Turkish Journal of Agriculture - Food Science and Technology, 11(s1): 2512-2517, 2023
DOI: https://doi.org/10.24925/turjaf.v11is1.2512-2517.6416

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology Publishing (TURSTEP)

Examination of Air Quality of Dr. Sami Yağız Street in Niğde

Orhun Soydan[1,a,*]

[1]*Faculty of Architecture, Landscape Architecture Department, Niğde Ömer Halisdemir University, Niğde, Türkiye*
[*]*Corresponding author*

ARTICLE INFO

Research Article

Received : 02.10.2023
Accepted : 07.12.2023

Keywords:
Air
Air Quality
Geographic Information Systems
Landscape
Niğde

ABSTRACT

Air pollution can be defined as the accumulation of gas, air, or particulate matter released as a result of fuel residues and chemical processes in the atmosphere in amounts that harm the lives of living things. Rapid urbanization, industrialization, increase in the number of motor vehicles, meteorological conditions, fuels used for heating, and the spread of industrial establishments and thermal power plants play an important role in the increase in air pollution. Air pollution is a major environmental problem affecting people in both developed and developing countries, and it is estimated that megacities in developing countries, and a quarter of the world's population are exposed to unhealthy concentrations of air pollutants. People living in cities with high outdoor air pollution are more likely to suffer from heart disease, respiratory problems, and lung cancer than those living in urban areas with clean air. In the industrialized western world, urban air pollution is in some respects in its final stages, with a dramatic decline in SO_2 and soot levels. The increase in the number of private vehicles is a newly emerging problem. Rapid urbanization in most developing countries has so far led to uncontrolled growth and environmental degradation. Air pollution levels are still rising in many cities. In this study, air quality was tried to be measured along Dr. Sami Yağız Street, which is one of the most heavily used areas of Niğde. H_2S, O_2 and CO measurements were made at 25 points at equal intervals on both sides of the street. Measurements were made at a total of 4 different time periods per day. The obtained values were transferred to ArcGIS 10.3 software and maps were produced. Measurement of gases other than H_2S is not distributed homogeneously along the street, and traffic density and the businesses on the sides of the street cause changes in the rates of the gases.

[a] *orhunsoydan@ohu.edu.tr* *https://orcid.org/0000-0003-0723-921X*

This work is licensed under Creative Commons Attribution 4.0 International License

Introduction

Damage to vegetation in urban ecosystems, change or decrease in its quantity and quality, causes air pollution and environmental problems that negatively affect public health and ecological functioning (Hutyra et al., 2011). The Right to Clean Air Platform (THHP) stated that air pollution, which is considered among the risk factors that cause the most diseases and deaths in our country, rose to the 6th place in 2017, while it was seventh in 2007 (THHP, 2020).

It is known that carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and ozone (O_3) gases, which increase in the air, especially as a result of the use of fossil fuels, cause respiratory diseases, cardiovascular diseases and neurotoxic effects in humans (THHP, 2020). It has been determined that the air pollution seen in our cities during the winter months is caused by the fuels consumed for heating purposes, especially approximately 90% of SO_2 comes from this source, 10% comes from industry, traffic and wind erosion, and non-fuel sources have a 20% share in smoke.

In addition, it causes a wide variety of damages to plants, such as loss of vegetation and species, deterioration of chlorophyll structure, affecting the development of vegetative parts, fertilization biology, fruit set, yield, and quality (Turalıoğlu, 2011). In addition, carbon-based pollutants create a greenhouse effect, causing an increase in air temperature, the emergence of a heat island effect, acid rain, and climate change (Cui and de Foy, 2012; Tursun et al., 2018).

PM2.5 and PM10 particles are the most important air pollution components, which are expressed as a mixture of solid and liquid particles suspended in the air and are formed as a result of human activities such as heating, transportation, industry, and electricity generation.

These particles cause many diseases related to the respiratory, cardiovascular, and nervous systems,

especially cancer (Perez et al., 2015; Tonyaloğlu et al., 2021). On the other hand, the presence of trees in urban areas provides social, cultural and human health benefits as well as various ecosystem services on important issues such as carbon capture and storage, removal of atmospheric pollution, reduction of urban heat island effect and reduction of rainwater surface runoff (Nowak et al., 2013). In this context, mapping, measuring and evaluating ecosystem services are of great importance in terms of natural resource management, as well as the creation of planning decisions and policies and economic resource management (Burkhard and Maes, 2017; Kesgin Atak and Tonyaloğlu Ersoy, 2020; Tonyaloğlu Ersoy, 2020).

Green areas covered with vegetation improve air quality by filtering pollutants in the atmosphere, depending on the ecological characteristics of the plants, climate and environmental conditions. Trees improve the air quality of their environment by absorbing pollutants in the air through the stomata in their leaves during respiration or by trapping pollutants in the atmosphere with their leaves. These pollutants retained on the leaf surface remain on the plant until the tree loses its leaves or the leaves are washed away by rainfall. The air quality improvement functions of trees are high when they are close to pollutant sources. For this reason, in many cities, the focus of adaptation efforts to climate change is on reducing the amount of pollutants released into the atmosphere, afforesting roads that are sources of pollution to create green corridors, and calculating the ecosystem services provided by these corridors (Hepcan and Cangüzel, 2021).

Streets are exposed to intense air pollution due to traffic density and urbanization in the immediate vicinity. Although this pressure is tried to be reduced by afforestation and median works on the sides of the streets, the pavement width on the sides of the roads is not sufficient and the plant species selected in the medians are not among the types that reduce air pollution, causing these problems to continue.

Air pollution is generally grouped under three headings. These; air pollution caused by heating, transportation and industry. Air pollution caused by heating is a phenomenon that occurs especially in winter months. Fire has been one of the important needs for humanity since its discovery. It was used extensively, especially for heating purposes. Today, we use stoves and radiators in homes, schools and workplaces for heating purposes during the winter months. Wood, coal, fuel oil and natural gas are used as fuel in stoves and radiators. When these fuels are burned in stoves and radiators, carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NOx) and particulate matter coming out of the chimneys pollute the air.

In addition to the pollution caused by heating in cities, the harmful exhaust gases caused by motor vehicles, which increase in parallel with the increase in population and income level, also emerge as an important air pollution problem that needs to be taken precautions.Harmful substances in the exhaust gases emitted by gasoline and diesel vehicles cause much more damage to the environment, especially in large urban centers where population and traffic are dense.

It is a multifaceted and mutually influencing relationship with industry, which is one of the main sectors of development, and in addition to the positive results created by this interaction, if precautions are not taken in terms of environmental protection and appropriate technologies are not used, the problem of pollution arises, which has negative consequences on the environment, gradually leading to the destruction of resources and rapid pollution of the environment. and causes the benefits expected from the industrial sector to gradually decrease (Anonymous, 2023).

Main purpose of this study is to determine the main factor causing air pollution on the selected street. Changes in the measurement values of gases according to determined time periods and the reasons for this were determined. The most important feature of the study is that January was selected as the measurement time. The coldest month in Niğde is January. An attempt was made to measure the air quality of the street depending on heating and motor vehicle use.

Materials and Method

In the study, it was planned to produce maps of the gases that affect the air quality of Dr Sami Yağız Street in Niğde Province. Niğde is surrounded by Mersin to the south, Konya to the west, Nevşehir to the north, Aksaray to the northeast, and Kayseri to the east (Figure 1). Therefore, the main material of the study consists of data from Dr. Sami Yağız Street and its surroundings. Dr. Sami Yağız Street is one of the longest streets of Niğde Province and is approximately 1.5 km long and 15 meters wide. Dr. Sami Yağız Street is located at 37.966373 latitude and 34.672649 longitude (Figure 2).

Figure 1. Location of the study area

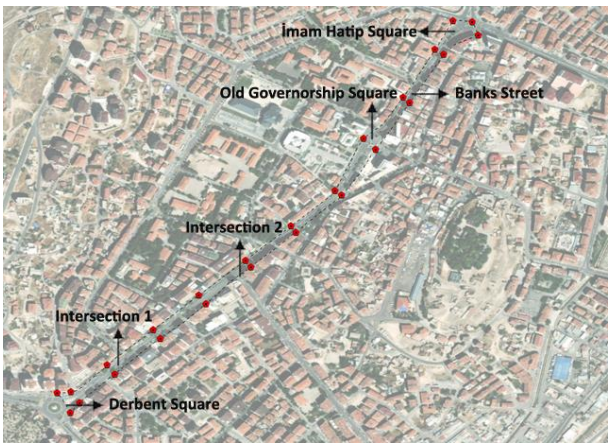

Figure 2. Dr. Sami Yağız Street and measurement points

O_2, CO and H_2S measurements were made at 25 points at equal intervals on both sides of the street. Measurements were made on weekdays. The reason for this is that the street is exposed to heavy traffic on weekdays, especially for reasons such as school, work, etc. In addition, measurements were made on weekdays to determine the effects of the restaurants on the sides of the street on air quality.

After determining the days to be measured, the time period in which the measurement would be made was discussed. As a result of the observations, the street is heavily used at 09:00, 12:00, 15:00 and 18:00. 09:00 and 18:00 are the time period for going home, work, and returning to school, work, etc. It is used intensively in the 12:00 and 15:00 time zones for various reasons (eating, public, banking, etc.). The obtained values were transferred to ArcGIS 10.3 software and maps were produced. Through the maps, it was determined in which time periods the gas density changed and in which parts of the street the gas density changed and the reasons.

Results and Discussion

The results of the measurements for CO are given in Figure 3-6. According to the CO gas measurement results along the street, it was determined that the gas rate changed according to the time periods measured.

In addition, it was determined that the CO gas rate was not distributed homogeneously throughout the street during the same time periods. The danger limit for the amount of CO in the air is given as 50 ppm or 55 mg/m^3. Symptoms of CO poisoning generally begin when the ambient level reaches 100 ppm.

According to the measurement results, it was determined that the amount of CO in the air along the street was below 50 ppm. However, in the measurements made at Imam Hatip Square, the westernmost end of the area, at 09:00 on Monday, a rate slightly above 50 ppm was detected. However, according to the measurement results, it was determined that the time period with the lowest CO amount was 09:00.

According to the measurement results, it was determined that the CO rate in the air was higher especially between 09:00 and 15:00 compared to other time periods. While the CO level is highest in the eastern part of the street in the measurements made at 09:00, the CO amount increases at 12:00 and 15:00, especially at intersections and areas where bus stops are located.

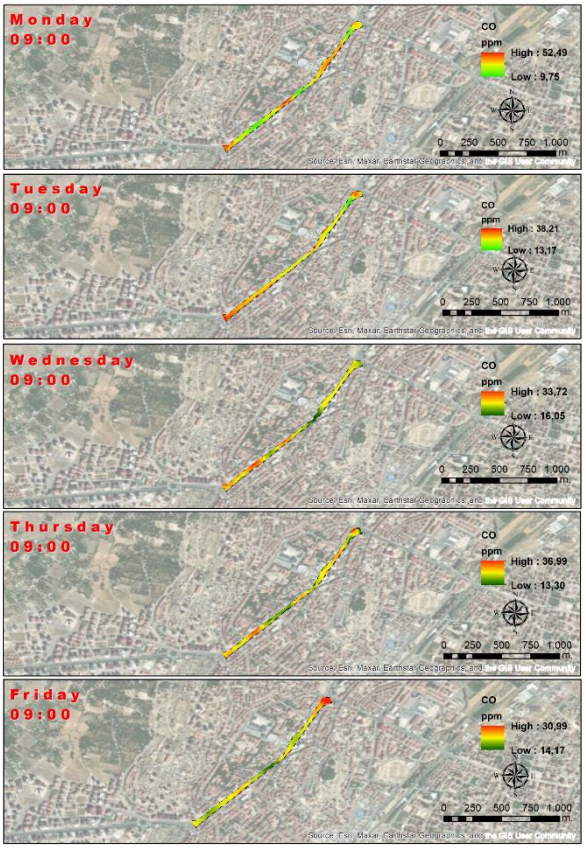

Figure 3. CO measurement – 09:00

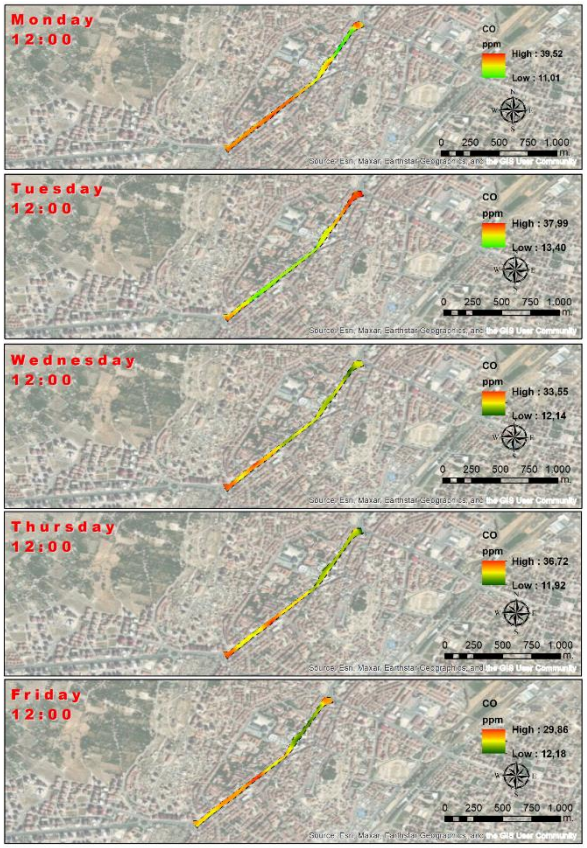

Figure 4. CO measurement – 12:00

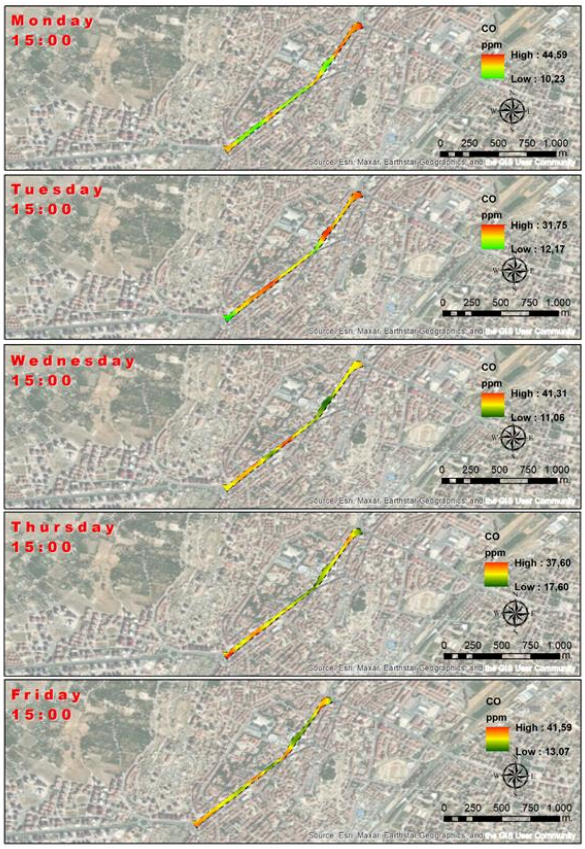

Figure 5. CO measurement – 15:00

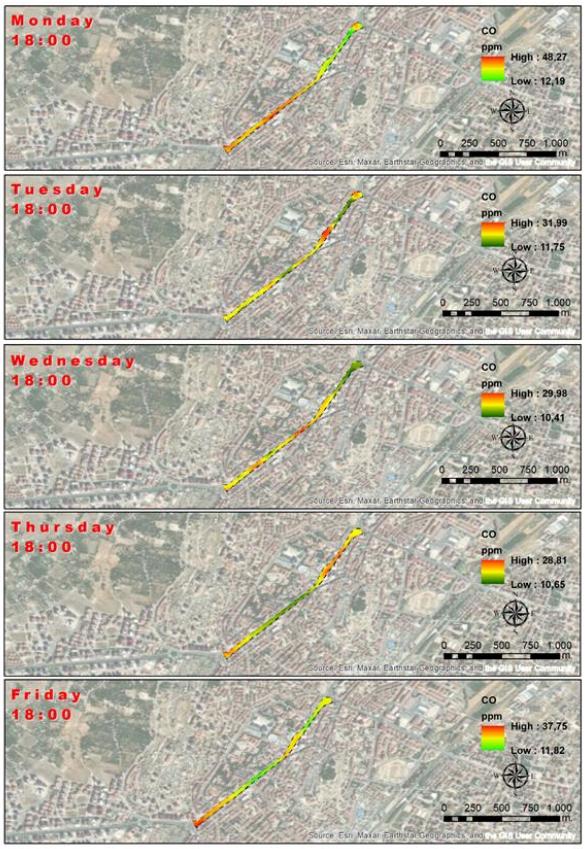

Figure 6. CO measurement – 18:00

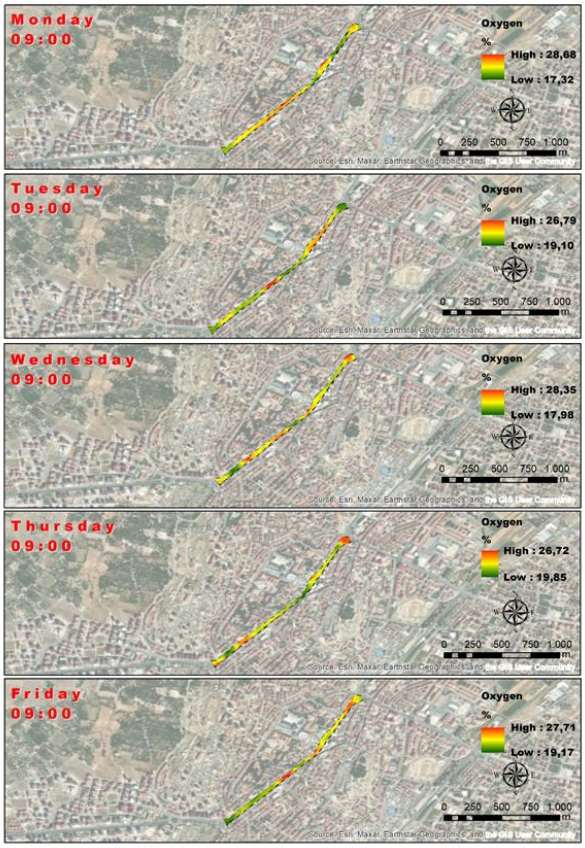

Figure 7. O_2 measurement – 09:00

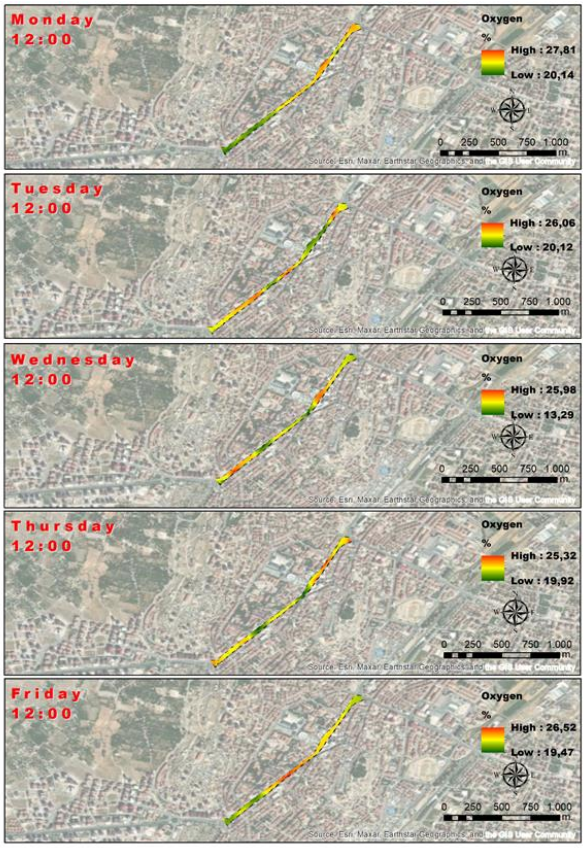

Figure 8. O_2 measurement – 12:00

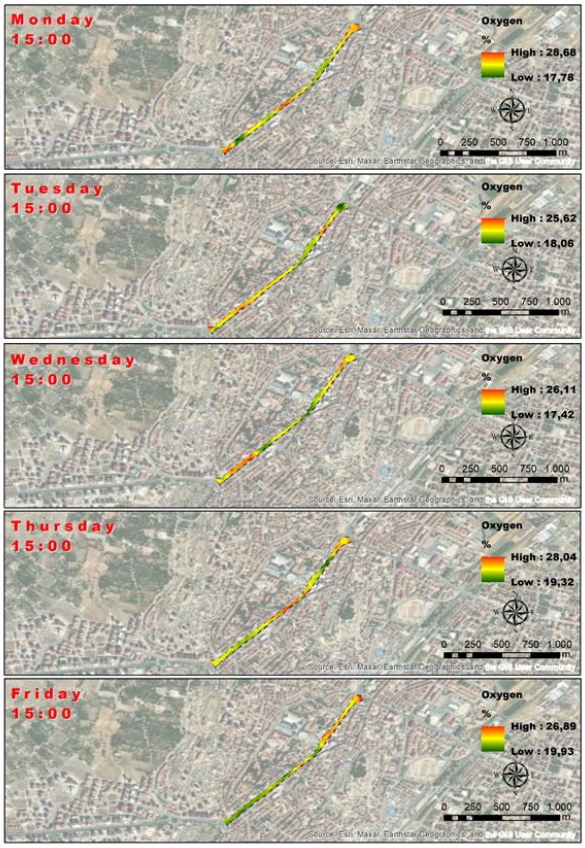

Figure 9. O_2 measurement – 15:00

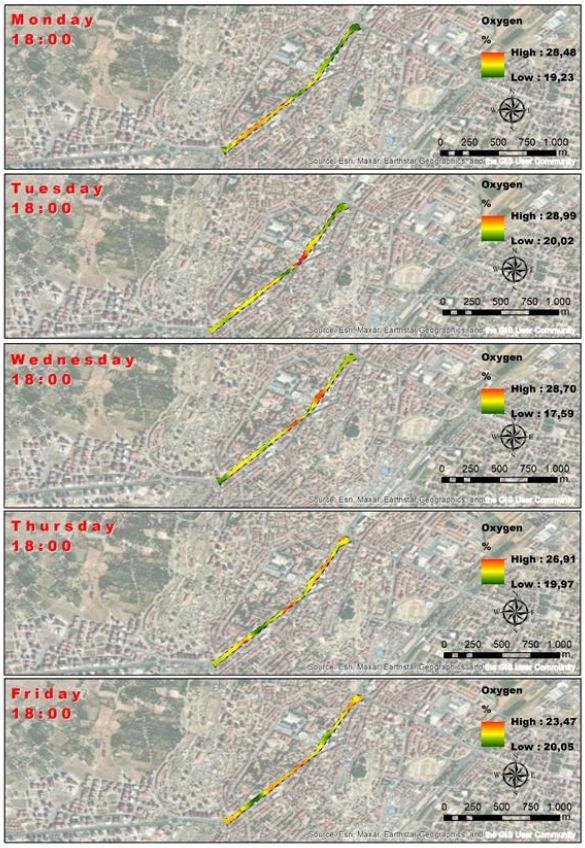

Figure 10. O_2 measurement – 18:00

Because the opening time of banks is 09.30, the amount of CO in Banks Street is low especially in the morning hours, but the CO gas rate in this street increases at 15:00 and 18:00. In measurements made at 12:00, 15:00 and 18:00, the CO level is at its highest levels especially at intersections and on Bankalar Street, where the street narrows. The results of the measurements for O_2 are given in Figure 7-10. There is normally around 21% oxygen in the air. In order to breathe healthily, the amount of oxygen in the air must not fall below this rate. According to the measurement results, it was determined that the oxygen rate in the air along the street was close to this value, was above this rate at certain times of the day, and was 1 - 2 points behind this rate in a very small part of the street. According to the measurement results, it was determined that the oxygen rate in the air was less than other time periods, especially between 12:00 and 15:00.

In the measurements made at 09:00, it was determined that the oxygen rate was lowest in the western part of the street, while the oxygen rate increased in this part of the street over time, and decreased towards the western part of the street. The concentration of Hydrogen Sulfide, which occurs naturally between 0.0001 - 0.0002 ppm in clean air, should not exceed 0.05 ppm according to standards and an hourly average of 0.125 ppm.

As a result of the measurements, it was determined that the H_2S rate in the air showed almost no change and had a value close to 0.0001 pm. H_2S gas generally changes instantaneously in areas located in heavy industrial facilities. There is no industrial facility that could cause environmental waste or pollution along the street examined within the scope of the study. For this reason, it has been determined that the rate of H_2S gas in the air remains within the determined limit values and there is no negative situation in terms of air quality.

Conclusion

According to the report published by the Ministry of Environment, Urbanization and Climate in 2020; In Niğde Province, there is felt and detected pollution caused by SO_2 during the winter months, late autumn and early spring.

This shows that the source of air pollution in Niğde (in terms of SO_2 pollution) is not the pollution caused by industry and motor vehicles, but the air pollution caused by heating and meteorological factors. owever, in this study, contrary to the report, it was determined that the amount of CO gas in the air increased especially at certain times of the day, especially due to motor vehicles.

The gases in which the measurements are made are close to the desired values and are slightly below or above the limit values determined at certain times of the day. The main reason why the rates of gases in the air vary in certain parts of the street according to the time periods when measurements are made is the traffic density on the street.

According to the measurement and observation results, the street has very intense usage at 15:00, when the oxygen rate is lowest and the C0 rate is highest. Likewise, the reason why the ratio changes like this at 09:00 or 18:00 is again related to the gases released into the environment by motor vehicles. One of the most important reasons why the oxygen rate is high in certain areas is the plant tissue on the edges of the street and median strips. Although the plant tissue is dense, especially in the area known as Bankalar Street, it has been determined that the O2 rate in these sections decreases due to the busy vehicles on the roadside.

Figure 11. a) İmam Hatip Square b) Banks Street

Figure 12. Restaurants on the street

It has been determined that another reason why the amount of oxygen in the street decreases and the amount of CO increases in certain periods of time is due to the restaurants located in certain areas of the street. The oxygen content in certain areas changes instantaneously, especially due to the harmful gases released from the chimneys of these areas**.** The industrial branches operating throughout Niğde vary. Air pollution caused by industry mainly occurs as a result of choosing the wrong location, using inappropriate fuel, and discharging waste gases into the receiving environment without taking adequate technical precautions.

Although the calcite quarries located around the city do not have a direct impact on residential areas, the dust created as a result of the activities of these facilities has negative effects on the air quality of the city. Facilities with a high risk of dust formation should be moved out of residential areas. In the layout planning of the city, construction patterns that would obstruct the flow of wind within the city should be prevented. Zoning regulations should be made to ensure a certain distance between industrial facilities and residential areas, and infrastructure works should be carried out to move industrial facilities and workshops within the city out of the urban settlement.

Acknowledgements

This research was presented at the 3rd International Congress of the Turkish Journal of Agriculture - Food Science and Technology, Malatya, Turkiye, held on 13 and 16 September 2023 (as an oral presentation).

References

Anonymous. 2023. https://webdosya.csb.gov.tr/db/nigde/webmenu/webmenu16107.pdf. Acces Date: 11.09.2023

Burkhard B, Maes J. 2017. Mapping Ecosystem Services. Advanced Books. Pensoft Publishers, Sofia (2017): 374s.

Clean Air Right Platform (THHP). 2020. Black report 2020 Air Pollution and Health Effects., Printworld Matbaa San.ve Tic. A.Ş., Istanbul, 108 p.

Cui YY, De Foy B. 2012. Seasonal variations of the urban heat island at the surface and the near-surface and reductions due to urban vegetation in Mexico City. Journal of Applied Meteorology and Climatology, 51(5), 855-868. https://doi.org/10.1175/JAMC-D-11-0104.1

Hepcan ÇC, Cangüzel A. 2021. The effect of Bornova University Avenue road trees on air quality. Ege University Faculty of Agriculture Journal, 58(2), 247-252. https://doi.org/10.20289/zfdergi.697540

Hutyra LR, Yoon B, Hepinstall-Cymerman J, Alberti M. 2011. Carbon consequences of land cover change and expansion of urban lands: A case study in the Seattle metropolitan region. Landscape and urban planning, 103(1), 83-93. https://doi.org/10.1016/j.landurbplan.2011.06.004

Kesgin Atak B, Tonyaloğlu Ersoy E. 2020. Monitoring the Spatiotemporal Changes in Regional Ecosystem Health: a Case Study in Izmir, Turkey. Environmental Monitoring and Assessment 192: 1-14. https://doi.org/10.1007/s10661-020-08357-4

Nowak DJ, Hoehn RE, Bodine AR, Crane DE, Dwyer JF, Bonnewell V, Watson G. 2013. Urban trees and forests of the Chicago region. Resour. Bull. NRS-84, 106(10.2737), 114 p.

Perez L, Grize L, Infanger D, Künzli N, Sommer H, Alt GM, Schindler C. 2015. Associations of daily levels of PM10 and NO_2 with emergency hospital admissions and mortality in Switzerland: Trends and missed prevention potential over the last decade. Environmental research, 140, 554-561. https://doi.org/10.1016/j.envres.2015.05.005

Tonyaloğlu EE, Atak BK, Yiğit M. 2021. Examination of air quality, one of the regulating ecosystem services, in the Efeler-Aydın example. Adnan Menderes University Faculty of Agriculture Journal, 18(1), 119-125. https://doi.org/10.25308/aduziraat.867541

Tonyaloğlu Ersoy E. 2020. Spatiotemporal Dynamics of Urban Ecosystem Services in Turkey: The Case of Bornova, Izmir. Urban Forestry and Urban Greening 49: 126631. https://doi.org/10.1016/j.ufug.2020.126631

Turalioğlu FS. 2011. Changes in ozone, nitrogen dioxide and sulfur dioxide, which are harmful to plants, in the Erzurum atmosphere. Journal of Agricultural Faculty of Gaziosmanpaşa University (JAFAG), 2011(1), 73-77.

Tursun N, Üremiş İ, Bozdoğan O, Doğan, MN. 2018. Investigation of the responses of some important weeds to temperature and CO2 increases. Erciyes University Institute of Science and Technology Journal of Science, 34(3), 26-35.