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STUDY OF AIR QUALITY IN THE VICINITY OF A HOSPITAL WASTE INCINERATOR IN BAGHDAD: A CASE STUDY IN ALKARKH MATERNITY HOSPITAL

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Abstract

The air quality monitoring in the vicinity of the hospitals waste incinerator is a foremost important strategy for the management and control of air pollution in the near-field of health-care units and nearby areas as well. Therefore, the prime objective of the present study are to monitor ambient air quality with respect to sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and hydrogen sulfide (H_2S) in the vicinity of the maternity hospital waste incinerator in Alkarkh . Three sites have been selected near the incinerator, i.e., 50, 100 m and 200 m along with an unpolluted site approximately 3 km upwind from the waste incineration unit. The air quality monitoring for pre-selected parameters has been carried out during working hours of the incinerator. It has been found that the concentration of pollutants (SO_2, NO_2 and H_2S) increases with downwind in very small amounts and has been observed to be maximum at a downwind distance of 200 m, and the minimum near the source. It was also noted that the observed concentrations of the above-mentioned pollutants were less than the prescribed limits for air quality issued by the Iraqi Ministry of Environment standards.

Keywords: Incineration, Hospital Waste, Air Quality, Monitoring, Vicinity

INTRODUCTION

The hospital waste management requires increased attention and diligence to avoid adverse health impacts associated with poor practice, including exposure to infectious micro-organisms and toxins. The waste generated by health-care facilities contains about 85%, non-hazardous waste comparable to domestic waste and the remaining 15% is considered to be hazardous waste that may be infectious, chemical or radioactive. The disposal of untreated hospital wastes in landfills can lead to the contamination of surface, and ground waters. (Jangsawang, et.al., 2005) and (Njagi, et. al., 2012) have reported many techniques for treatments of hospital wastes, such as steam sterilization, chemical disinfection, ionizing radiation, microwaving, recycling, incineration, and biological systems like enzymes. The incineration methods for hospital wastes are dual-chamber air controlled incinerators, multiple chamber incinerators, rotary kilns incinerators, cement incinerators, the fluidized furnace combustion technique, combustion with energy recovery, and pyrolysis incinerators (Trinh et. al., 2020); (Raila and Anderson, 2017); (Zhao et. al., 2009). Incineration has been used widely for hospital waste management (Kerchich et. al., 2018) due to its advantages of reducing the mass of waste by more than 70 wt. % (Tsakalou et. al., 2018) and the volume of waste by around 90% (Gidarakos et. al., 2009) destruction of toxic and infectious organic components, and the feasibility of heat recovery or electricity (Zhao et. al., 2009); (Rahim et. al., 2016). The emitted pollutants of uncontrolled incinerators are particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, heavy metals (cadmium, mercury, lead, arsenic, chrome, manganese, and nickel) as well as furans and dioxins etc. (Lee et. al., 2003); (Alvim-Ferraz and Afonso, 2003); (Szewczyńska et.al, 2009). In Baghdad, the predominant approaching wind direction is south-east to north-west throughout the year. The peoples residing in north-west direction is most affected due to air pollution generated through improper and uncontrolled incineration of hospital waste. The presence of air pollutants such as particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and heavy metals causes acute and chronic respiratory diseases and other health impacts. The SPMs and So_x have a synergistic effect and in concentrations of 80 µg/m3 (annual mean) lead to aggravation of chronic obstructive lung disease, increased risk of acute and chronic respiratory illness and altered lung function in children (Narendran et. al.,2006). Air quality monitoring is considered to be one of the key elements to allow effective decision-making on air quality issues in an urban area. It also provides the data required to assess compliance with current ambient air quality guidelines and standards as well as to assess the trends in air pollutant concentrations (Haq and Schwela, 2008). It is also used to determine the effectiveness of existing and proposed policies to control air pollution. Therefore, the present study aims to monitor the air quality parameters – sulphur dioxide (SO_2), Nitrogen Dioxide (NO_2) and Hydrogen Sulphide (H_2S) in the downwind (50 m, 100 m and 200 m) of the incinerator provided in the hospital.

MATERIALS AND METHODS

Study Area:

Three sits were selected near the Alkarkh maternity hospital waste incinerator of Baghdad within ranges (50, 100 and 200 m) to monitor and control the pollutants generated from the incinerator Similarly, an unpolluted site approximately 3 km upwind of a hospital waste incinerator was selected as a control site for the purpose of comparison, All samples were collected for the march 2021 season.

Monitor and analyze the data taken:

In this study, a device of the type JXBS-4001-GAS was used to measure the concentration of gases (SO_2 and NO_2) and a device of the type HT-1805 was used to measure the concentration of gas (H_2S), where the polluted air was monitored in sites Alkarkh maternity hospital. The readings were taken with these above-mentioned devices for a period of one month, at a rate of three days of each week, at an average of one hour, where the hand-held devices are operated and I stand in the previously identified areas, The first sample was taken at a distance (50m) from the source of pollution resulting from the incinerator, the second sample was taken at a distance (100m) from the source of pollution and the third sample was taken at a distance (200m) from the source of pollution, noting that the above-mentioned devices, when operated, give readings of the concentrations of each pollutant mentioned when operating these devices for the three sites, and then the average of these readings is taken.

Statistical data analysis:

The statistical program SPSS version 20 was used in this study for the purpose of evaluating the effect of the various factors coefficients (distance). The analysis of variance (ANOVA) test for the least significant difference (LSD) at level 0.05 ($P \leq 0.05$) was used to compare the mean values.

RESULTS AND DISCUSSION

Concentration of SO_2 (ppm):

Table No. 1 shows a non-significant increase in the concentrations of SO_2 within the specified distances (50, 100, 200 m) compared to the control and it was found that the concentration increases with the wind distance. The maximum at a distance of 200 m was (0.1045±0.001258) and that the minimum was (0.1015±0.001041) near the source. The cause may be pollution resulting from car exhausts or pollution resulting from the operation of nearby electricity generators or may be due to the increase in atmospheric turbulence during March which led to more mixing resulting in increased concentration values for locations. Figure 1 shows the concentration pollution of SO_2 with the distances of the three sites. It was noted that the values of SO_2 that were measured for the month of March were less than the specified standards for air quality issued by the Iraqi Ministry of Environment (0.15 ppm) (Lafta et al., 2014).

Table 1 Shows the Concentration of (SO_2 ppm) in the air that was monitored during the March

Parameter / Group	SO_2 (Mean+SD)
Control	A 0.101±0.02328
50m Distance	A 0.1015±0.001041
100m Distance	A 0.103±0.001826
200m Distance	A 0.1045±0.001258
P-value	0.943
LSD	Non-Significant

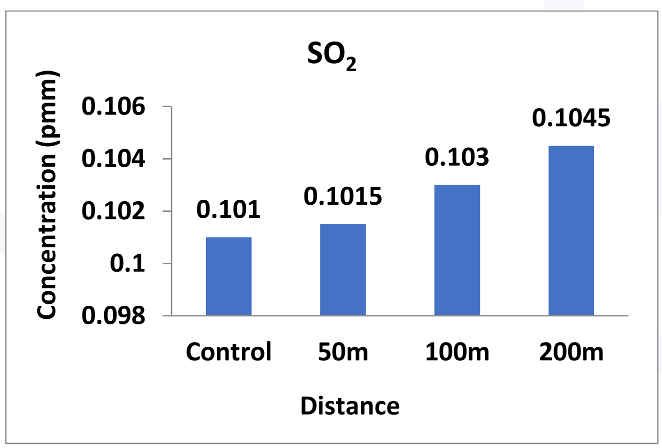

Figure 1 shows the concentration pollution of SO_2 with distances

Concentration of NO_2 (ppm):

Table No. 2 shows a non-significant increase in the concentrations of NO_2 within the specified distances (50, 100, 200 m) compared to the control and it was found that the concentration increases with the wind distance. The maximum at a

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distance of 200 m was (0.0765±0.00497) and that the minimum was (0.0735±0.00719) near the source. The cause may be pollution resulting from car exhausts or pollution resulting from the operation of nearby electricity generators or may be due to the increase in atmospheric turbulence during March which led to more mixing resulting in increased concentration values for all locations. Figure 2 shows the concentration pollution of NO_2 with the distances of the three sites. It was noted that the values of NO_2 that were measured for the month of March were less than the specified standards for air quality issued by the Iraqi Ministry of Environment (N02 as0.25 ppm for one-hour exposure) (Lafta et al., 2014).

Table 2 shows the Concentration of (NO_2 ppm) in the air that was monitored during the March

Parameter / Group	NO_2 (Mean+SD)
Control	A 0.072±0.00671
50m Distance	A 0.0735±0.00719
100m Distance	A 0.075±0.00648
200m Distance	A 0.0765±0.00497
P-value	**0.595**
LSD	**Non-Significant**

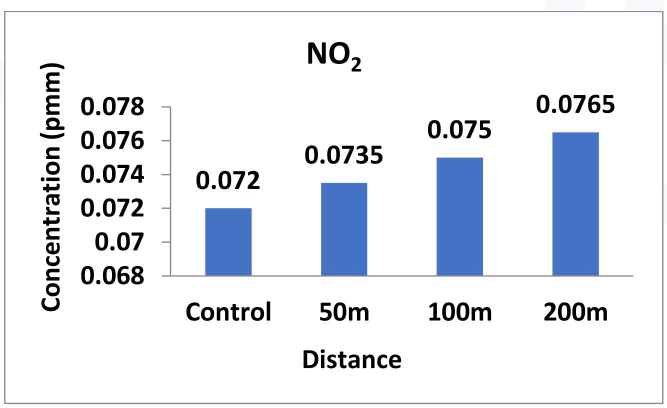

Figure 2 shows the concentration pollution of NO_2 with distances

Concentration of H_2S (ppm):

Table No. 3 shows a non-significant increase in the concentrations of H_2S within the specified distances (50, 100, 200 m) compared to the control and it was found that the concentration increases with the wind distance. The maximum at a distance of 200 m was (0.192±0.001414) and that the minimum was (0.1905±0.001803) near the source. The cause may be pollution resulting from car exhausts or pollution resulting from the operation of nearby electricity generators or may be due to the increase in atmospheric turbulence during March which led to more mixing resulting in increased concentration values for all locations. Figure 3 shows the concentration pollution of H_2S with the distances of the three sites. Noting that H_2S had no air quality limit because it is a dangerous gas and is not supposed to be present in the surrounding air (Lafta et al., 2014), (Khalid A. Rasheed. et., al 2016).

Table 3 shows the Concentration of (H_2S ppm) in the air that was monitored during the March

Parameter / Group	H_2S (Mean+SD)
Control	A 0.190±0.01155
50m Distance	A 0.1905±0.001803
100m Distance	A 0.19125±0.000715
200m Distance	A 0.192±0.001414
P-value	**0.926**
LSD	**Non-Significant**

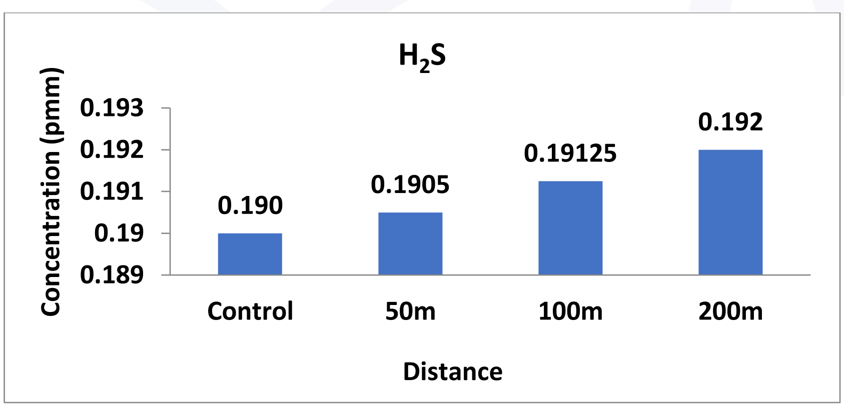

Figure 3 shows the concentration pollution of H_2S with distances

CONCLUSIONS

1- The study shows a non-significant increase in the concentrations of (SO_2, NO_2 and
H_2S) between the control and the specified distances (50,100, 200 m).

2 - The concentrations values of SO_2, NO_2 and H_2S that were measured for the month of March were less than the specified standards for air quality issued by the Iraqi Ministry of Environment.

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