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Seasonal Variations of Air Pollutants Concentrations within Baghdad City

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Abstract- *Air pollution is increased significantly nowadays due to various industrial activities and car combustion emissions. In this work, data have been collected from Al-Jadrya Monitoring Station (JMS). The effects of seasonal variation on the pollutants concentration were examined. Furthermore, relations of nitrogen oxides concentrations (NOx) were assessed during the first hours of the working days. Three randomly days from each of January, February, July and August have been taken to represent winter and summer seasons, respectively. It has been found that concentrations of all examined pollutants have not exceeded the acceptable limits. However, nitrogen oxides (NOx) seem to be effected by seasonal variation where its concentration has increased in June and August of the summer season. The concentrations of other pollutants (SO_2, CO, PM) have not been influenced by seasonal variations, and they depend on the gaseous source emissions at different times of the year. Hourly monitoring for nitrogen oxides (NOx) concentration showed increasing in concentrations during the summer season, especially in the early hours of the working days.*

Keywords- *Air pollution, Temperature, SO_2, CO, NOx, PM.*

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1. Introduction

The weather and local climate like sunshine hours, rain, air temperature and wind speed can affect air quality. It is well known that air pollution is changed hourly [1] depending on different variables such as weather pattern, location and quantity and quality of emitting pollutants. Air pollution is one human-made factor that is trapping sunlight and causing climate change and increasing levels of air pollutants. [2]. However, weather may have direct effects on air quality at a given location and it has been found that sunshine, rain, air temperature and wind play significant role on air pollution where sunshine makes some contaminants undergo chemical reactions, producing smog while rain washes out water-soluble pollutants and particulate matter and higher air temperatures speed up chemical reactions in the air [3-6]. Also, wind speed, atmospheric turbulence/stability, and mixing depth-affect the dispersal and dilution of pollutants. The wind transports air pollutants and causing them to disperse. In the higher wind speed, extra pollutants are dispersed, and the lower their concentration. Nevertheless, high wind can also create dust – a problem in dry, windy rural areas [7]. Surface inversions are responsible for producing smog, trapping the pollutants created by vehicles, fires and industrial activities [8-10].
Moreover, the hydrocarbons and nitrogen oxides existing in these trapped pollutants are transformed into harmful ozone by sunlight. The stratosphere's inversion traps pollutants in the constant layer, which is naturally occurs when greenhouse gases are injected high into the atmosphere by volcanic eruptions. Without the horizontal mixing providing by convection, these gases stay suspended in the inversion layer and cause a continuing influence on the global climate [11].
It is well documented that air pollution causes severe environmental and public health problems and various works have examined the impacts of all air pollutants and reported significant findings [12-14]. However, such effects on human are linked to pollutant concentration, exposure type (occupational and environmental), period (actuate and chronic), biological nurture and other environmental factors [15-17] and on the environment are related to pH, availability, ambient temperature, salinity and other chemical variables [18-21].
The current work was carried out to examine certain air pollutant obtained from Al-Jadrya

monitoring station within Baghdad city and to assess the possible effects of these contaminants on climate change.

2. Methodology

Data of nitrogen oxides (NOx), sulphate dioxide (SO_2), carbon monoxide (CO) and particulate matter (PM) measured hourly on daily base for 12 months are obtained from Al-Jadrya monitoring station (JMS) but only those of four months (January, February, July, and August) to represent winter and summer seasons were applied in this study as the main air pollutants. NOx concentrations which represent the summation of NO and NO_2 showed increasing in concentrations during January and June. NO emitted mainly from cars combustion then transferred rapidly to NO_2 and other secondary compounds in the presence of sunlight, in addition to the other sources of NO_2 emission, which lead to increase the concentration of NOx.

3. Results and Discussion

Figure 1 shows the mean concentrations of NO, NO2 and NOx measured during 8 months. It seems clearly that mean concentrations of nitrogen oxides were varied during all measuring periods. However, these data were within the acceptable limits (250 ppb).

Obviously, it seems that stagnant weather conditions have resulted in increasing NOx concentration, especially during the summer season. Figures (2, 3, and 4) represent SO_2, CO and PM concentrations, respectively. From these figures, it appears that these concentrations were not affected by the seasonal variation despite their concentrations were fluctuated and this may be due to the pollutants concentration emitted from different sources.

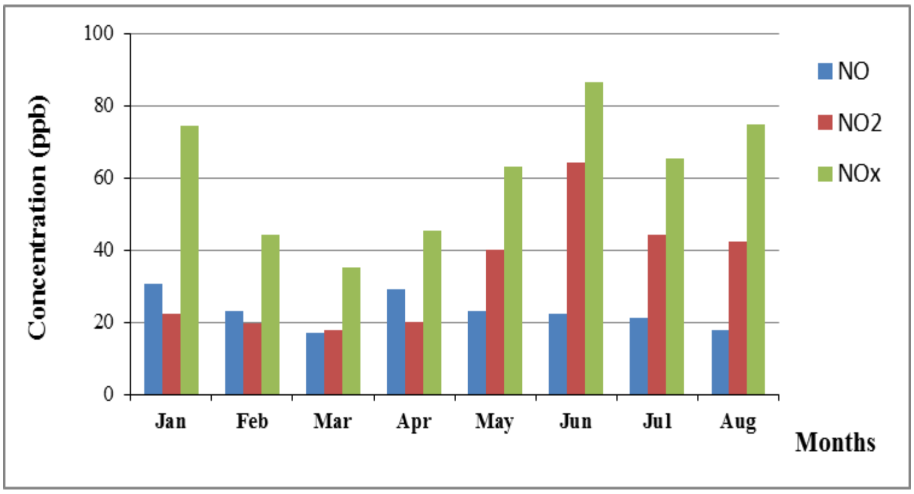

Figure 1: Monthly means of nitrogen oxides concentrations

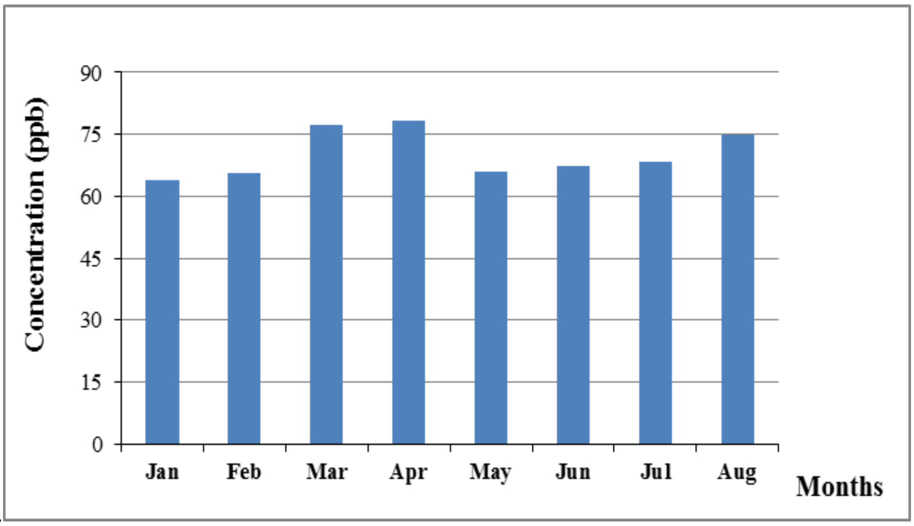

Figure 2: Monthly averages of sulphate dioxide concentrations

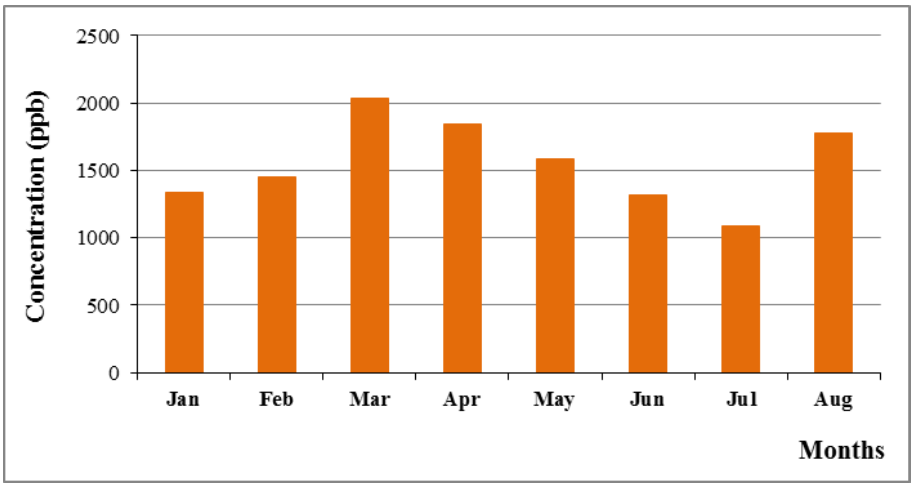

Figure 3: Monthly averages of carbon monoxide concentrations

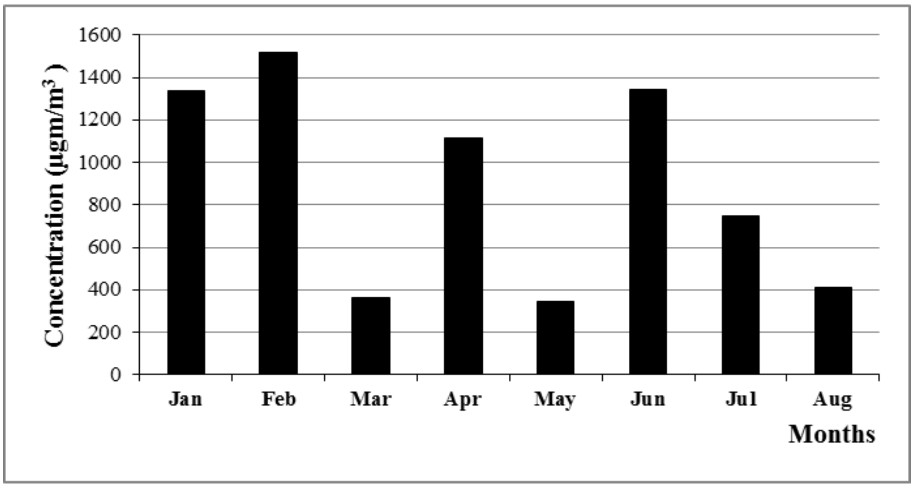

Figure 4: Monthly averages of particulate matter concentrations

January and February months have been examined as an indication for the winter season. General increasing in nitrogen oxides concentrations was shown in the first early hours of the working days and this may be related to an increased number of a used vehicle, while the other pollutants concentrations were fluctuated according to the using other sources of emissions. Although the increasing in NOx concentration but such increased, concentrations did not exceed 22 ppb for NO_2 gas. This value is lower than the acceptable limits for NO_2 emission which is 250 ppb .Increasing NO concentration has led to the generation of NO_2 gas even at small amounts and this may be due to the photochemical reaction as shown in Figure 5.

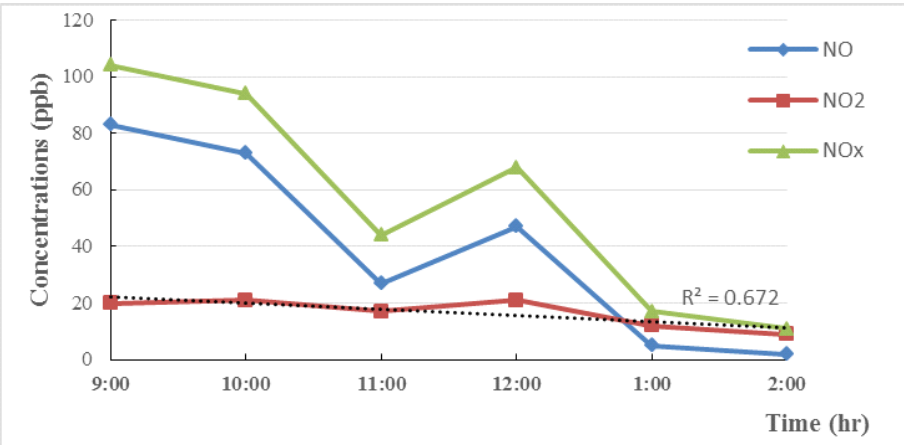

Figure 5: Nitrogen oxides concentration during day hours in 13th Jan. -2013 (a.m.)

Slight increasing in NO_2 concentration was shown at different hour times of the day due to other sources of NO_2 emissions like burning source in the surrounding area of the examined station. Furthermore, NOx concentration was suddenly reduced at 11 a.m. where this reduction may be attributed to several variables such as less traffic intensity, wind speed and direction, the efficient of the readings sensor as shown in Figures 6 and 7.

According to the Ministry of Environment report, there was a burning source in the period between 8 and 10a.m., which was reached to its maximum value at 11 a.m. due to the photochemical reaction as shown in Figure 8.

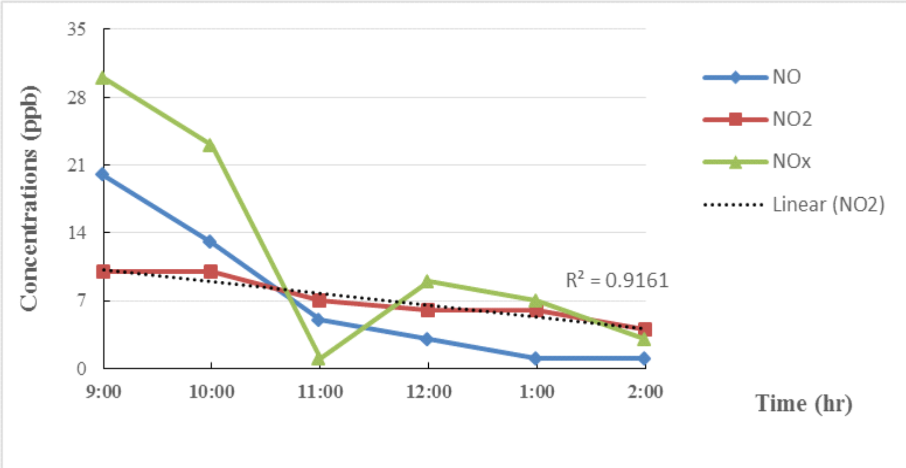

Figure 6: Nitrogen oxides concentration during day hours in 15th Jan. -2013 (a.m.)

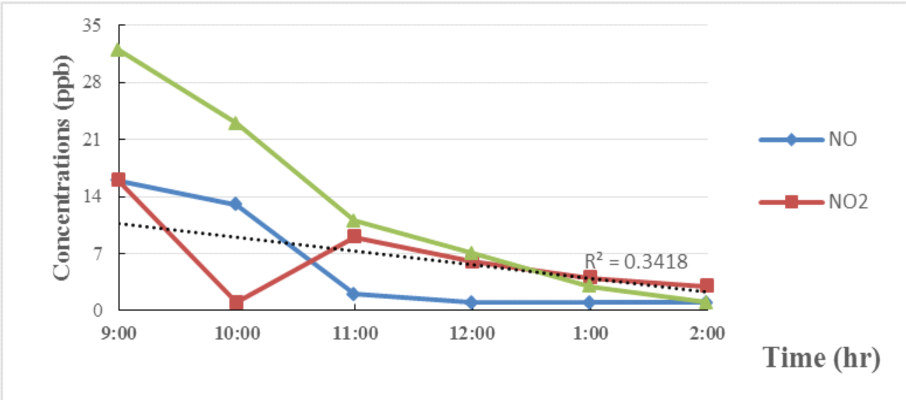

Figure 7: Nitrogen oxides concentration during day hours in 21st Jan.-2013 (a.m.)

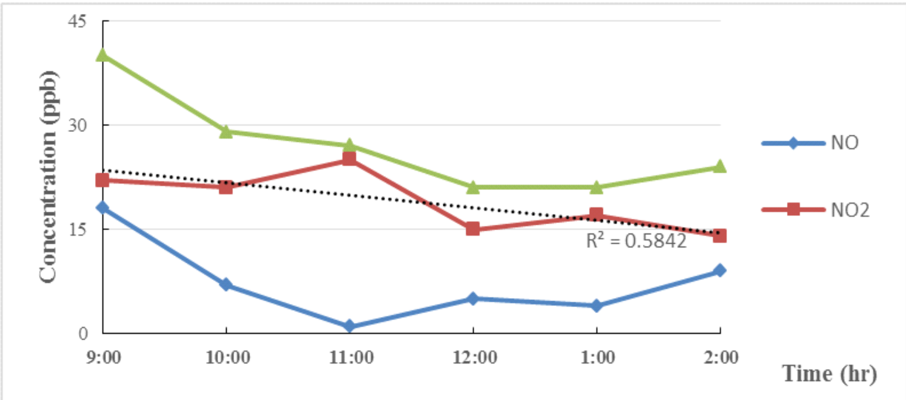

Figure 8: Nitrogen oxides concentration during day hours in 3rd Feb-2013 (a.m.)

NO_2 gas can be generated from gases produced by the electric generators, which led to an increase in the concentration on NO_2 gas at the first hours of the day, as shown in Figure 9. Furthermore, the sudden increase in NO gas may be linked to the last hours of the official working hours.

Winds movement and direction may also contribute to a sudden increase of NO concentration, as shown at

10a.m. in Figure 10. In this figure, the wind direction was north-west, mild to moderate and sometimes be active according to the Ministry of Environment report

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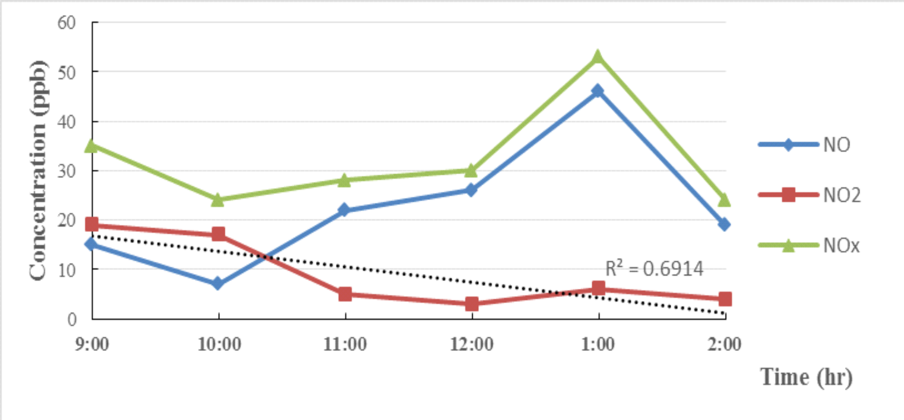

Figure 9: Nitrogen oxides concentration during day hours in 12th Feb- 2013 (a.m.)

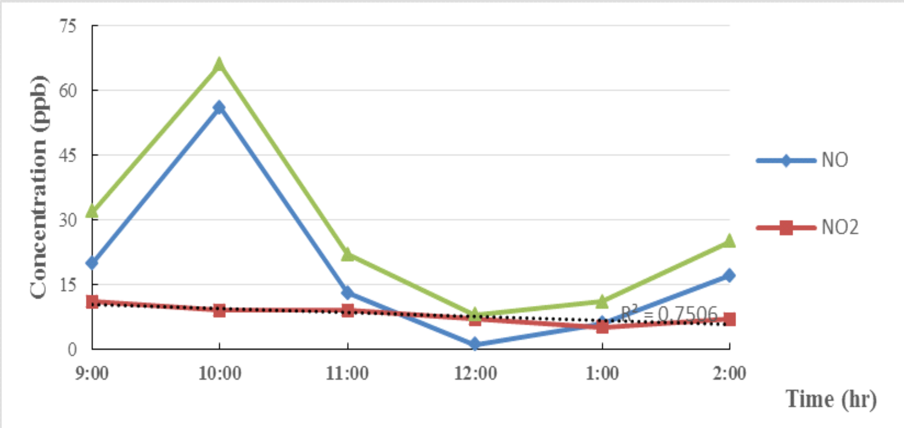

Figure 10: Nitrogen oxides concentration during day hours in 24th Feb.-2013 (a.m.)

In the summer season, stagnant weather conditions with low air movement and increasing ambient air temperature led to general increasing in NO_2 concentrations. These concentrations reached to more than 50ppb, which is less than the acceptable limits 250 ppb but more than maximum emissions in the winter season. Gases generated from reaction with sunlight, cars combustion, burning and other sources continued to be confined in the surrounding air of the source's emissions. Nitrogen dioxide concentration is sequacious with NO concentration as shown in Figure 11 which shows a general decrease in NO and NO_2 concentrations during the day hours.

The drop in NO_2 concentration is shown in Figures 12, 13, 14 and 15 during the period between 10 11 am, and this may be because of the relative reduction in traffic jams especially in this period which is considered to be a holiday for most schools and colleges. The increased concentration of NO_2 after this time can be explained due to increasing ambient air temperature, which increases the photochemical reaction.

In Figure 16, the reaction returned to its almost sequential form between NO and NO_2, in addition to other sources of burning expected to increase NO_2 concentration.

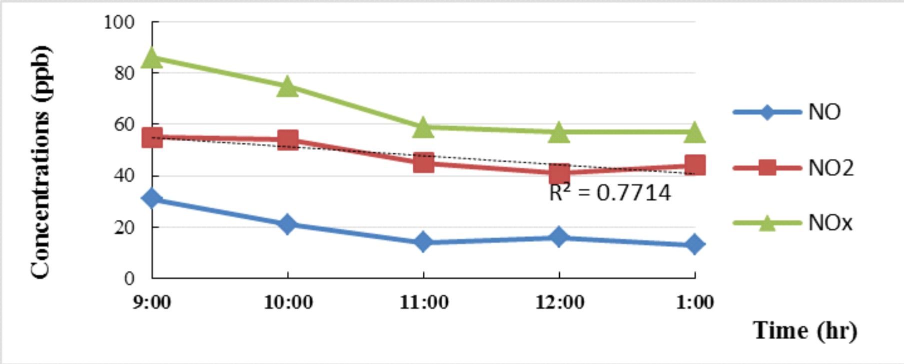

Figure 11: Nitrogen oxides concentration during day hours in 7th July-2013 (a.m.)

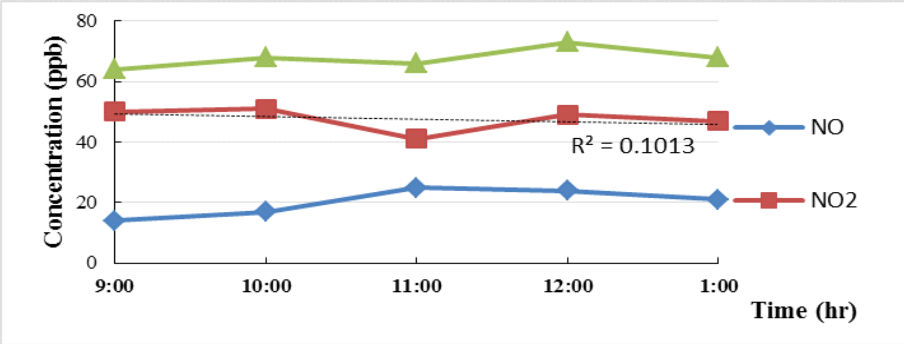

Figure 12: Nitrogen oxides concentration during day hours in 15th July- 2013 (a.m.)

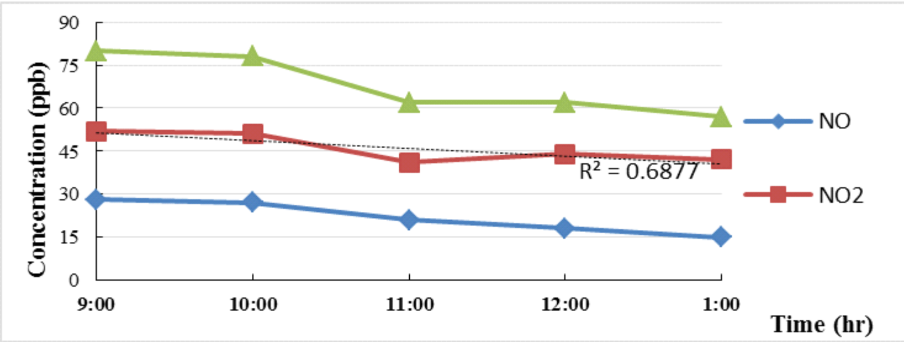

Figure 13: Nitrogen oxides concentration during day hours in 24th July-2013 (a.m.)

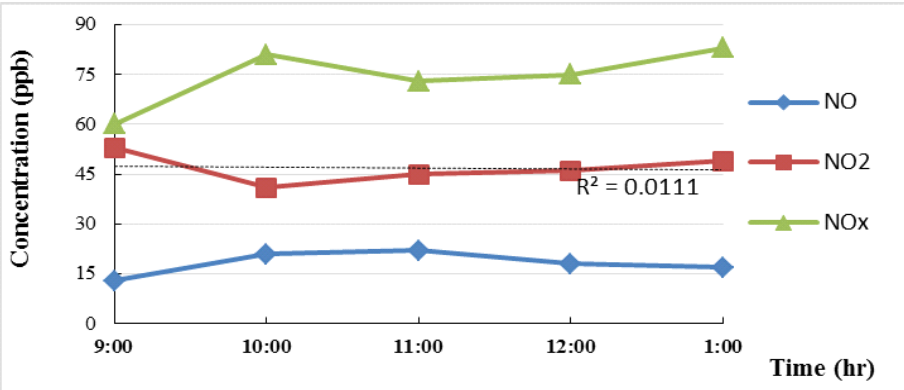

Figure 14: Nitrogen oxides concentration during day hours in 4th August- 2013 (a.m.)

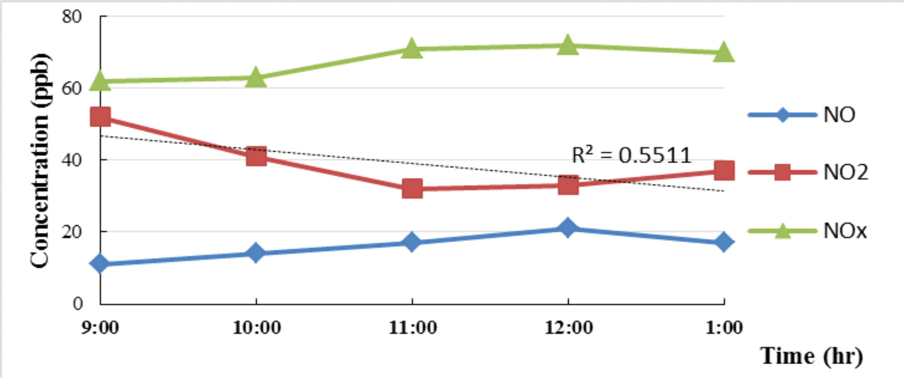

Figure 15: Nitrogen oxides concentration during day hours in 12August-2013 (a.m.)

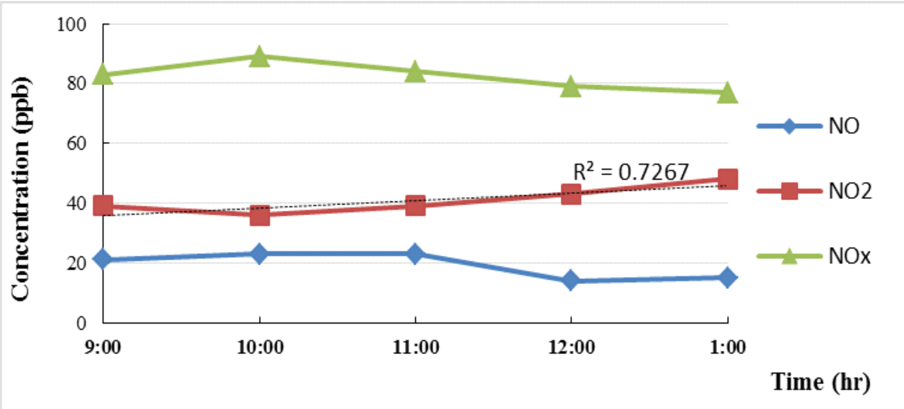

Figure 16: Nitrogen oxides concentration during day hours in 13th August-2013 (a.m.)

Apparently, cold temperatures and stagnant air have an approach of producing a build-up of these substances near the ground, mostly through a weather phenomenon called temperature inversions [22-23]. In other seasons, warm air sits near the earth, and the air can rise easily and transport away pollutants [24-25]. In a temperature inversion, cold air is trapped near the earth ground by a layer of warm air. The warm condition, air acts as a lid, holding down these substances. Throughout a temperature inversion, smoke cannot rise, and carbon monoxide can reach unnatural levels. Wind, rain and snowstorms are occasionally called scrubbers since they help clear out and disperse substances of concern. Most of the time in the winter, the ambient outdoor air quality in the fort air partnership air shed stays within worthy or low health risk ranges, as measured by the Alberta Air Quality Health Index (AQHI). If AQHI readings are increased in the winter, it is mostly as a result of the temperature inversion phenomenon. Concerning to the air pollution, the atmospheric layer stretches from an average of seven miles to 31 miles above the earth's surface. The stratosphere sits atop the troposphere, which is the lowest layer of the atmosphere and home to the majority of all weather. The stratosphere's temperature inversion impacts global, long-term air pollution [8-9]. Main health consequences of exposure to air contamination comprise an increased risk of heart disease and lung cancer [26-29]. However, the actual health impacts of air pollution would be affected by several factors such as exposure routes and types, pollutant chemical structure and concentration, health record and infection, gender, and age [30-32].

4. Conclusions

•Increasing in nitrogen oxides concentration was shown in January and Jun, which indicates the effect of seasonal weather condition on the photochemical reaction.

•Other seasons of the year showed fluctuated increasing in concentrations due to pollutants dispersion through air movement, which reduces the reaction.

•Pollutants like SO_2, CO, and particulate matter, seems not to be affected by seasonal variation. Concentrations are fluctuated according to the pollutants emissions from different sources like burning and cars fuel combustion.

•Winter season showed high variation in nitrogen oxides concentration, but the maximum concentration reached is 22 ppb, which is less than the maximum acceptable limits 250 ppb.

•Summer season showed less variation in nitrogen oxides concentration. Maximum concentrations reached to 50 ppb due to the photochemical reaction and increase in ambient air temperature.

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