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Air Pollution Evaluation in Dohuk City Road Urban CBD Area

Dr. Abdulkhalik A.M. AL-Taei
Assistant Professor/Transportation Engineering, Mosul University/College of Engineering/Civil Dept., Iraq

Abstract

In this study, the air pollution problem is evaluated in Dohuk City by collecting a lot of data concerning air pollution main gases found in the environment of Dohuk City was collected around the urban area of the city presented by some GIS maps for the city during a period of ten months. Gas classes considered in this study are both carbon monoxide, CO, and sulphur dioxide SO_2, as they are the most two hazardous types of gases threatening human life and causing usually a lot of diseases coming from traffic vehicle emissions. Study area is including the 43 geographic traffic zones to which Dohuk City Urban Area was divided by its Municipality Directorate. Data collection in this study is including the measurement of CO, and SO_2 concentrations using a certain measuring instrument called WASP-D_4 Gas Analyzer a Multi-Gas Detector. Gas concentration measurement included all the geographic area from which Dohuk City Infrastructure is composed. Data analysis was conducted by plotting both graphs, and GIS Maps showing each gas concentration variation, along three parts of average day out of ten month of data measurements. CO, and SO_2 are found to be very low in concentration at morning period until mid-day period, but then increases drastically especially CO after that up to midnight time. Maximum value of concentration of both gases are going to move like the average value in a similar trend, but not to pass the maximum recommended values limited by the Iraqi Ministry of Environment, or Kurdistan Region Local Standards.

Key word: Air Pollution, Dohuk, CO, SO2 Gases.

INTRODUCTION

Most of the people associated with air pollution are highly from visible sources, such as industries with tall stacks. This may include power plants, smelters, refineries, steel plants, pulp and paper plants, manufacturing plants and incinerators. The types of air pollutants released depend on the types of processes taking place at the plant. Industrial emissions aren't the only source of air pollution. Vehicle exhaust contains a number of gaseous and particulate pollutants including carbon monoxide, nitrogen oxides, particulate matter and unburned hydrocarbons. This emission source includes personal, as well as commercial vehicles (i.e., trucks, construction and agricultural equipment). The primary sources of residential air pollution including home heating, use of fuel-powered household tools (i.e., lawnmowers and snow blowers), recreational vehicles (i.e., snowmobiles and all-terrain vehicles), campfires, open burning of yard waste, and consumer products (i.e., cleaning products paints and inks).

Kusuma, M.R. (1999)[1], in his research developed a heuristic transportation-air quality study especially designed to achieve understanding of how congestion mitigation strategies applied to different types of land use developments, defined by transportation system characteristics, affect the improvement of emission-related air quality in the area. Land use developments are defined by four transportation system characteristics: land use type, land use density, traffic signal density, and through traffic volumes.

Jire.R. and others (2005)[2], examined the potential associations between exposure to episode of air pollution and alterations in semen quality. The air pollution, resulting from combustion of coal for industry and home heating in the Teplice District of the Czech Republic, was much higher during winter than at the other times of year with peaks exceeding US air quality standards of the tests conducted on adult persons. Routine semen analysis on male sperms during two classified periods as low and high exposure from ambient air pollution monitoring. Results from repeated measure analysis show a significant association between exposure to periods of high air pollution (i.e., at or above the US standards air quality limits), and the percentage of sperm with DNA fragmentation according to sperm chromatin structure assay (SCSA). The study concluded

that, exposure to air pollution to a long period of time may damage the sperm DNA structure and thereby the rates of male-mediated infertility, miscarriage, and other adverse reproduction outcomes.

Gordon C., and Barry P., (2008)[3] described the poor air quality in Britain that has negative effects on our health, our environment and our economy health effects include eye and throat irritation, breathing difficulties, and the aggravation of existing heart and lung conditions. Air pollution can also lead to people taking more medications, visiting their doctor or emergency room more often, being admitted to hospital more often, or even dying prematurely. For example, according to the provincial Health Officer, outdoor air pollution contributes to as many as 250 premature deaths was province every year and increases health care costs by an estimated as $85 million. Impacts on the environment range from smog in the air, to damaged plant tissues to the transfer of pollutants from the air to land and water. Economic impacts include potential losses in sectors such as tourism and agriculture. Poor air quality can also limit opportunities for economic growth. Outdoor air pollution has a number of components that vary in intensity according to their sources. They include Sulphur Dioxide, a gas produced from fossil, fuel combustion and natural sources such as volcanoes; volatile organic compound and nitrogen oxides, produced by combustion processes such as those in engines and furnaces. Both sulphur dioxide and nitrogen oxides can lead to acid rain. Nitrogen oxides and volatile organic compounds can also lead to production of ground-level ozone, one of the main ingredients in smog and one of the worst offenders in terms of its impact on human and environmental health.

2.2-Problem Definition:

Population increase and their high intent to own cars are the main causes of generating more traffic demand on the urban road networks and then more effluents from mobile as a source. Nowadays, Duhok City is dealing with an explosive growth in the car ownership and the personal utilization of his/or her car to execute trips is enormous. The population total number is less than double during the last fourteen years in the Dohuk City CBD and sub-urban areas composed of 43 citizen districts as given from the Dohuk City Census Directorate (4). Preferences in using the private cars increased the travel demand which caused rapid motorization in many countries around the world. Now, most people are highly dependent on the private car travel as a part of their freedom. This phenomenon was caused mainly due to the attractiveness of car and people like to drive privately. New roads are generating faster traffic and longer trips. More trips by car and higher vehicles-miles of travel led to more traffic congestion and caused the longer travel time and traffic delays, high fuel consumption of non-renewable energy resource and pollution. In addition to congestion, private motorization is also affecting the safety of the vulnerable road users, high consumption of fuel, and caused serious threats to the quality of human environment.

2.3-Purpose of the Study:

In order to perform an air pollution evaluation study in a highly congested popular and traffic city like Dohuk considered in Iraq and all other relative countries as a very beautiful and tourist attractive city in order mainly to give instructions of how to improve the general climate and living environment in it. The main purposes the author thinks that it should be satisfied from this study are:

- To estimate the emission level of each one of the toxic gases of CO, NO, NO_2, and SO_2 known to be produced from vehicle exhaust gases, and compare the different city traffic zones using the air pollution measurements;
- To compare maximum limits of the concentrations of each gas with the recommended level by the Iraqi Ministry of Environment, or Kurdistan Region Local Standards;
- To take opinion about the time period during a certain day when the gas concentration is going to increase and decrease;
- Monthly variation of the different gas type emissions when, and where within Dohuk City urban area;
- Using GIS technique for comparison of the concentration of different toxic gases, and to test the efficiency of this technique in the presentation of air pollution collected data;
- To study air pollution of different gases along Kurdistan Arterial Road which is the major road in Dohuk City, and how toxic gas production from traffic is going to vary;
- Time distribution of the concentration of different toxic gases on along this road; and
- Which one of the measured gases is going to be generated more along Barzan Arterial Road, and when, and where?

2.4 RESEARCH METHODOLOGY

In this study, a certain methodology was followed in order to satisfy all the goals for which the study has been designed. Figure (1) is showing the research method flow diagram and the different steps selected to reach the main study purposes.

Study area selected is including the whole infrastructure of Dohuk City shown in Figure (2) as a GIS Map prepared by Dohuk City Municipality Directorate (5). The map is containing 43 traffic analysis zones, and data collection included these analysis zone in data collection by gas analyser instrument during a period of ten months located within (2014-2015) for 24 hours' continuous observations reading. Readings taken were close to the data collected from Shorash Station related to Dohuk.

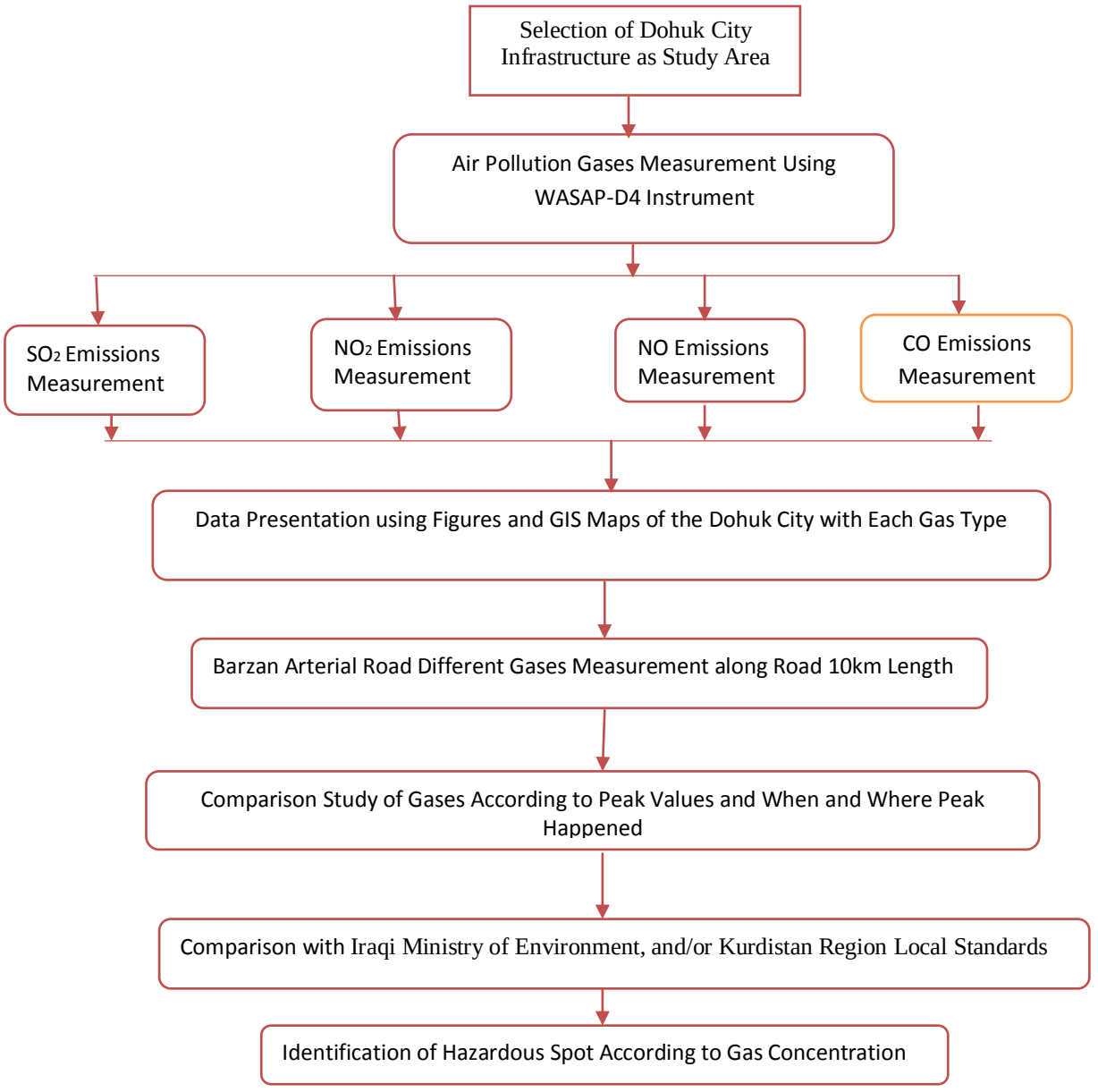

Figure (1): Research Work Flow Diagram

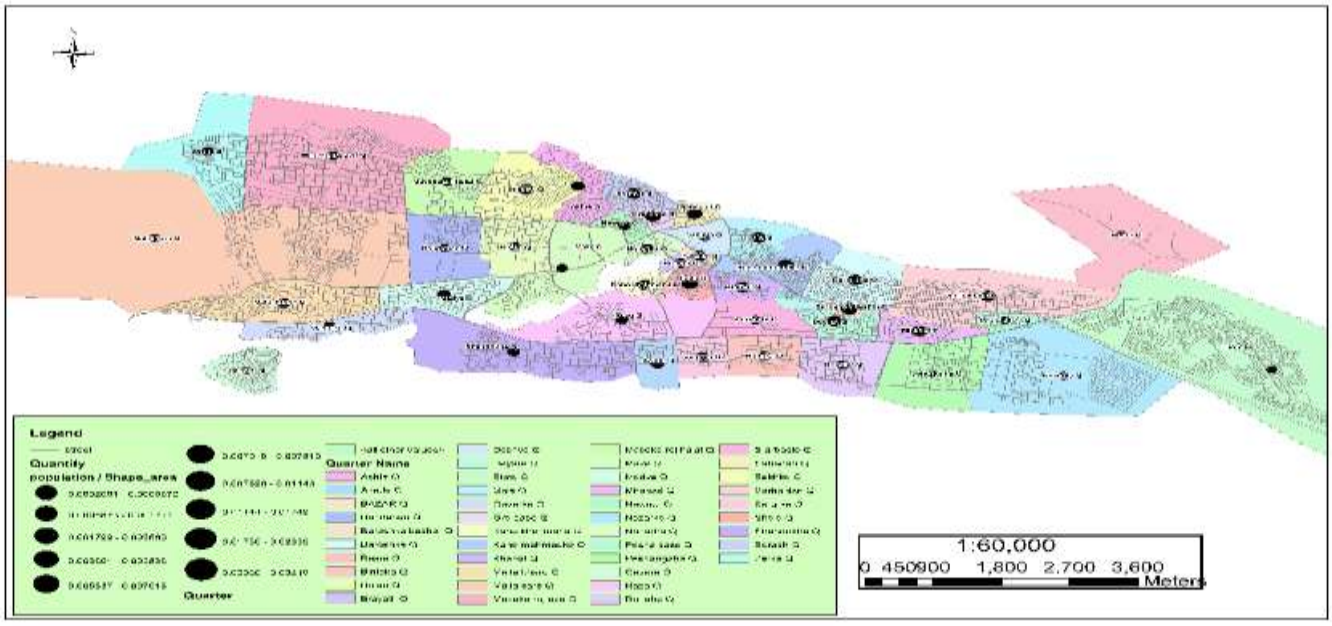

Figure (2): Dohuk City GIS Map Showing Research Work Study Area (5)

Environment Directorate data (6). Hundreds of gas concentration observations were compiled in order to understand how the variation of gas concentrations is going to happen, and when, and where dangerous concentration are probable to happen, and with which amount. In this study CO, and SO_2 are studied in detail, the other two gases could be found in the original study given by Nihely (2015)[7].

2.5-Data Presentation and Analysis:

According to the data collected in this study during a ten-month period during (2014-2015), showing the hourly variation of the concentrations of four main toxic pollutants usually found in the air of the city which are, CO, NO_2, NO, and SO_2. The following description is showing how each one of them is going to vary in concentration during the hours of a certain day plotted with Microsoft Excel Package Version 10(2014)[8]:

2.6-Hourly Variation of CO Pollutant in Dohuk City:

The first feature reflecting air pollution hazard in Dohuk City is the CO gas measured concentration. Figure (3), is showing the eight-hour period measurement of the CO gas, depending on their sources of data collection. The Figure showing that, CO variation is going to be less than average during night time from (00.00-8:00) A.M. then it is starting to increase more than average during the noon, and afternoon period to be more than average values. Maximum permissible value of the concentration of this pollutant in Kurdistan Region is 9.0 ppm measured for eight hours' period as shown in Figure (4-2), the obtained hourly concentration of CO gas is highly lower than this recommended value (2014)[8]. From this result, it could be concluded that, CO gas as highly hazardous pollutant is still under control in Dohuk City. Figure (4) is showing the maximum concentration of the CO gas as noticed in some places in Dohuk City. Figure (4) is going to give the same indication and variation of results of the lower values, but little higher during the period afternoon until midnight. The following GIS maps shown in Figures (5), (6), and (7) are showing the average values of CO air pollutant gas data obtained for ten months during the period (2014-2015) for all the Dohuk City Urban Area. The three maps showing that, CO concentrations are going to increase step by step from Morning up to Evening periods drastically, which is a dangerous phenomenon in this city.

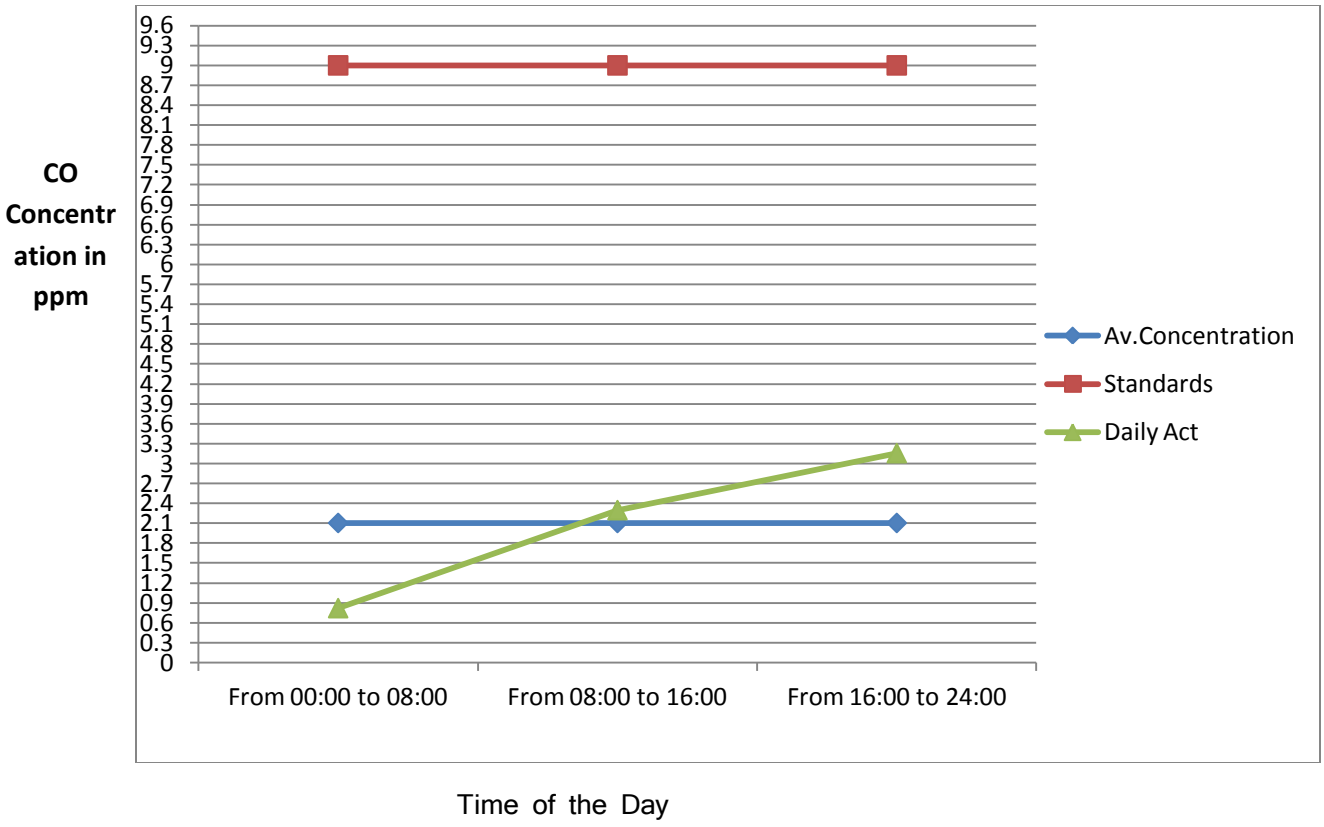

Figure (3): Average Measured Hourly Annual CO Gas Concentrations in Dohuk City during Ten Months Period in (2014-2015)

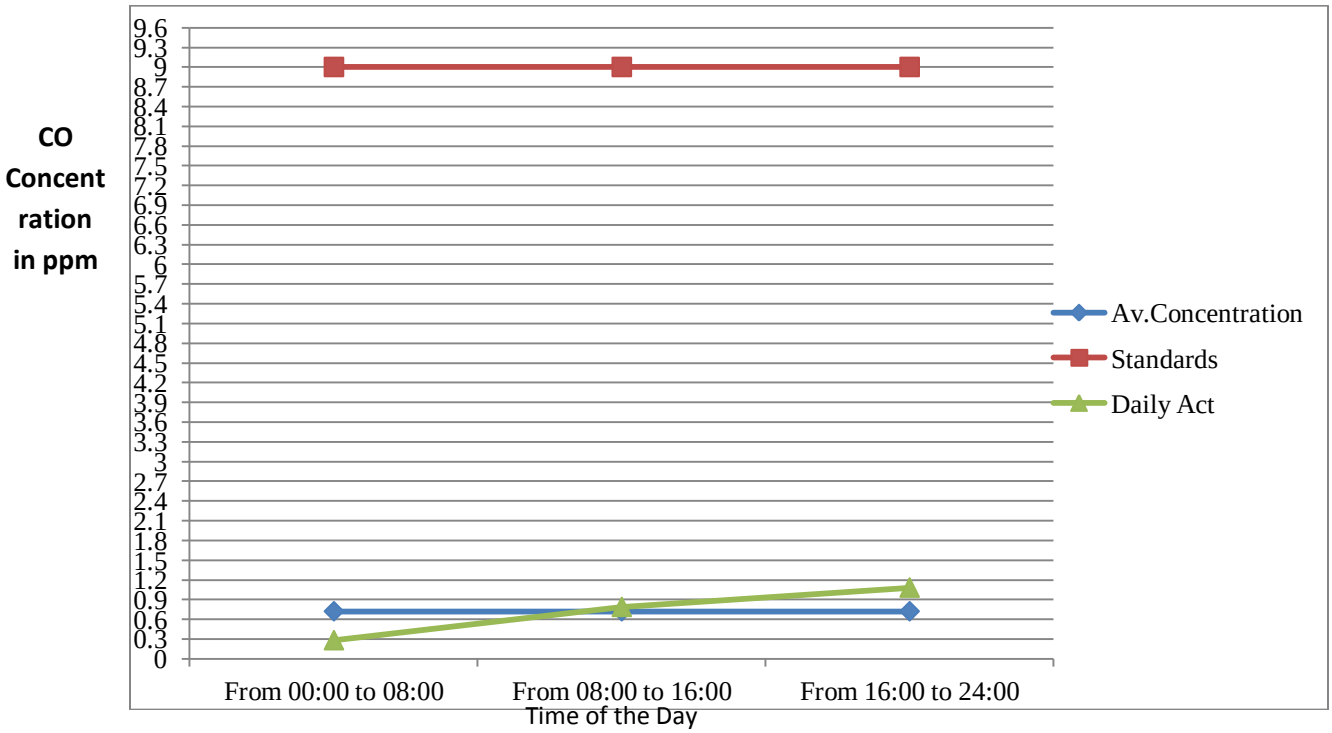

Figure (4): Maximum Observed Hourly CO Gas Concentrations in Dohuk City during Ten Months in (2014-2015)

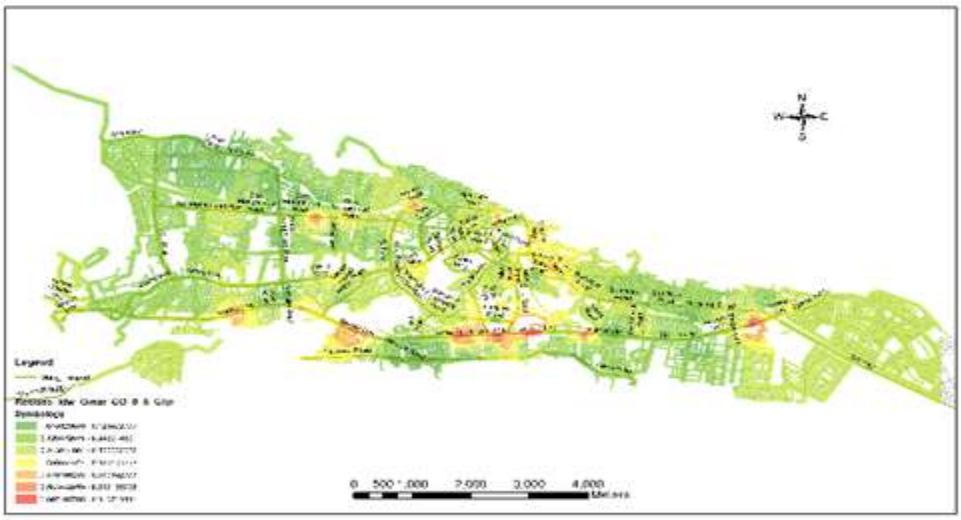

Figure (5): GIS Map for the Dohuk City Showing CO Pollutant Concentrations on Dohuk City Urban Area during the Period (00:00-8:00) at Morning

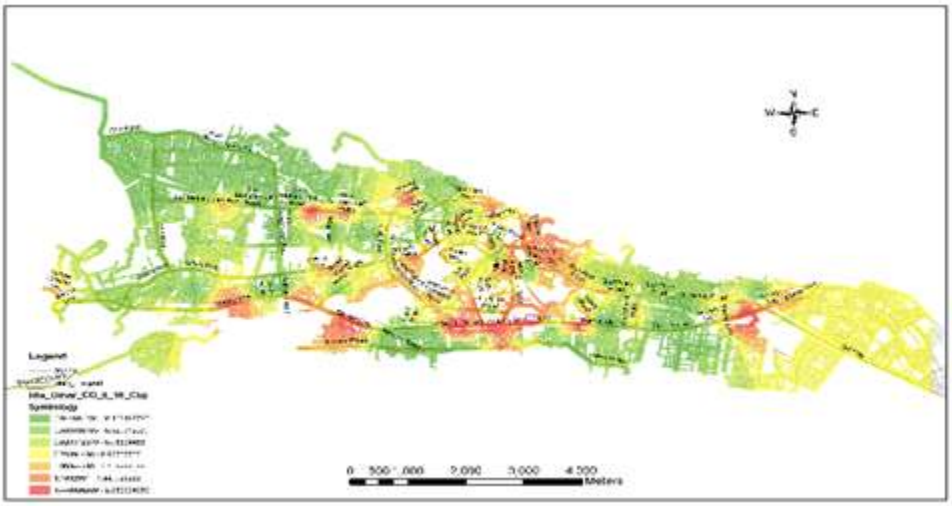

Figure (6): GIS Map for the Dohuk City Showing CO Pollutant Concentrations on Dohuk City Urban Area during the Period (00:08-16:00) at Mid-day

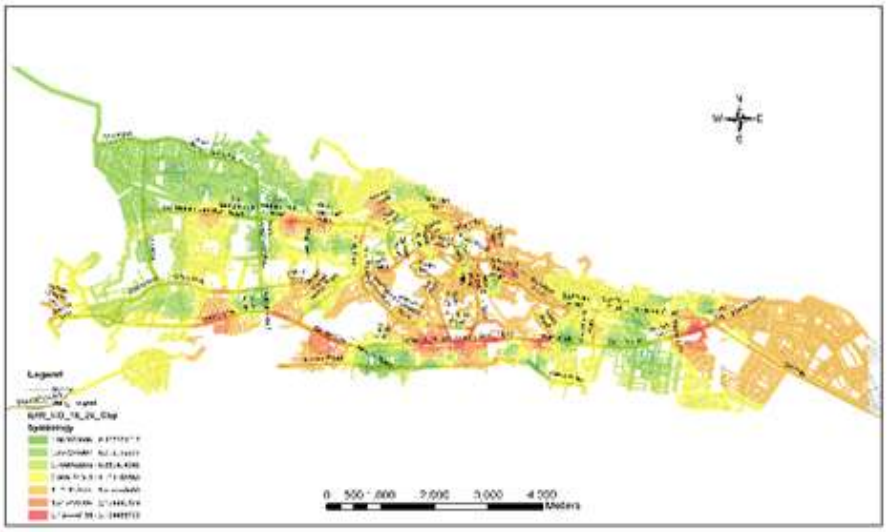

Figure (7): GIS Map for the Dohuk City Showing CO Pollutant Concentrations on Dohuk City Urban Area during the Period (00:16-24:00) at Evening

2.7-Hourly Variation of SO_2 Pollutant in Dohuk City:

The second parameter obtained out of the measurement of pollutant in Dohuk City in this study is the concentrations of a most dangerous gas produced due to traffic movement and their internal combustion engines, is SO_2. Figure (8) is showing how this gas is going to increase in its amount from mid-night period up to the end of the day. SO_2 trend in increasing along the day and night is looking like the other above three pollutants mentioned above. It is increasing at the first (8-10) hours at A.M period, then it becomes above the total average value for the last three years of data obtained for Dohuk City. After mid-day, it is going to increase above the average limit and still continuously increasing until midnight period. The values described in Figure (8) are not coming to overpass the maximum value recommended by (IMES), which is 0.03 ppm considering one year measurement period (2010)[9].

Sulphur dioxide occurs both naturally and as a result of man's activities. Sulphur dioxide is a colorless gas with a strong choking smell which easily dissolves in water to form sulphur acid H_2SO_4. It is relatively dense; about 2.5 times heavier than air as given by SEPA (2012)[10]. Maximum observed values of SO_2 gas concentrations in some hot spots shown on the map of the city in Figure (10) up to Figure (12) in red color is showing a similar trend shown in Figure (9) for the same SO_2 pollutant, which gives the same trend in the variation of the gas concentrations, but higher in values close to the maximum recommended especially at afternoon periods. The following GIS maps shown in Figures (11), (12), and (13) are showing the average values of SO_2 air pollutant gas data obtained for ten months during the period (2014-2015) for all the Dohuk City Urban Area. The three Figures are showing that, SO_2 concentrations are going to increase step by step from Morning up to Evening periods drastically, which is a dangerous phenomenon in this city.

2.8-CO Pollutant Variation along Barzan Arterial Road Length:

Carbon monoxide pollutant average concentrations measured in this study is plotted in Figure (13) plotted with Microsoft Excel Package Version 10. (2014)[8], to show how it is coming to change with the different segments of Barzan arterial road. Maximum values of this gas are taken to be presented in the Figure. Gas concentration is going to be low at the (00:00-08:00) A.M. period with low values at the beginning of the road, then it is increasing with increase in the length of this road up to (16:00-24:00) midnight period to obtain peak gas concentration values when distance amount is located between (4,000-6,000) meters. Values

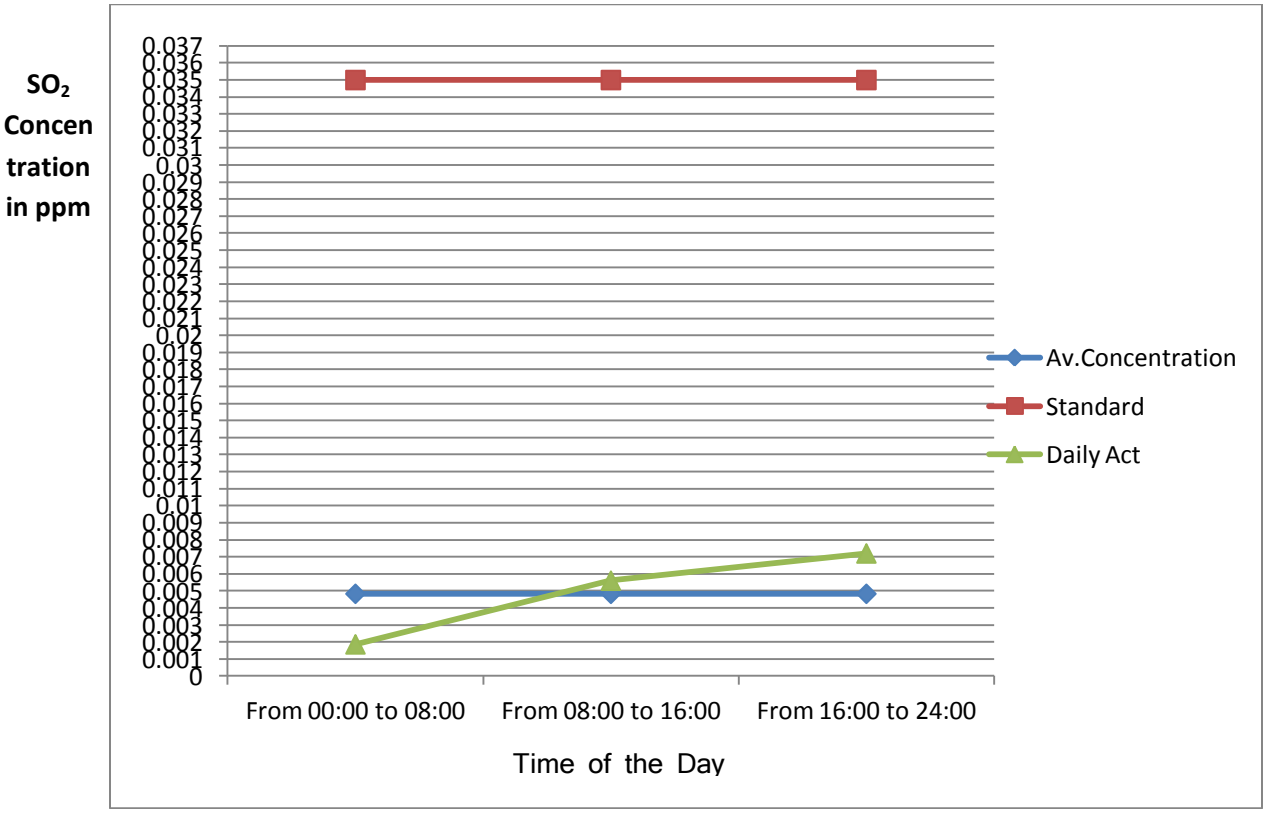

Figure (8): Average Measured Hourly SO2 Gas Concentrations in Dohuk City during Ten Month Period on (2014-2015)

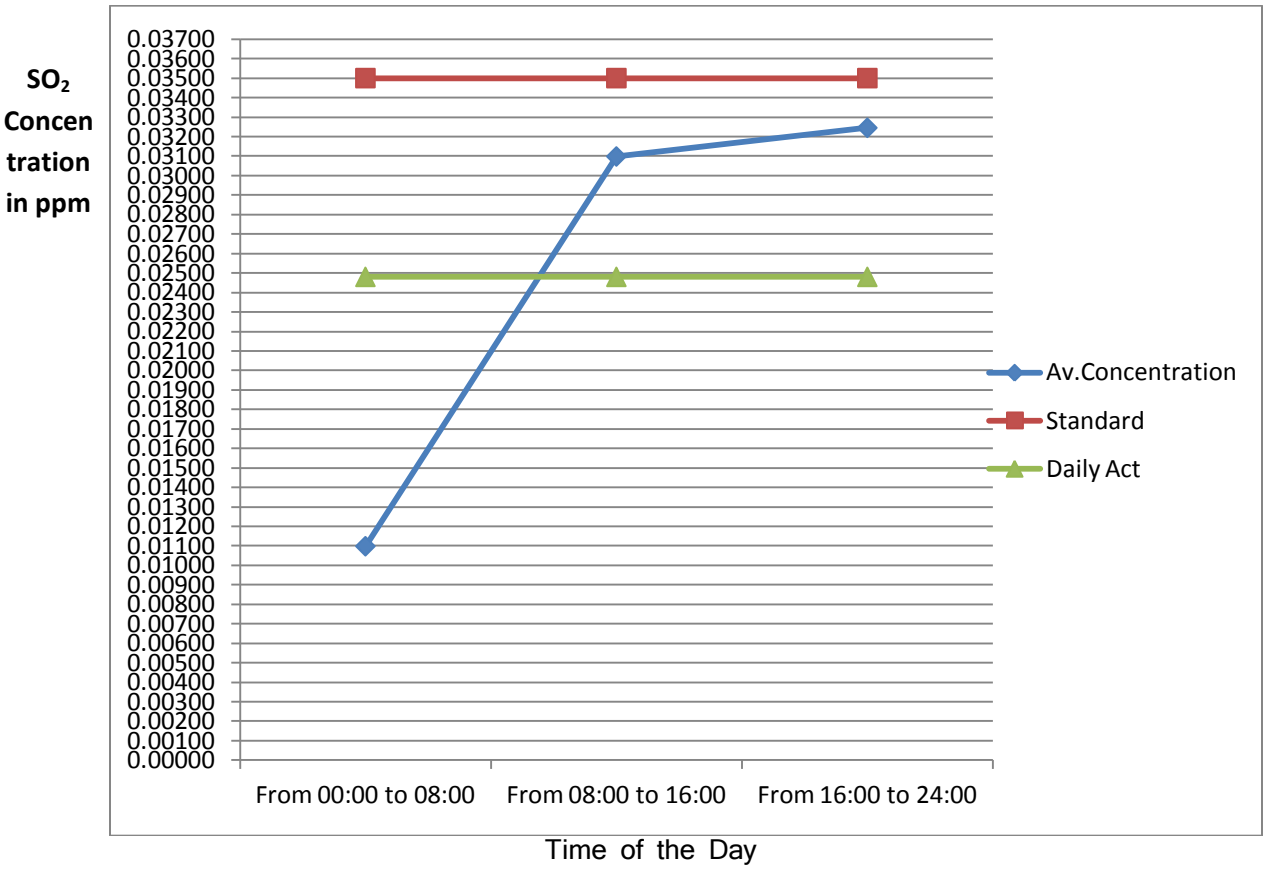

Figure (9): Maximum Observed Hourly SO2 Gas Concentrations in Dohuk City during Ten Months Period on (2014-2015)

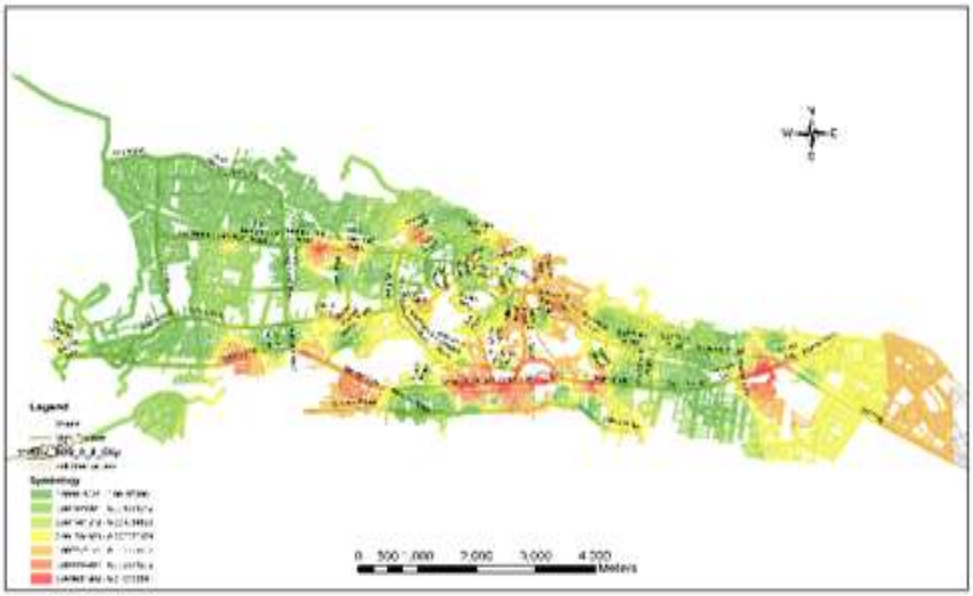

Figure (10): GIS Map for the Dohuk City Showing SO_2 Pollutant Concentrations on Dohuk City Urban Area during the Period (00:00-8:00) at Morning

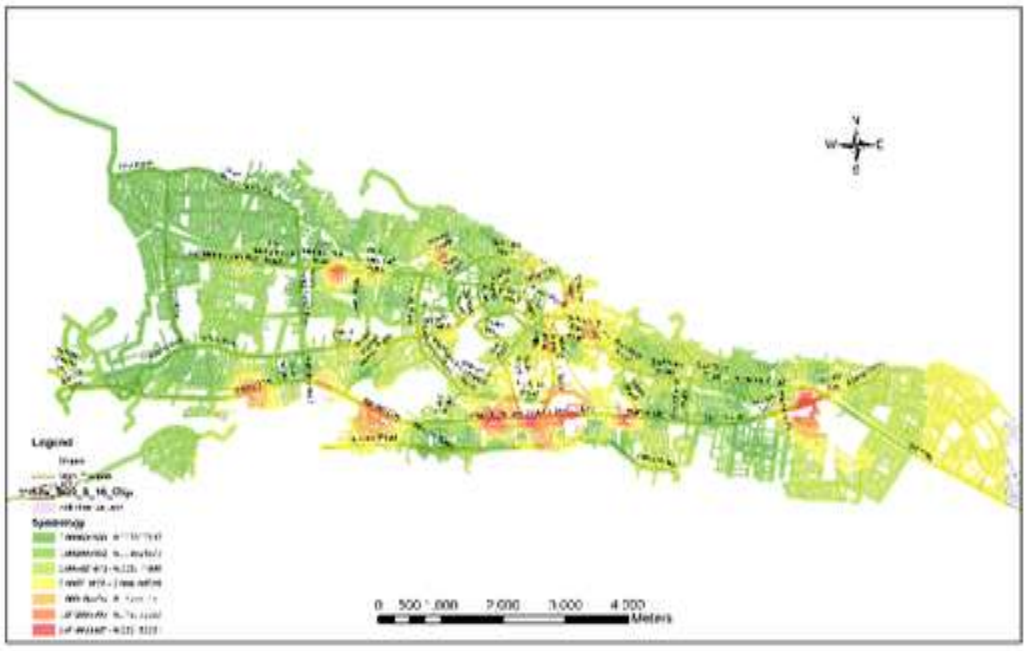

Figure (11): GIS Map for the Dohuk City Showing SO_2 Pollutant Concentrations on Dohuk City Urban Area during the Period (08:00-16:00) at Mid-Day Period

of CO concentration is shown in Figure (14) to decrease for all periods with the increase in road length of this road, especially after 6,000 meters' value of distance from beginning. Average values of CO concentration are following the same trend discussed above, but it is lower than both pollutant values obtained for the two periods from (8:00-24:00). The maximum obtained concentration value obtained of this dangerous gas is lower than the standard permissible limit of 9 ppm given above (2010)[9]. Figure (3) is showing the concentrations of this gas during the period from (00:00-8:00) in red color, meanwhile Figure (14) is showing that, the concentrations of this gas during the period (8:00-16:00) at mid-day period is maximum. It is shown from Figure (13) that CO concentrations on Barzan Road during this period is higher and distributed along a wider area than the other period as given in Figure (4).

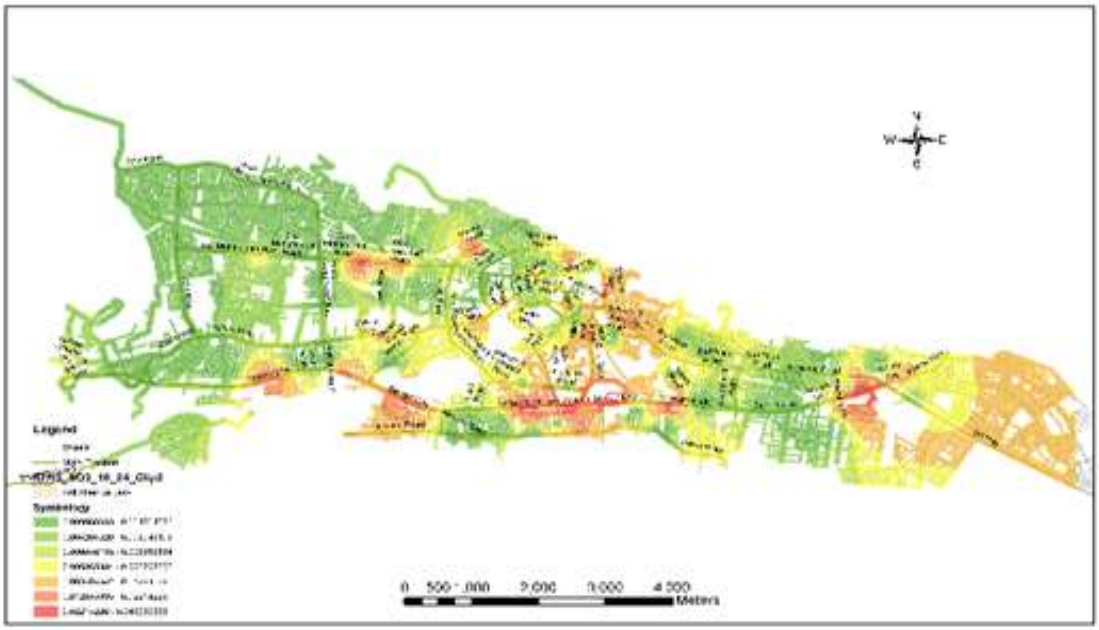

Figure (12): GIS Map for the Dohuk City Showing SO_2 Pollutant Concentrations on Dohuk City Urban Area during the Period (16:00-24:00) at Evening Period

2.9-SO_2 Pollutant Variation along Barzan Arterial Road Length:

Sulphur dioxide pollutant average concentrations measured in this study is plotted in Figure (14) to show how it is coming to change with the different segments of Barzan arterial road. Maximum values of this gas are taken to be presented in this Figure. Gas concentration is going to be moderate in value at the (00:00-08:00) A.M. period at the start length of the road, then it is slightly increasing with increase in length of this road up to (16:00-24:00) midnight period however, road length is increasing to obtain peak values of gas concentration at sections located between (3,500-5,000) meters. Values of SO_2 concentration is shown in Figure (14) to increase for all periods with the increase in road length of this road, especially after 3,500 meters' value. Average values of SO_2 concentration is following the same trend discussed above, but it is lower than both pollutant values obtained for the two periods from (8:00-24:00) hr. The maximum concentration value obtained of this dangerous gas is more than the standard permissible limit of 0.030ppm given by (IMES), especially at the section located between (4,000-5,500) meters during the hourly period from (8:00-24:00) hr which is a long-time period of subjecting to this dangerous gas during which most human activities are being executed (2010)[9].

CONCLUSIONS AND RECOMMENDATIONS

In this study, a lot of data concerning air pollution main gases found in the environment of Dohuk City was collected around the urban area of the city presented by some GIS maps for the city during a period of ten months. Out of the discussions, many conclusions are found interesting to be given here in this chapter for application, and further future studies, and/or updates. Conclusions drawn out from this study are given below:

1- CO pollutant variation is going to be less than average during night time from (00.00-8:00) A.M. then it is starting to increase more than average during the noon, and afternoon period to be more than average values, and the obtained hourly concentration of CO gas is highly lower than the recommended value, so it is under control;

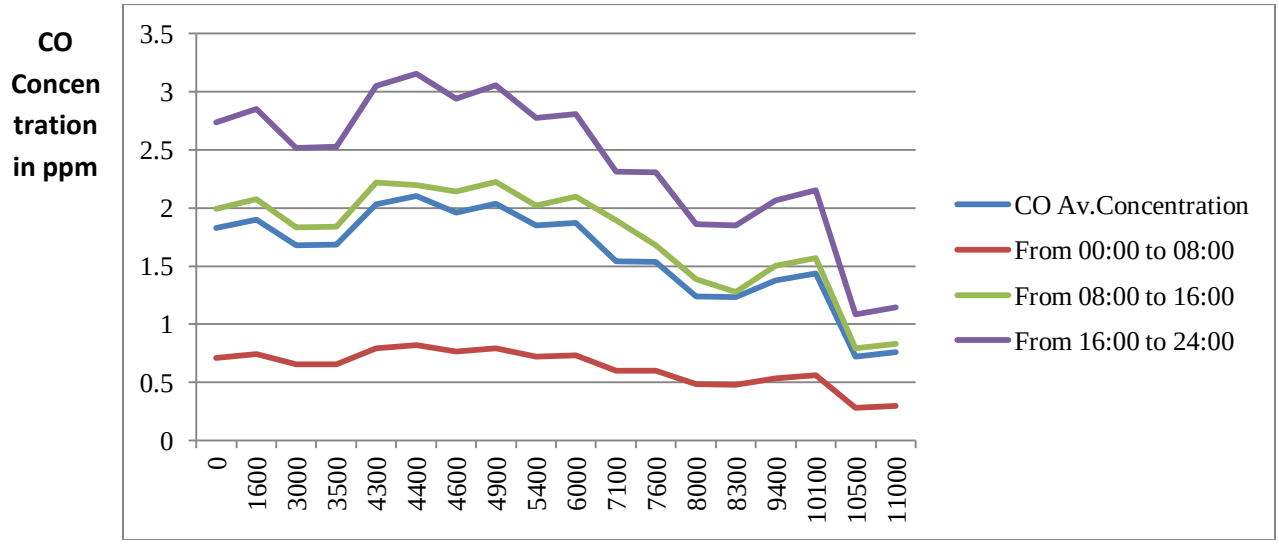

Figure (13): Maximum Observed Hourly CO Gas Concentrations on Barzan Arterial Road Located in Dohuk City during Ten Months Period on (2014-2015)

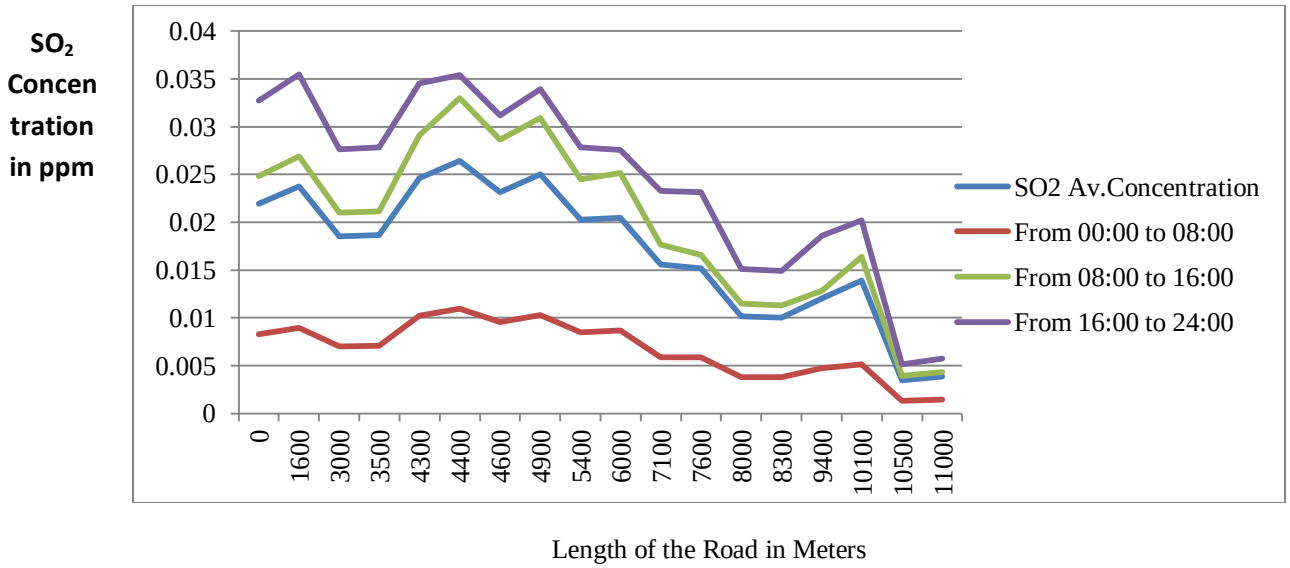

Figure (14): Maximum Observed Hourly NO2 Gas Concentrations on Barzan Arterial Road Located in Dohuk City during Ten Months Period on (2014-2015)

2- Maximum concentrations of CO pollutant are following the same trend as average value, but they still remain lower than Kurdistan Region recommended values of 9.0 ppm;
3- SO_2 is increasing at the first (8-10) hours at A.M period, then it becomes above the total average value for the last three years of data obtained for Dohuk City. After mid-day, it is going to increase above the average limit, and still continuously increasing until midnight period;
4- SO_2 values are not coming to overpass the maximum value recommended by Iraqi Ministry of Environment Standards, which is 0.03 ppm considering one year measurement period, but higher in values close to the maximum recommended, especially at afternoon periods;
5- CO gas concentration along Barzan Arterial Road is going to be low at the (00:00-08: 00) A.M. period with low values at the beginning of the road, then it is increasing with increase in the length of this road up to (16:00-24:00) midnight period to obtain peak gas concentration values when distance is located between (4,000-6,000) meters;
6- On Barzan Arterial Road, maximum CO concentration value obtained in this study of this dangerous gas is lower than the standard permissible limit of 9 ppm given above;
7- SO_2 gas concentration is going to be moderate in value at the (00:00-08:00) A.M. period at the start length of Barzan Arterial Road, then it is slightly increasing with increase in length of this road up to (16:00-24:00) midnight period however, road length is increasing to obtain peak values of gas concentration at sections located between (3,500-5,000) meters;
8- Maximum concentration of SO_2 value obtained of this dangerous gas is more than the standard permissible limit of 0.030ppm given above, especially at the section located between (4,000-5,500) meters during the hourly period from (8:00-24:00) hr which is a long-time period of exposure to this dangerous gas during which most human activities are being executed; and
9- CO which is the most hazardous gas is having the highest average values than the other three pollutants along the Barzan Arterial Road length from start to end. Concentration values occurring along the high ocncentration value periods mentioned above (i.e, after 8:00 hr A.M. period).

Some of the recommendations seem necessary to be reminded out of this study in Dohuk City are:

1- Data compiled out of this study is recommended for building a lot of emperical models related to the effect of different traffic, and geometric variables on the main roads in Dohuk City to put further sought decisions about the air pollution problem in this city;
2- Air pollution data base is recommneded to be built by DED for the Dohuk City to be updated from time to time and execute more evaluation studies about the air pollution problem threatening a lot of people living in this city as

original citizens, or tourists. More advanced air pollution system including well-trained staff, and up-to-date measuring instrumnetations;

3- Points of high concentrations of toxic gase found in this study recommneded to be deeply studied and sought decisions to be put to overcome more severe healthy problems in the future;
4- Fuel used by car engine should be more traeted to get more pure type without lead contents that produce some types toxic pollutants to environment such as high Octane Benzene with 95% content or more; and
5- Improvement of Dohuk City Infrastructure ,especiallt Barzan Arterial Road by changing the geometric design of most of the signalized intersections located on by installing new interchange overpasses ,and underpasses in order to remove ,or reduce at least traffic time delays , which are the main sources of delay.

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