

# **Air Pollutants Effects on the Environment of the Al-Durra Site in Aqaba City**

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**ABSTRACT:** This Air pollutant concentrations data including, Sulfur Dioxide ( $\text{SO}_2$ ), Particulate matter ( $\text{PM}_{10}$ ), Carbon Monoxide ( $\text{CO}$ ), and Nitrogen Oxides ( $\text{NO}_x$ ), measured in the year 2011 are presented, to compared the limits of the surrounding air as defined by Jordanian standards.

One site in the Aqaba border have been chosen with a view to making appropriate commendations to improve the air quality there on the one hand, and to considering both the environmental and economic aspects in the course of enduring development on the other.

It has also come out with the fact that sulfur dioxide and the particular matter  $\text{PM}_{10}$ , have exceeded the limits of Jordanian standards, where as carbon monoxide, nitrogen oxides, maintained, their low levels, with no record of violation of the Jordanian standard limits.

**KEYWORDS:** Concentration; Sulfur Dioxide; Carbon Oxides; Nitrogen Oxides;  $\text{PM}_{10}$ ; Jordanian Standard; Wind Speed; Wind Direction..

## **I. INTRODUCTION**

Al-Durra area is one of the border crossings between Jordan and Saudi Arabia. It is established in 1966, and it is locates on the shore of the Gulf of Aqaba between the Jordanian city of Aqaba, and the Haql town in Al-Juf field in Saudi Arabia. It is locates in the industrial area. The border crossing center is about 30 km from both Aqaba and Haql, and about 280 km from the Saudi city of Tabuk, figure1.

In this study, the level of air pollutions is checked for each of  $\text{SO}_2$ ,  $\text{PM}_{10}$ ,  $\text{CO}$ , and  $\text{NO}_x$ .

Sulfur dioxide is formed when fuel containing sulfur is burned and during metal smelting and other industrial processes [1, 2, 3]. High concentrations of  $\text{SO}_2$  can cause wheezing, shortness of breath, cardiovascular diseases. Together,  $\text{SO}_2$  and  $\text{NO}_x$  are major precursors to acidic deposition, such as acid rain, and accelerate corrosion of buildings and monuments [4, 5, 6, 7, 8].

Particulate matter is the general term used for a mixture of solid particles and liquid droplets found in the air.  $\text{PM}_{10}$ , the coarse particles, are generally emitted from sources such as vehicles travelling on unpaved roads [1, 4]. In addition to health problems (respiratory problems, asthma, decrease lung function, premature death),  $\text{PM}_{10}$  is the major cause of reduced visibility and can damage paints and building materials [1, 13].

Carbon Monoxide ( $\text{CO}$ ) is a gas with no color or smell. It emanates from the incomplete combustion interaction of hydrocarbon fuel. However, the main source of this gas is the traffic movement on road, especially the benzene – operating vehicles. In fact, the  $\text{CO}$  affecting danger on man lies in its potential of creating carboxyl hemoglobin in man's blood, which really causes man's blood inability to carry oxygen to his organs. As such, it exposes to further danger those people who suffer from the inefficiency of extending oxygen to heart and brain (e.g. patients of coronary artery) [8, 14, 15, 16, 17, 18].

Nitrogen oxides ( $\text{NO}_x$ ), the term used to describe the sum of  $\text{NO}$  and  $\text{NO}_2$ , play a major role in the formation of tropospheric ozone can also contribute to the formation of acid rain. Long-term exposures (e.g. one year) to nitrogen oxide concentrations may damage forest and vegetation [9]. Nitrogen oxides are formed in high- temperature

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combustion processes, mainly in petrol and diesel vehicles [19, 20, 21]. The pollutants have been checked in this study within the limits determined by the Jordanian standards of the ambient air (table 1) [22]. Those pollutants have been checked in the study within the limits determined by the Jordanian standards of the ambient air in the chosen site.

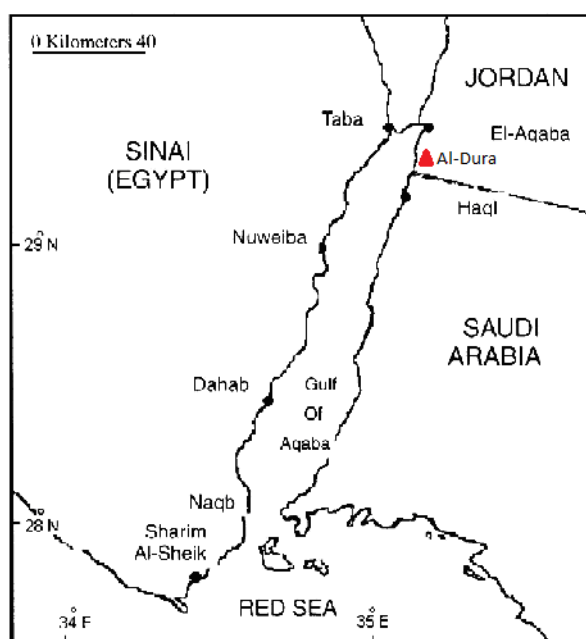


Fig. 1. Al-Durra Location Map.

## II. MATERIALS AND METHODS

The air samples are analyzed for CO concentrations using a Non-Dispersive Infrared. The SO<sub>2</sub> analyses are done using Ultra-Violet Fluorescence. The NO<sub>x</sub> analyses are done using analyser Chemiluminescence. The analyses equipments are calibrated using a Portable Calibration model that uses Permeation tubes.

The Wind speed and direction are measured at the site using a Metro-Unit. Additionally, meteorological data are collected at the Aqaba weather station. Wind speed, wind direction, ambient temperature, barometric pressure, are measured hourly. The meteorological data are being collected to permit correlation of pollutants levels and wind characteristics and to develop a database for future dispersion modelling application.

Assessment of the status of the air pollution is based on air pollution standards specified by new Jordanian standard (Table 1) published on 2006, No.1140.

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Table 1: Air Pollutants Concentration Limits in Jordan, Standard 1140/2006 (Jordanian Standards, 2006).

Pollutant	Average Exposure Time	Concentration Limit (ppm)	Number of Allowed Exceeds
SO <sub>2</sub>	1 hour	0.3	Three times within any 12 months
SO <sub>2</sub>	24 hours	0.14	One time within a year
SO <sub>2</sub>	Annual	0.04	-
CO	1 hour	26	Three times within any 12 months
CO	8 hours	9	Three times within any 12 months
NO <sub>2</sub>	1 hour	0.21	Three times within any 12 months
NO <sub>2</sub>	24 hours	0.08	Three times within any 12 months
NO <sub>2</sub>	yearly	0.05	-
PM10	24 hours	0.12	Three times within any 12 months
PM10	Annual	0.07	

## III. RESULTS AND DISCUSSIONS

### SULFUR DIOXIDE (SO<sub>2</sub>)

Figures 2 and 3 show the SO<sub>2</sub> the daily average and the daily maximum concentrations, respectively. The daily concentrations of SO<sub>2</sub> varied between 0.00048 and 0.053 ppm .These concentrations did not exceed the daily limit of the Jordanian SO<sub>2</sub> standards 0.14 ppm from January to December from 2011.

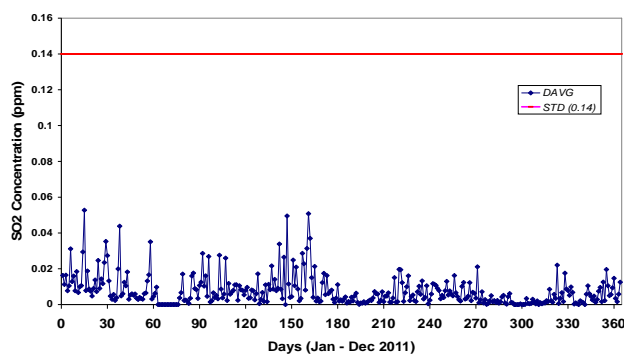


Fig. 2. Daily Averages Concentrations of SO<sub>2</sub>

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Figure 3. shows the max daily average that, the monitoring results of SO<sub>2</sub> in that year had registered SO<sub>2</sub>'s highest level of 0.374 ppm, and that 18 cases of exceeding the Jordanian standard limits 1140/2006 were, , i.e. 5.19%.

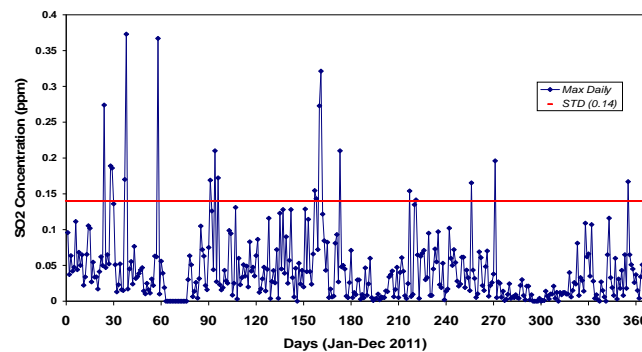


Fig. 3. Max Daily Averages Concentrations of SO<sub>2</sub>

Figure 4. shows the direction of wind distribution at the time of the daily exceeding of the Jordanian standards. This exactly clarifies the great pollution danger by SO<sub>2</sub> which the monitoring site is exposed to as north west has winds increased to 29 %, north winds to 21 %, East 13%, and South winds to 9 %. All together, those winds amounted to 72 % a very high degree of wind accumulation that permanently exposes the monitoring site to SO<sub>2</sub> pollution.

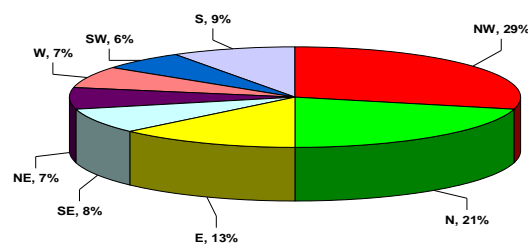


Fig. 4. Wind direction during days at which SO<sub>2</sub> daily average concentration exceeded JS limit.

Fig. 5. shows the wind speed distribution that prevailed during the study period, The excess to the maximum daily average, as defined by Jordanian standards, is recorded at the monitoring site, after being divided in seven speeds (0-1 knots), (1-2 knots), (2-5 knots), (5-10 knots), (10-15 knots), (15-20 knots) and bigger than 20 knots. It appears from the figure that the highest percentage of wind speed was 37%; (5-10) knot per hour, followed by the rate of 32 % percentage which is date to the speed (2-5) knot per hour. It was counted for 77% representing the speeds between 0 and15 knot per hour.

Thus it can be said that the wind speed that prevailed during the study period, were slow and medium speed, which caused a dust, in following paragraph.

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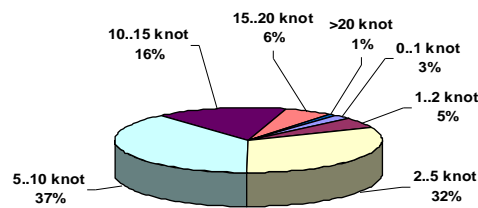


Fig. 5. Wind speed distribution at Al-Durra site

## PARTICULAR MATTER PM10

Fig. 6. shows the daily averages concentrations of PM10 that, the monitoring results of PM10 in that year had registered PM10's highest level of 0.82 ppm, and that 41 cases of exceeding the Jordanian standard limits were, i.e. 13.66%.

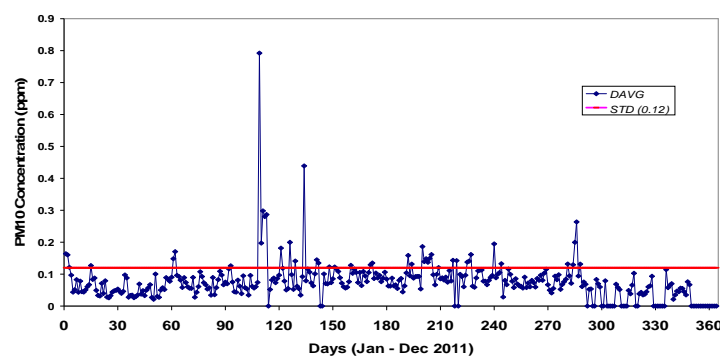


Fig. 6. Daily Averages Concentrations of PM10

## CARBON MONOXIDE (CO)

Carbon Monoxide is produced by the incomplete combustion of the fossil fuels – gasoline, fuel oil, coal and wood used in boilers, engines, oil burners, gas fires, water heaters, solid fuel appliances and open fires.

Dangerous amounts of CO can accumulate when as a result of poor installation, poor maintenance or failure or damage to an appliance in service, the fuel is not burned properly, or when rooms are poorly ventilated and the Carbon Monoxide is unable to escape.

Carbon Monoxide is probably the worst substance you'll come into contact with in your daily life (in your home, at work, garage, or car). Having no smell, taste or color, in today's world of improved insulation and double glazing it has become increasingly important to have good ventilation, maintain all appliances regularly and to have absolutely

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reliable detector alarms installed giving both a visual and audible immediately there is a build up of CO to dangerous levels.

Figures 7 and 8 show the daily averages Concentrations, and maximum 8-hourly concentrations of CO, respectively. The figures show that the concentrations have some peaks that most likely correspond to manufacturing activities, traffic, and weather conditions. The figures indicate that none of the Jordanian CO standards have been exceeded in 2011.

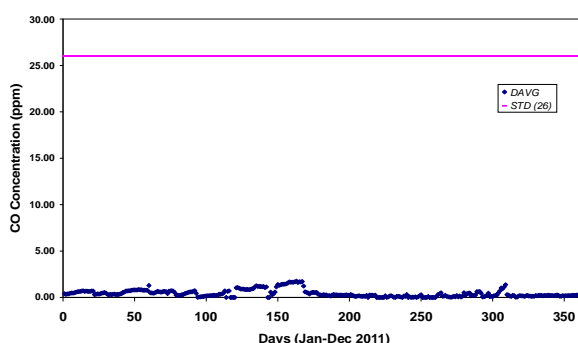


Fig. 7. Daily Averages Concentrations of CO

It is believed that the high SO<sub>2</sub>, and CO concentrations observed at the residential site are due to motor vehicle traffic on nearby highways and roads.

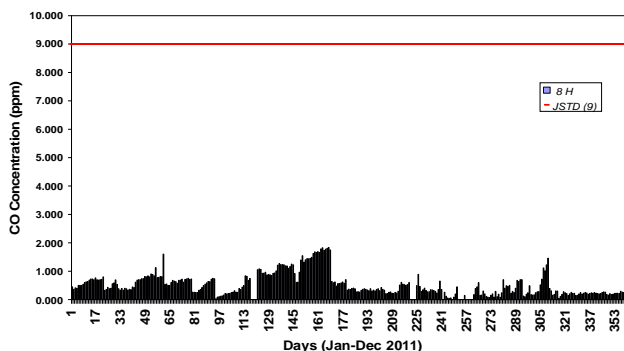


Fig. 8. Max Hourly Averages Concentrations of CO

The World health Organization and the United Nation Environmental Program (WHO, UNEP, 1992) made several recommendations for developing countries to follow to address the problems of urbanization and air

- Air quality management should be implemented urgently.
- More attention should be given to short-term, realistic approaches to begin to reduce some of the air pollution. Steps which can be taken include energy conservation, institution of motor vehicle inspection programs and phasing out lead in petrol. Promotion of the use of mass transit and finding alternatives to open burning of refuse provide some other opportunities for reducing air pollution in the near term.
- In the longer term, preventive measures must be incorporated in new industrial and urban developments. Proper urban and transportation planning can achieve significant improvements in air quality, as can the introduction of clean modern technology.

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## NITROGEN OXIDES (NO, NO<sub>2</sub>, NO<sub>x</sub>)

The results of 2011 monitoring show that no exceeds to the daily averages concentrations of nitrogen oxides (NO, NO<sub>2</sub>, NO<sub>x</sub>), as defined by the Jordanian standards.

Fig. 9. shows that the daily averages concentrations of NO<sub>x</sub>, NO<sub>2</sub> and NO were 0.079, 0.07 and 0.019 ppm respectively. The first and second readings of the recording were carried in the end of May, while the third reading was done in February.

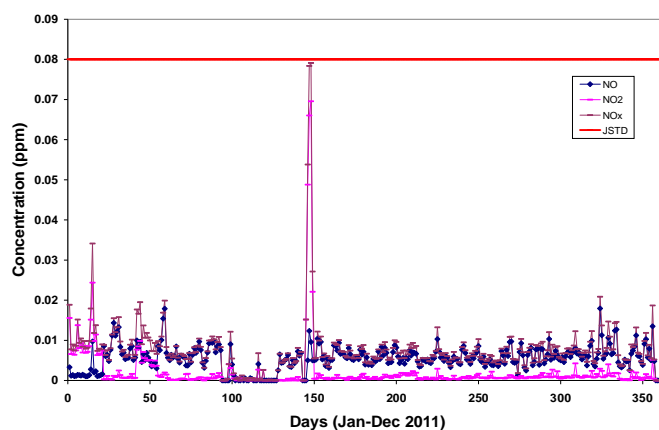


Fig. 9. Daily Averages Concentrations of NO, NO<sub>2</sub> and NO<sub>x</sub>

## IV. CONCLUSION

1. The study has shown that SO<sub>2</sub> and PM<sub>10</sub> (which contains the most of health-affecting pollutants) were exceeded the Jordanian standard in observation site, whereas no surpassing was recorded by CO, and nitrogen oxides.
2. The study recommends the substitution of heavy fuel, which contains high rate of sulfur, by natural gas which is environmentally clean, and contains less ash and less sulfur.
3. Citizens can help reduce air pollutant emissions by conserving electricity, properly maintaining vehicles, and cut-down on the use of motor vehicle
4. The freshness of the air in one's environment has a most fundamental and direct impact on the quality and length of one's life. Air is more a necessity of life than either food or water.
5. In the absence of controls, the automotive emissions will likely increase. Therefore, the need for automotive emissions controls is paramount.

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