growth of dust mites, also the proper temperature is the primary indoor air requirement and extreme indoor temperatures leads to serious health hazard [11]. It is important to estate the effect of ventilation on indoor air quality, low rates of ventilation, have been interrelated with health and perceived air quality consequences [12].

In developing countries worldwide indoor air pollution has become the primary problem for human health. In 2001, 1.8 million deaths resulting from indoor air pollution exposure has been associated with lung cancer, chronic lung disease or acute respiratory infection; 900,000 of these deaths were observed in children under 5 years of age [13]. A great number of studies have found a correlation between airborne particulate matter and the negative effects of these materials on the health of humans of different age groups [14] In some epidemiological studies, these effects have been associated with different particle sizes (PM2.5 and PM10) [15]. In a previous study of fine particles (PM2.5), the exposure to PM2.5 increased by 10 μg / m3, indicating that the risk of death is increasing in the range of 8-18% [16].

This study aims to record the concentrations of particulate matters with 2.5 μm in diameter using a particle counter during 2 seasons at Konya cities shopping centers and determine the point where the peak values estimated in.

MATERIALS AND METHODS

Working field

Two different shopping centers in Konya city were chosen as data collection field. The first location for collecting the data is rainbow social facilities taking place at Selcuk University, Alaaddin Keykubat campus. Assuming that the number of students in the university is 80000 people, approximately 30% of them visits the building every day for different reasons , this means a serious number for an indoor.

Mega shopping and living center Novada chosen to be the second location for taking measurements. this building consist of 3 floors and has 127 stores, 30 coffee shop restaurants and entertainment areas with Total indoor area about 67 thousand 926 square meters [17]. In this type of shopping centers, there are restaurants and social activity areas and because it is used actively, it is considered suitable for measuring by thinking that the pollution level is high.

PM Measurement

1.Equipment

Particle meter (particle counter PCE-PCO1) used in this study was provided by Selcuk University - Environmental Engineering Department. It is a laser particle counter, or dust measuring device, used to measure the concentration of particles in the air. is ideal for monitoring indoor air quality, exposure to exhaust, cigarette or tobacco smoke, levels of airborne dust and other harmful air pollutants [18].

The important features of the device are the ability to measure 6 different particle sizes (0.3-10 ,m), to achieve fast, easy and high accuracy results, as well as temperature, relative humidity and dew point measurement. In addition, it has been selected in this study due to its lightness and being easily portable.

Figure 1. Particle counter PCE-PCO1 Handheld laser dust measuring device for monitoring indoor air quality, clean room particulate concentrations, and exposure to dust

The instrument must be charged and prepared before going to the measuring location and reset in a dust-free environment (calibration) before measuring. After reaching the measurement area, the device is turned on by pressing the power button and then ENTER button to switch to the particle counting screen. The dust and temperature sensors on the top of the device are opened and the START / RUN button is pressed and the unit starts measuring for 30 seconds. data is saved by pressing the F2 button after the measurement time is over.

2. Sampling points

In this study, 30 points were determined for the measurement to be performed. 13 of these points are located in the Selcuk University rainbow social facilities which we named it a location for convenience.

The other 17 points are divided into 4 floors in the building of the Novada shopping center. The division plan of the measurement points is shown in the table. this location also named as B location for convenience.

Table 1. The location of measuring points at Novada shopping center

Measuring point	The floor where is located	Measuring point	The floor where is located
1	-1	10	1
2	0	11	1
3	0	12	2
4	0	13	2
5	0	14	2
6	1	15	2
7	1	16	2
8	1	17	2
9	1		

Buildings variables recorded during the study period included ventilation system, number of persons visiting theese places during the data recording hours, portal status (open or closed), room temperature and humility.

Concentration of particle measurement PM2.5 in these two locations was assessed by a direct-reading instrument (particle counter PCE-PCO1) during two study periods summer and autumn, which simultaneously provided the particle size and every 2 hours over the course of one day, seven times a week as shown in the figure 2.

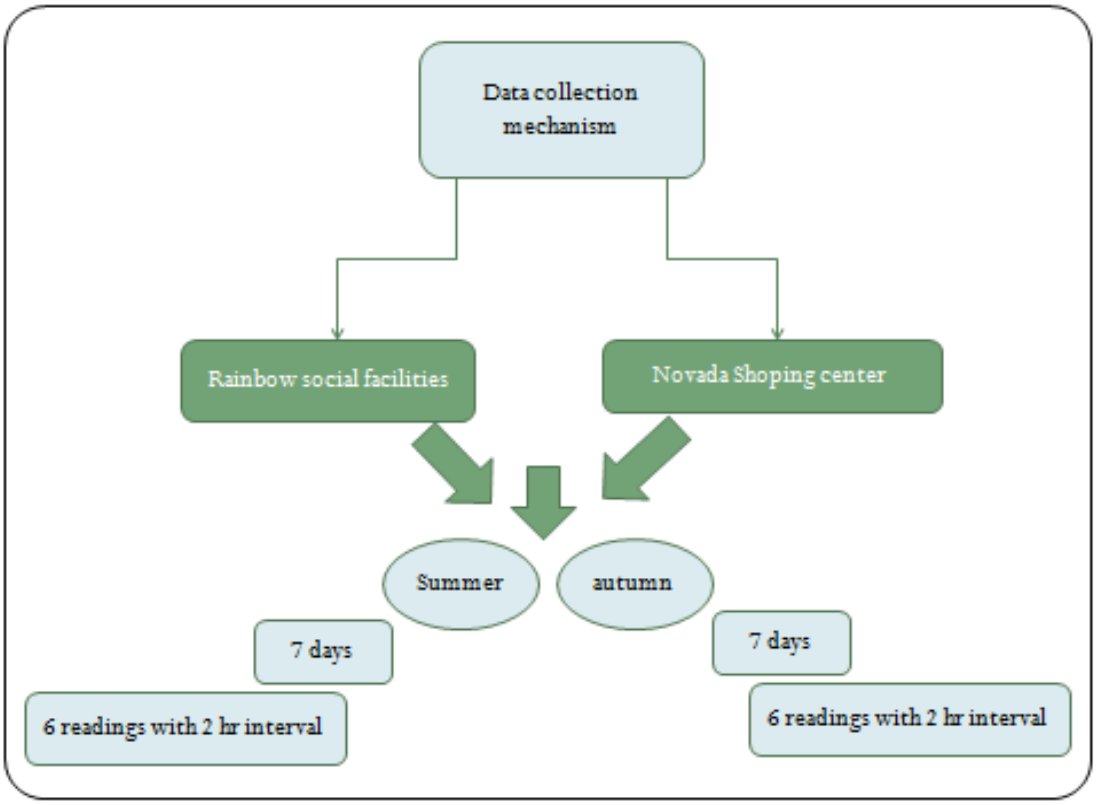

Figure 2. The mechanism of data collection during 2 season

RESULTS

Particulate matter measurements were performed at each A and B location for 10 hours, depending on the work hours of the places in the summer and autumn season. The measurements were taken at 13 point in the location A (rainbow social facilities), 17 point in the location B (Novada shopping center). All of these points located insinde the buildings.

The highest values for summer season were obtained at point AB (1739 mg/m^3),this point is located in closed hallway without doors or window that opens to the outside , the concentration of this point recorded the highest value all of the measuring time in comparing with other points especially after midday hours as it shown in the figure 3.

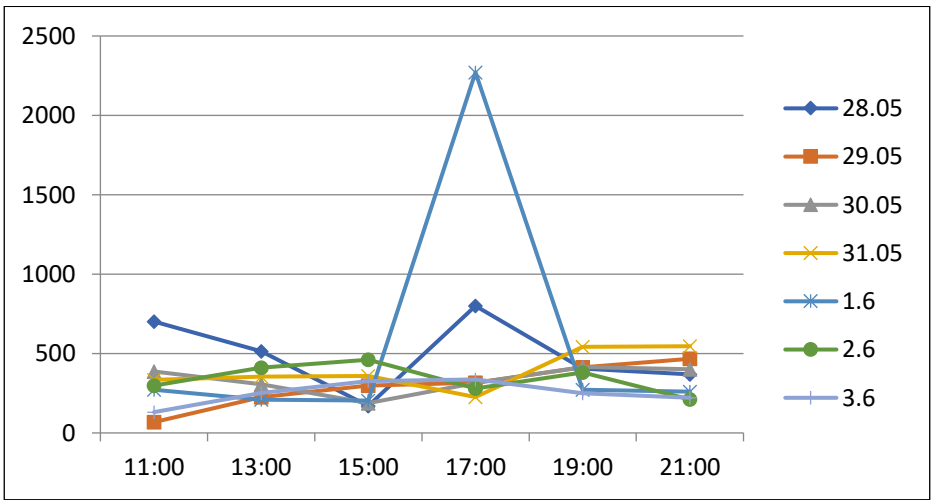

Figure 3. Point AB with highest value of PM2.5 at summer season

When the B location was examined, the highest value obtained during the week was seen at point B1 with concentration of (1653 mg/m^3). this value continued to maintain its height both on weekdays

and on weekends. The B1 point is located on the 1st floor, on the ground floor of the closed car park. The values shown in the figure 4.

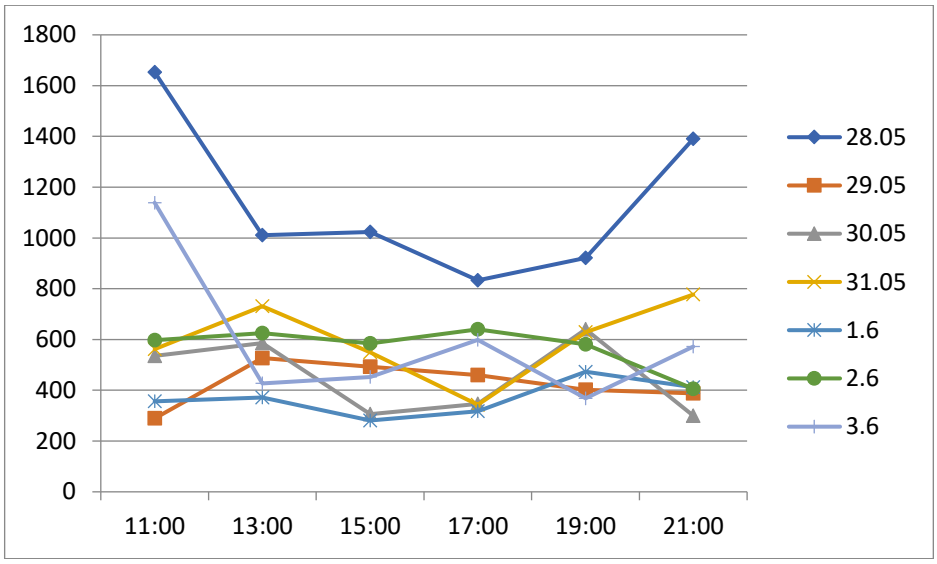

Figure 4. Point B1 the highest value of the summer season

Autumn measurements are not changed for the same points. there is also an increase in the values compared to the summer period from (1739 mg/m³) to (3785 mg/m³) at AB point. the values of the weekend approximately didn't exceed (1400 mg/m³).

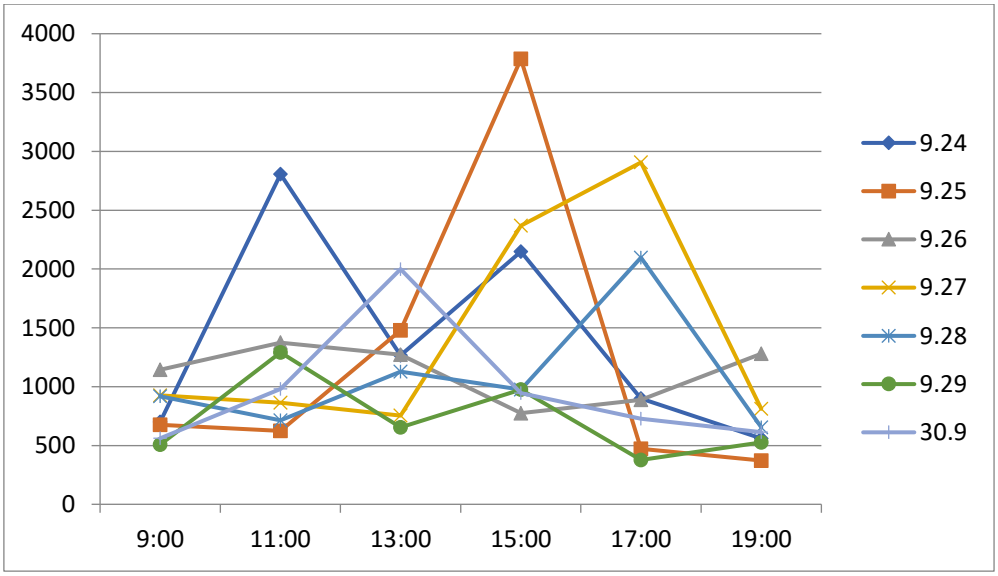

Figure 5. Point AB with highest value of PM2.5 at autumn season

(3302 mg/m³) was the maximum value of the autumn season at B1. at this point, when we look at the weekend values, it is seen that there is a serious increase according to the weekdays.

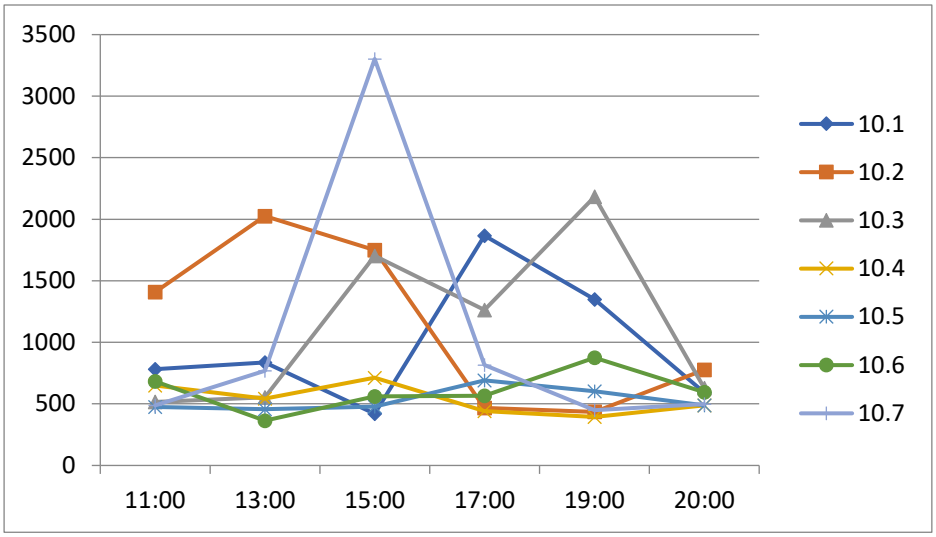

Figure 6. Location B1 with the highest values of PM2.5 at autumn season

DISCUSSION

In the results interpreted based on the points showing the highest values from the measurement periods performed during the summer and autumn periods It is observed that there is a difference between summer and winter seasons, and autumn values are higher than summer.

AB point is located in the back corridor of the building and doesn't has windows or doors that opened d'rectly to the outside , There are cooking stoves, hairdressers, and tailor-made shops in this hallway. in return, there is only one ventilation space in the ceiling and a high value indicates that the ventilation is insufficient for a corridor with such shops. AB point located at the campus so The number of student visits decreases to less than half on weekends, for this reason the concentrations of $PM_{2.5}$ at the weekends also decreases significantly.

For point B1 that is located on the -1floor of the sopping center building, it has a single exit door to the closed parking garage that causes the particulate matter due to the emissions of the vehicles to be trapped inside, and leads to an increase in the PM concentration espacially at the weekend because it is an holiday and the rate of visits increases in comparing with the weekdays generally in shopping centers.

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