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Monitoring of Total Hydrocarbons and Particulate Matters in AL Nasiriya City, South of Iraq.

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***Abstract*— In the current study concentrations of some air pollutants included total hydrocarbons (THCs) and particulate matter (PM10) were estimated. Samples were collected monthly from January to December 2020 in five stations in AL- Nasiriya City. Stations 1, 2, 3, and 4 were located at industrial, commercial, and residential areas, respectively, while the fifth station was located in a rural area. The Horiba Mobile Laboratory monitored air pollutants was used in the study for the estimation, it contains a mobile ambient air quality monitoring system. The results showed a variable concentrations of THCs and PM10 among seasons and stations during the study period. The highest value was found in Station 3 for THCs, while the highest concentration for PM10 was in stations 2, 3, and 4, respectively. Moreover, the results showed variable AQI values in all stations of the study for PM10. In general, all concentrations of PM10 were above the WHO and Iraqi standards.**

***Keywords*: air pollutants, air quality index, THCs, PM10, Al-Nasiriya City**

I. INTRODUCTION

Pollution is defined as the introduction of substances, directly or indirectly, from human activities, into the environment, water, air, and soil, which leads to harm to public health and environmental quality (Farmer, 2013). Air pollution can be defined as the presence of certain substances in the atmosphere at concentrations that may cause undesirable effects on humans and the environment. Among these materials are gases, including nitrogen oxides, sulfur oxides, carbon monoxide and hydrocarbons, particles (dust, smoke, fumes and aerosols) and radioactive materials. Most of these substances are in low concentrations and naturally available in the atmosphere and are usually harmless (Admassu and Wubeshet, 2006).

Pollutants are available in many forms, solid particles, liquid droplets, or gases. These are either natural or added by human and are also classified as primary or secondary pollutants. The primary pollutants are produced directly, such as ash or gases from car emissions. Secondary pollutants interact with other components or primary pollutants, such as ozone gas (Choudhary and Garg, 2013). Industrialization, population increase, urbanization, human activities, and deforestation are among the main causes of environmental pollution. This may lead to environmental changes that are harmful to living organisms. The main air pollutants are the smoke emitted from vehicles and factories, such as chlorofluorocarbons, nitrogen oxides, carbon monoxide, and dust particles (Tyagi et al., 2014). Outdoor air pollution is one of the biggest environmental problems that threaten human health and consequently human life globally. The world health organization recorded 4.2 million deaths annually in 2016 due to outdoor air pollution (WHO, 2018).

Many developing countries suffered from air pollution; Iraq is one of these countries. Vehicles, trucks, and power plant stations are the main sources of air pollution in Iraq. Also, burning oil and natural gas are considered air pollution sources (Kadhem et al., 2017). Hence, the current study aims to estimate the concentrations of total hydrocarbons THCs and particulate matter PM10 in the air in Al-Nasiriya City. Furthermore, to find out the spread of pollutants in the City and comparing it with the available local and international standards.

II. MATERIALS AND METHODS

A. Area of the study

The present study was conducted in the city of Nasiriya. The city is located in the south of Iraq, it is in the center of Thi_Qar province. Nasiriya City is a crowded city with 588121 people, a congested and commercial city. Samples were collected from five stations distributed in different areas (industrial, commercial, residents, heavy traffic, and rural area) from January to December 2020 (Figure 1). All sites of the stations are shown in Table 1.

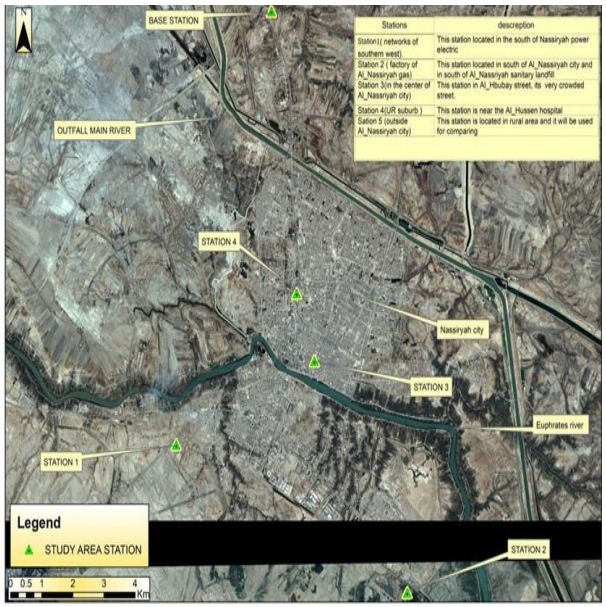

Figure 1. Study station in Al-Nasiriya City, south of Iraq

Table 1. Description of the study sites

Sites	Description of the sites
St_1 (southwest electricity networks directorate). **N: 31 01 44.14** **E: 46 12 24.12**	**The station is located in the southeast of AL-Nasiriya power station.**
St_2 (near the Thi_Qar oil refinery). **N: 30 59 41.19** **E: 46 13 37.72**	**The station is located in the south of AL-Nasiriya City and near the Thi_Qar oil refinery. As well as it is located in the west of the AL- Nasiriya landfill.**
St_3 (Al-Haboubi Street). **N: 31 02 31. 17** **E: 46 15 44.88**	**This station is located in Al_Haboubi street. A very crowded street and it is the center of AL-Nasiriya City.**
St_4 (UR district) **N: 31 03 36.66** **E: 46 14 51.39**	**The station is located near the Al_Hussain hospital. The hospital is located in a corroded street in the AL-Nasiriya City.**
St_5 (rural area). **N: 31 07 34.38** **E: 46 14 15.12**	**The station is located in a rural area, and it was selected for the comparison.**

B. Instruments

Horiba Mobile Laboratory was used in the present study. The laboratory contains a mobile ambient air quality monitoring system (pictures 1 and 2). Total hydrocarbons and particulate matter PM10 were measured using the following instruments.

- Ambient THC Analyzer – APHA-370
- Ambient Dust Analyzer – APDA-372

Pictures 1 and 2: Ambient air quality monitoring system.

III. RESULTS

The results of the present study indicated that there were seasonal variations of total hydrocarbons THCs and particulate matter PM10 in the selected stations in Al-Nasiriya City.

For THCs, the highest concentrations mean was in Station 3 in the spring season, it was 3.89 ppm and the lowest concentration mean was in Station 5 in the same season with a concentration of 2 ppm. Simultaneously, the mean concentration was 2.52 ppm during the study period (Figure 2).

For particulate matter PM_{10}, Station 5 was observed to have the lowest concentration mean with 64 ppm in winter season; the highest concentration mean 345 ppm was at Station 2 in summer season. In contrast, the mean

concentration during the study period was 195.95 ppm (Figure 3).

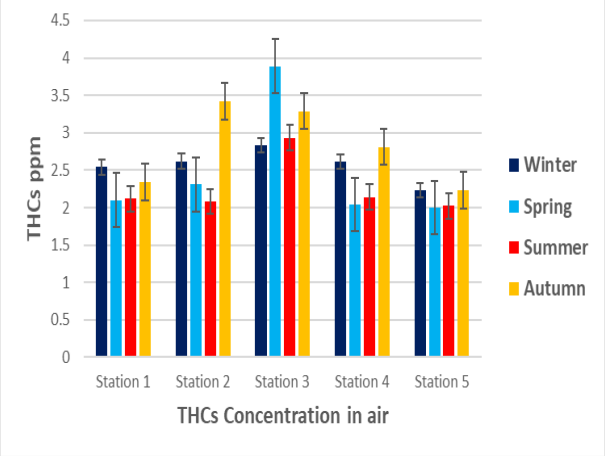

Figure 2. THCs concentrations in air (ppm) for four seasons in five selected stations in Al-Nasiriya City, south of Iraq.

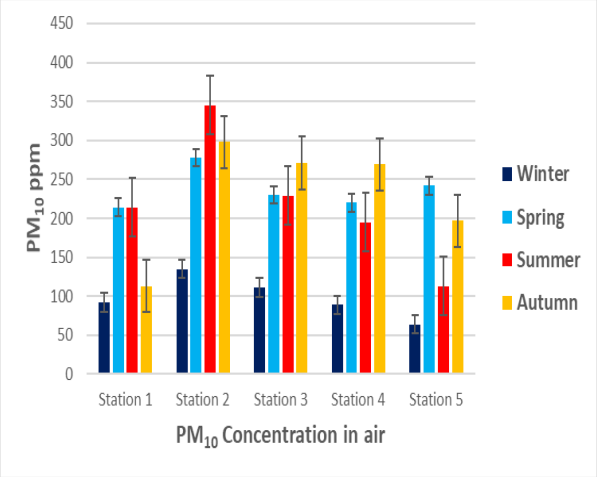

Figure 3. Particulate matter PM_{10} concentrations in air (ppm) in the five selected stations among seasons in Al- Nasiriya City, south of Iraq.

IV. Discussion

The results of the current study for THCs and PM10 seasonal concentration are presented in Table 2. It is clearly shown that the highest concentrations of THCs' was recorded at Station 3 in the spring season with 3.89 ppm. This was because this station is located in an area with heavy traffic with high commercial movement. In addition, it is located in approximately closed and crowded area. This lead to light breeze which has a weak impact on the dispersion of pollutants and consequently increases the pollutant concentrations in the selected area. Figure 4 shows that the wind speed is low in the third station, this due to the many buildings distributed near the station. On the other hand, the lowest concentration of THCs was 2 ppm and it was at Station 5 in the spring season, which is a rural area. These results have no agreement with Ziyadi (2010). In his study (Ziyadi (2010))about The effect of vehicle exhaust on air pollution in the city of Amara. The results of the present study are also not consistent with Al-Hassen et al., (2015) during their study of spatial analysis on the concentrations of air pollutants in Basra Province, southern of Iraq.

Statistical analysis showed significant differences among stations, the highest concentration differences were at Station 3 at $P<0.05$, while there were no significant differences among seasons. However, there was a negative correlation between THCs and wind speed at $p<0.01$.

For particulate matter PM10, the highest concentrations mean was 345 ppm at Station 2 in the summer season. This is because this station is located near the Thi- Qar oil refinery in the southeast of the AL-Nasiriya electric power station. Both (Thi- Qar oil refinery and Al-Nasiriya power station) emit a huge amount of polluted gases during their work. Therefor they can be considered as one of the particulate matter pollution sources. However, the lowest was 64 ppm at Station 5 in the winter season, this station was in a rural area. Generally and noticeably, all results of PM10 were above the WHO and Iraqi standards (Table 3).

The results of the present study agree with (Kinney et al., 2011) when they performed their study about PM10 in Nairobi, Kenya. Moreover, the results are consistent with (Hashim et al., 2021) during their study in Baghdad.

Statistical analysis showed that there were a significant differences among stations. The highest concentration differences were at Stations 2 3 and also, there were differences between seasons at a level of $p<0.05$.

The AQI index is an indicator which used to determine the degree of pollution in a city or pollutant source. This index is allowed to compare for primary air pollutants. These air pollutants are including PM, O3, SO2, NOx, and CO (Guttikunda, 2010).

For the mean of $P.M_{10}$ values, the AQI ranged from 86 to 155 for the five selected stations during the study period. Station 5 recorded the lowest AQI value which was 86, this is in the category moderate and the highest AQI value was at Station 2 with 155, this is in the category of unhealthy. Stations 1, 3, and 4 recorded 116, 128, and 120 respectively. All these values are in the category of unhealthy for sensitive groups at AQI index (Table 3).

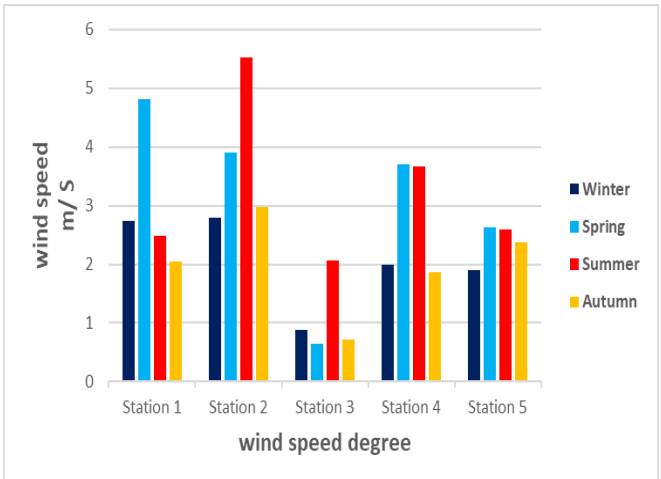

Figure 4. Wind speed in m/s of the selected five stations in Al-Nasiriya City, southern of Iraq.

Table 2. The THCs and PM10 concentration comparison

Gases pollutants	WHO standard µg/m^3	Iraqi standard µg/m^3	Stations				
			ST1	ST2	ST3	ST4	ST5
THCs			2.27	2.60	3.23	2.40	2.12
PM_{10} µg/m^3	20 µg/m^3 annual 50 µg/m^3 24 hour	50 µg/m^3 annual 100 µg/m^3 24 hour	186.2	264	209	193.2	126

Table 3. Spatial variations of PM10 pollutants according to the AQI with WHO and Iraqi Standard.

Gases pollution	Stations	Mean values µg/m^3	AQI Values	Levels of health concern	AQI standard
P.M_{10} µg/m^3	1	186.2	116	Unhealthy for sensitive groups	101-150
	2	264	155	Unhealthy	151-200
	3	209	128	Unhealthy for sensitive groups	101-150
	4	193.2	120	Unhealthy for sensitive groups	101-150
	5	126	86	Moderate	51-100

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