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Research Article

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Air Pollution Assessment at West Qurna -1 Oil felid at Basrah Governorate, southern Iraq

Hamid T. Al-Saad[1], Hamzah A. Kadhim[2], Makia M. Al-Hejuje[2]

[1]College of Marine Science, University of Basrah, Basrah, Iraq
[2]Department of geology, College of Science, Basrah University, Basrah, Iraq
Corresponding author,Hamid T.AL-Saad=email ,htalsaad@yahoo.com

Abstract Gaseous emissions monitored seasonally at ten stations selected at West Qurna-1 oil field at Basrah governorate during the period from January, 2018 to December, 2018. The results of the regional mean concentrations of the gasses at present study show that: The highest concentration of the gases (CO, CO_2, NOx, SOx, H_2S, CH_4 and HCs) were(31.70, 390.17 ,3.86, 4.28, 4.00, 16.96 and 16.76 ppm) respectively, While the lowest concentrations were (15.99, 202.62, 0.94, 2.01, 2.09, 7.32, and 3.29, ppm) respectively , whereas the highest mean concentration of O_3 gas was (0.32ppb) and the lowest was (0.01ppb).The result of the seasonal gasses shows that the highest mean of the gasses (CO, CO_2, NOx, SOx, H_2S, CH_4, and HCs) concentrations were recorded during Winter (27.19, 323.06, 2.96, 3.82, 3.45, 14.24, and 13.66, ppm) while the lowest were recorded during Summer (21.59, 299.14, 2.58, 3.24, 2.95, 13.43, and 11.83 ppm). The highest seasonal mean of the O_3 gas was recorded during Spring (0.16 ppb) while the lowest was during Summer (0.097ppb). The seasonal concentration for the studied gasses (except O_3) arranges as following: winter >spring >autumn>summer.

Keywords Air gasses, pollution, West Qurna-1 oil field

Introduction

Air pollution is caused by both natural and man-made sources. Major man-made sources include automobiles, power generation plants and the industrial activities, which represent the main source of air pollution. Mostly oil industrial activities using a huge amount of consumable fuel like power plants and oil refineries which released high emission of fume, solid particulates and toxic gases as compared with the other industries. These industries will be more hazardous upon their existence inside the limits of the cities, or them existence inside urban area, such as Basrah oil refinery. The oil refinery considered as an important source for air pollutants where volumes of the released pollutants from these industries were estimated to be in millions of tons per year [1].

Air pollution is considered as one of the severe problems that world facing today. It deteriorates ecological condition and can be defined as the fluctuation in any atmospheric constituent from the value that would have existed without human activity. Over the years there has been a continuous increase in human population, road transportation, vehicular traffic and industries which has resulted in further increasing in the concentration of gaseous and particulate pollutants that released to the environment [1]. Atmospheric pollution defines as that the presence of contaminants or pollutant substances in the air that interfere with human health or welfare, or produce other harmful environmental effects. Furthermore, atmospheric pollution is taken to be "the presence in the atmosphere of substances or energy in such quantities and of such duration as to be liable to cause harm to human, plant, animal life; damage to human-made materials and structures; changes in the weather and climate; interference with the comfortable enjoyment of life or property or other human activity" [2].

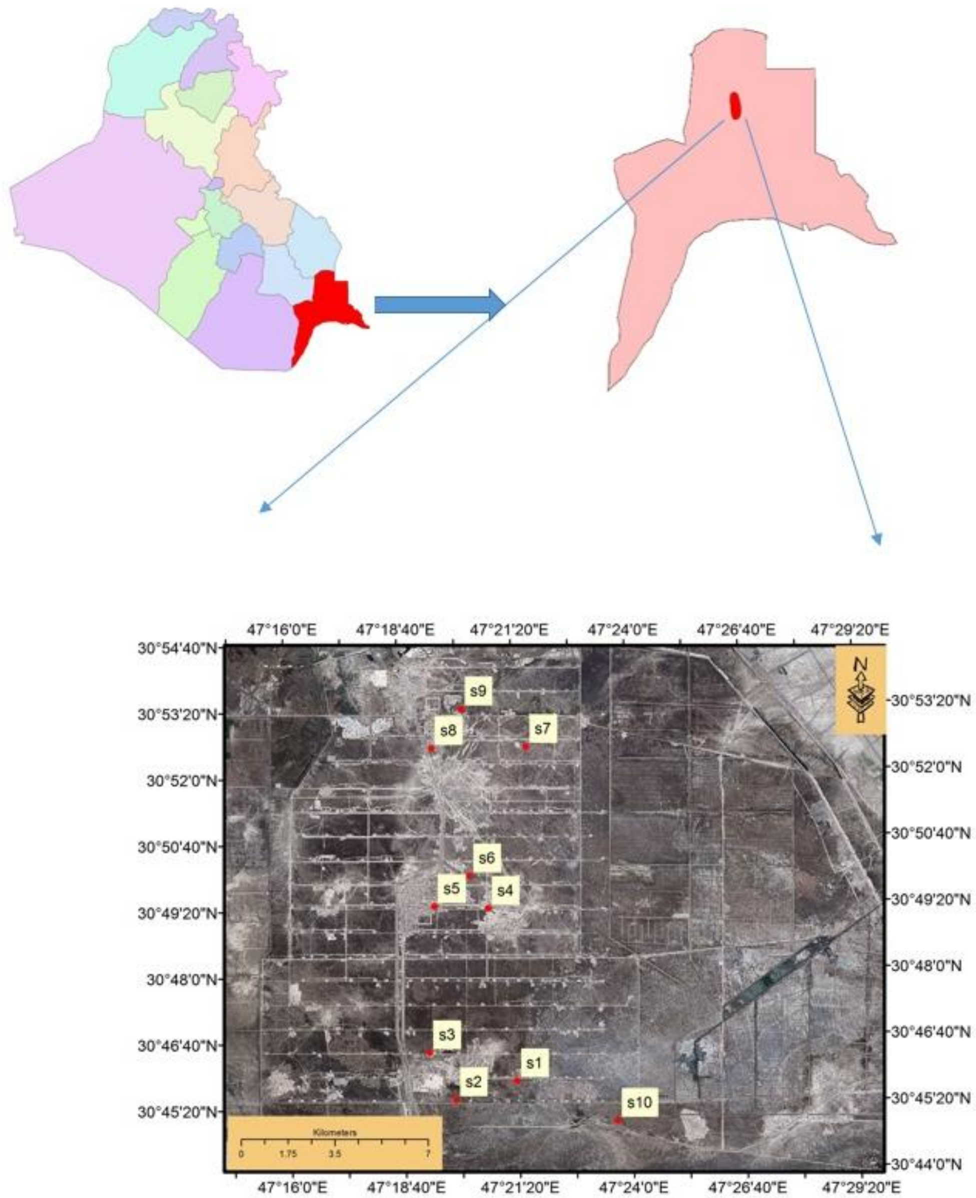

Figure 1: Study area

Air pollution is one of the most important issues around the world and becoming the fundamental pollution problem in many parts of the world, especially in Iraq. Air contamination is a developing risk to human health and well-being as well as natural environment. It can be triggered via factories' activities, power plants, motor vehicles, wildfires and windblown dust [3]. The health effect caused by air pollutants may range from subtle biochemical and physiological changes to difficulty breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions.

These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and even premature death mainly. Our air is a mixture of nitrogen and oxygengases, but containing much smaller amounts of water vapor, argon, and carbon dioxide, and other gases. Also, air contains suspended dust, spores, and bacteria. The percent composition of air varies only slightly with altitude and location because of the action of wind. Though, to understand the atmospheric pollution of a given area, an ambient air quality in that area should be assessed. Air quality can be assessed by measuring the levels of pollutants and lengths of exposure at which specific harms to health and welfare may occur [4].

The major air pollutants including: (Carbon monoxide, Carbon dioxide, Nitrogen dioxide, Sulfur dioxide, Hydrogen sulfide, Methane, Petroleum hydrocarbon gases and Ozone).
This aims of the present study is to determine the concentrations of air pollutants emitted from both stationary and mobile outdoor sources in West Qurna -1 Southern Iraq.

Material and Methods

Gaseous emissions monitored seasonally at ten stations selected at West Qurna-1 oil field at Basrah governorate during the period from January, 2018 to December, 2018 (Fig. 1).
The chosen stations are kept to monitor the ambient air quality and gaseous emissions released from the nearby industrial plants. Carbon monoxide (CO), carbon dioxide (CO_2), sulfate oxides (SO_x), nitrogen oxides (NO_x), ozone (O_3), petroleum hydrocarbons (HCs), methane (CH_4) and hydrogen sulfide (H_2S) are the gasses which measured in this work. HCs, NO_x, SO_x, O_3, and CO_2 concentrations are measured utilizing the portable detection instrument of Drager Chip-Measurement System, Germany, whereas CH_4, H_2S, and CO detected by the portable instrument of RK1 Gas Monitoring Eagle II, USA.

Results

The result of the seasonal gasses (CO, CO_2, NO_x, SO_x, H_2S, CH_4 and HCs) showed that the highest mean of the gasses were in winter (27.19, 323.06, 2.96, 3.82, 3.45, 14.24, 13.66 ppm) respectively, while the lowest concentrations were in summer (21.59, 299.14, 2.58, 3.24, 2.95, 13.43, 11.83 ppm) respectively. The highest seasonal mean concentration of O_3 gas (0.16ppb) in spring and the lowest (0.097ppb) in summer season, the seasonal concentrations of the studied gasses (except O_3)arrange as following ; Winter > Spring>Autumn >Summer (tables 1-8).

CO

Seasonal variations of CO gas were observed during this study. The highest seasonal mean concentrations (27.19) detected during Winter season, while lowest seasonal mean concentration (21.59) noticed during Summer season (Table 1, Fig. 2).

Table 1: Seasonal variations of CO (ppm) gas in air with mean in West Qurna1 oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	28.42	27.57	21.29	26.23	25.87	3.184
2	27.57	27.34	21.22	26.13	25.56	3.013
3	26.37	26.55	22.12	25.28	25.08	2.051
4	29.97	29.63	22.92	27.47	27.45	3.246
5	29.39	28.50	21.28	27.75	26.73	3.694
6	26.93	28.21	23.18	26.56	26.24	2.146
7	31.70	30.78	23.48	29.90	28.83	3.729
8	27.82	30.50	21.71	27.33	26.84	3.692
9	25.64	27.54	22.16	25.73	25.26	2.248
10	18.17	15.99	16.60	16.93	16.92	0.918
S. Mean	27.19	26.96	21.59	25.93	-	-

Sp. mean= Spatial mean, S. Mean= seasonal mean

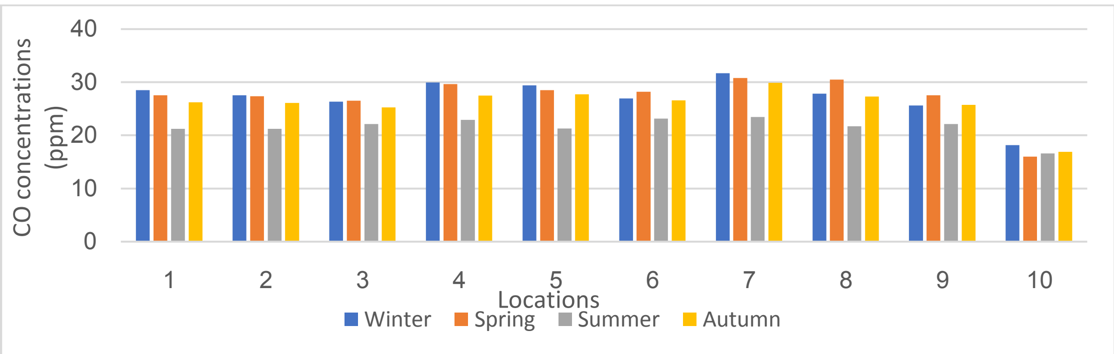

Figure 2: Seasonal concentrations of CO (ppm) gases at West Qurna-1 oil field

CO_2

Seasonal variations of gas CO_2 were observed during this study. The highest seasonal mean concentrations (323.06) detect during Winter season, while lowest seasonal mean concentration (299.14) noticed during Summer (Table 2, Fig. 3).

Table 2: Seasonal variations of CO_2 (ppm) gas in air with mean in West Qurna1 oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	390.17	380.93	371.47	380.23	380.70	7.640
2	310.65	300.74	287.01	298.59	299.24	9.702
3	308.28	301.03	286.93	300.53	299.19	8.909
4	387.17	371.26	363.63	373.21	373.81	9.814
5	299.60	285.01	276.67	283.53	311.22	9.562
6	297.73	281.53	271.46	279.44	307.54	10.821
7	389.75	347.30	334.91	340.28	353.06	24.613
8	316.52	310.27	301.42	311.76	309.99	6.306
9	309.99	301.34	295.59	321.31	307.05	11.194
10	220.77	211.03	202.62	204.29	234.67	8.240
S. Mean	323.06	309.04	299.14	299.35	-	-

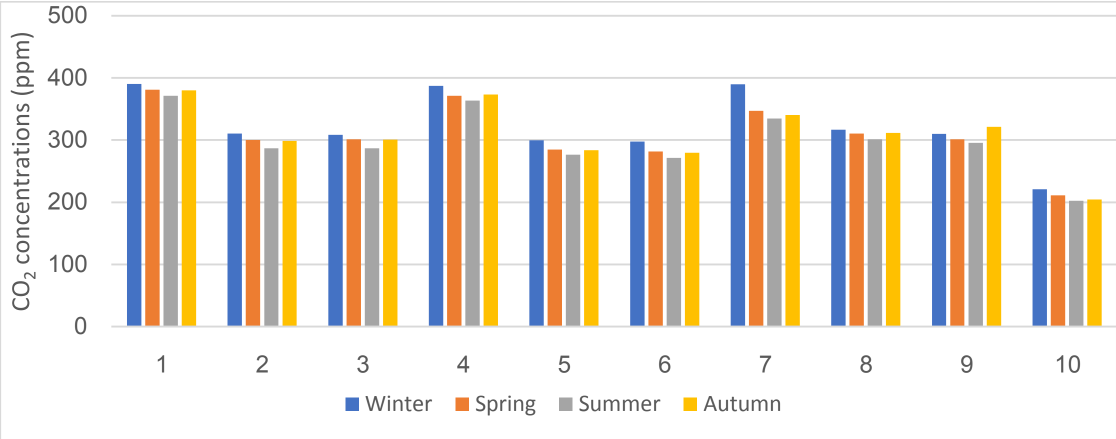

Figure 3: Seasonal concentrations of CO_2 (ppm) gases at West Qurna-1 oil fie

NOx

Seasonal variations of NOx gases were observed during this study. The highest seasonal mean concentrations (2.96) detect during Winter and Spring season, while lowest seasonal mean concentration (2.58) noticed during Summer season (Table 3 and Fig. 4).

Table 3: Seasonal variations of NOx (ppm) gas with mean in West Qurna1 oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	3.56	3.24	2.91	3.17	3.21	0.267
2	3.21	3.33	2.95	3.25	3.18	0.164
3	2.93	3.39	3.16	3.52	3.25	0.260
4	3.27	3.27	3.08	3.25	3.21	0.092
5	3.21	3.15	3.02	3.16	3.13	0.081
6	2.92	3.10	2.93	3.05	3.00	0.089
7	3.35	3.86	2.71	2.97	3.22	0.499
8	3.08	2.74	2.34	2.88	2.76	0.312
9	2.99	2.60	2.70	2.59	2.72	0.186
10	1.08	0.96	0.94	1.00	0.99	0.061
S. Mean	2.96	2.96	2.58	2.88	-	-

Sp. mean= Spatial mean, S. Mean= seasonal mean

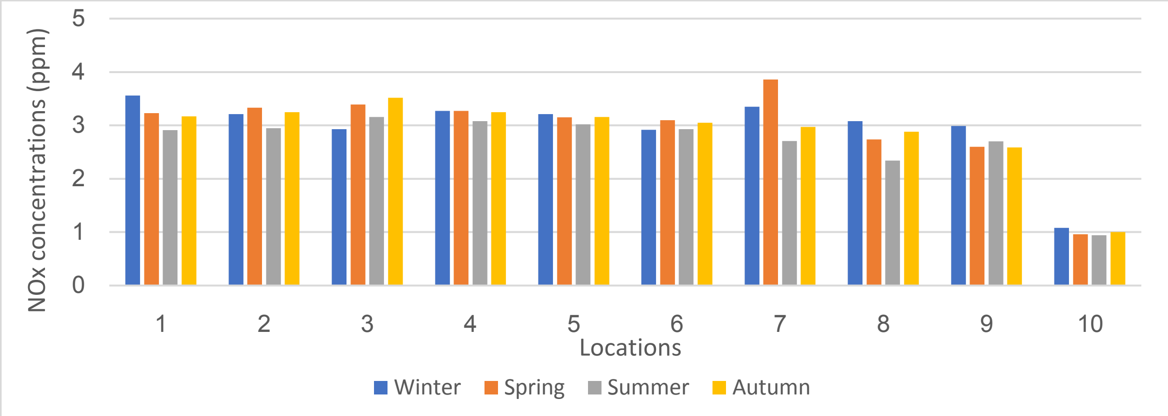

Figure 4: Seasonal concentrations of NOx (ppm) gases at West Qurna-1 oil field

Sox

Seasonal variations of gases SOx were observed during this study. The highest seasonal mean concentrations (3.82) detect during Winter season, while lowest seasonal mean concentration (3.24) noticed during Summer season (Table 4, Fig. 5).

Table 4: Seasonal variations of Sox (ppm) gases with mean in West Qurna1 oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	4.27	4.05	3.93	4.12	4.09	0.141
2	3.45	4.06	3.94	3.93	3.84	0.269
3	3.93	3.33	3.11	3.50	3.46	0.247
4	4.15	3.22	3.07	3.96	3.60	0.534
5	3.93	3.39	3.12	3.51	3.48	0.337
6	3.88	3.15	2.96	3.26	3.31	0.398
7	4.15	3.91	3.60	3.86	3.88	0.225
8	4.02	3.93	3.48	4.00	3.85	0.252
9	3.95	3.75	3.23	3.82	3.77	0.429
10	2.21	2.18	2.01	2.17	2.14	0.89
S. Mean	3.82	3.55	3.24	3.61	-	-

Sp. mean= Spatial mean, S. Mean= seasonal mean

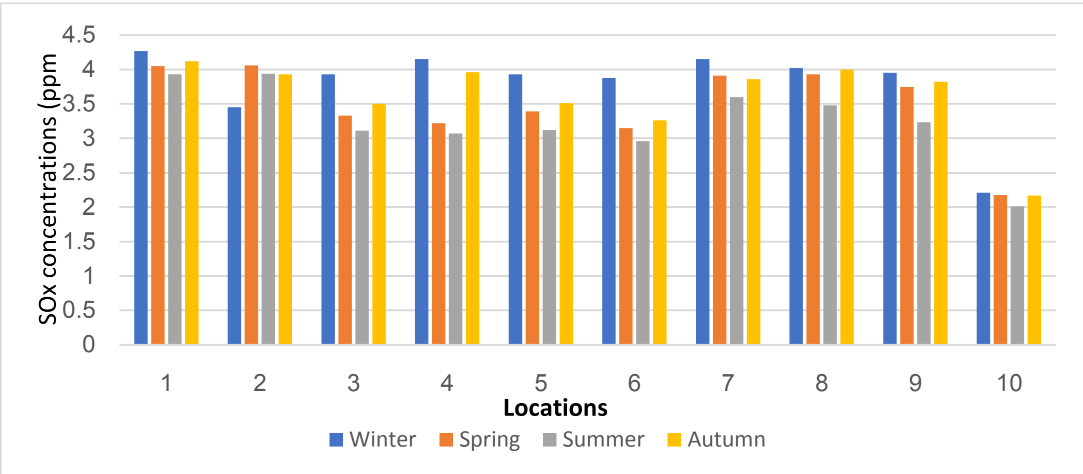

Figure 5: Seasonal concentrations of SOx (ppm) gases at West Qurna-1 oil field

H_2S

Seasonal variations of gas H_2S were observed during this study. The highest seasonal mean concentrations (3.45) detected during Winter season, while lowest seasonal mean concentration (2.95) noticed during Summer season (Table 5, Fig. 6).

Table 5: Seasonal variations of H_2S (ppm) gas with mean in West Qurna1oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	3.99	3.11	2.95	3.09	3.28	0.475
2	3.74	3.14	2.94	3.14	3.24	0.346
3	3.04	2.91	2.90	3.02	2.96	0.072
4	3.93	3.31	3.18	3.25	3.41	0.345
5	3.47	3.18	3.02	3.13	3.20	0.192
6	3.14	3.09	2.96	3.01	3.05	0.080
7	4.00	3.49	3.32	3.79	3.65	0.303
8	3.90	3.52	3.45	3.42	3.57	0.222
9	3.15	3.05	2.70	3.05	2.99	0.197
10	2.23	2.64	2.09	2.65	2.40	0.285
S. Mean	3.45	3.14	2.95	3.15	-	-

Sp. mean= Spatial mean, S. Mean= seasonal mean

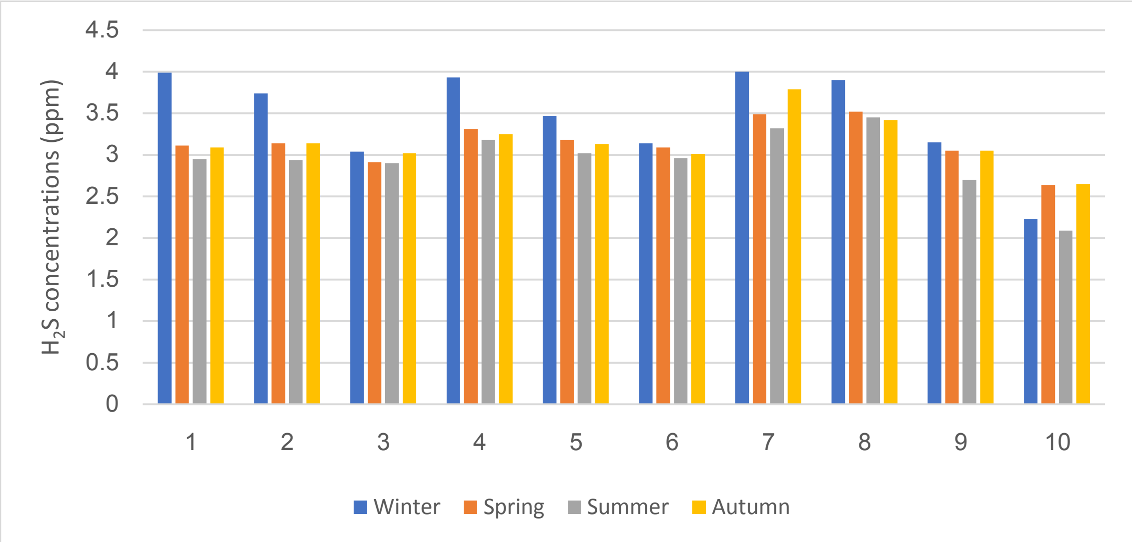

Figure 6: Seasonal concentrations of H_2S (ppm) gases at West Qurna-1 oil field

CH_4

Seasonal variations of CH_4 gas observed in this study. The highest seasonal mean concentrations (14.24) detected during Winter season while lowest mean concentration (13.43) noticed during Summer season (Table 6 and fig 7).

Table 6: Seasonal variations of CH_4 (ppm) gas with mean in West Qurna1 oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	16.96	15.78	15.33	16.00	16.01	0.725
2	16.21	15.58	15.09	15.89	15.69	0.476
3	15.48	15.48	15.01	15.45	15.35	0.230
4	15.55	14.91	14.53	14.97	14.99	0.421
5	14.75	14.11	13.92	13.86	14.09	0.274
6	13.79	14.03	13.92	13.59	13.83	0.189
7	14.89	13.53	13.31	13.56	13.82	0.720
8	13.51	13.23	13.02	13.29	13.26	0.201
9	12.78	13.17	12.86	13.29	13.02	0.243
10	8.81	7.88	7.32	8.14	8.03	0.618
S. Mean	14.24	13.77	13.43	13.80	-	-

Sp. mean= Spatial mean, S. Mean= seasonal mean

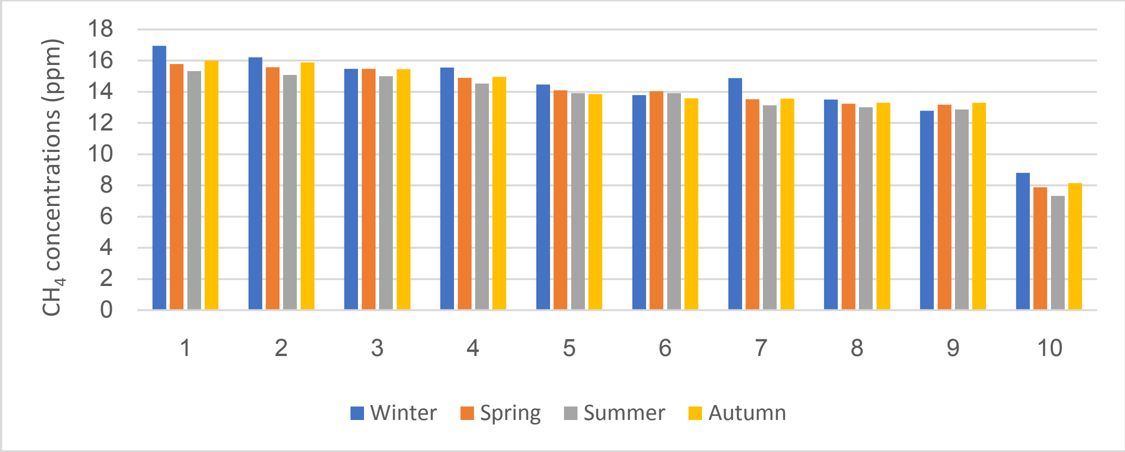

Figure 7: Seasonal concentrations of CH_4 (ppm) gases at West Qurna-1 oil field

HCs

Seasonal variations of HCs gases observed in this study. The highest seasonal mean concentration (13.66) detected during Winter season while lowest seasonal mean concentration (11.83) noticed during Summer season (Table 7, Fig. 8).

Table 7: Seasonal variations of HCs (ppm) gases with mean in West Qurna1 oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	16.76	15.46	14.95	15.62	15.69	0.763
2	15.25	14.53	14.10	14.10	14.49	0.542
3	14.05	14.03	13.83	13.83	13.93	0.121
4	15.21	13.93	13.43	14.17	14.18	0.749
5	14.24	12.81	12.08	12.35	12.87	0.961
6	13.98	12.07	11.73	13.22	12.75	1.038
7	14.69	13.50	12.94	13.47	13.65	0.739
8	14.18	12.99	12.19	13.51	13.21	0.840
9	12.43	10.11	9.82	11.06	10.85	1.175
10	5.86	3.80	3.29	3.90	4.21	1.130
S. Mean	13.66	12.32	11.83	12.52	-	-

Sp. mean= Spatial mean, S. Mean= seasonal mean

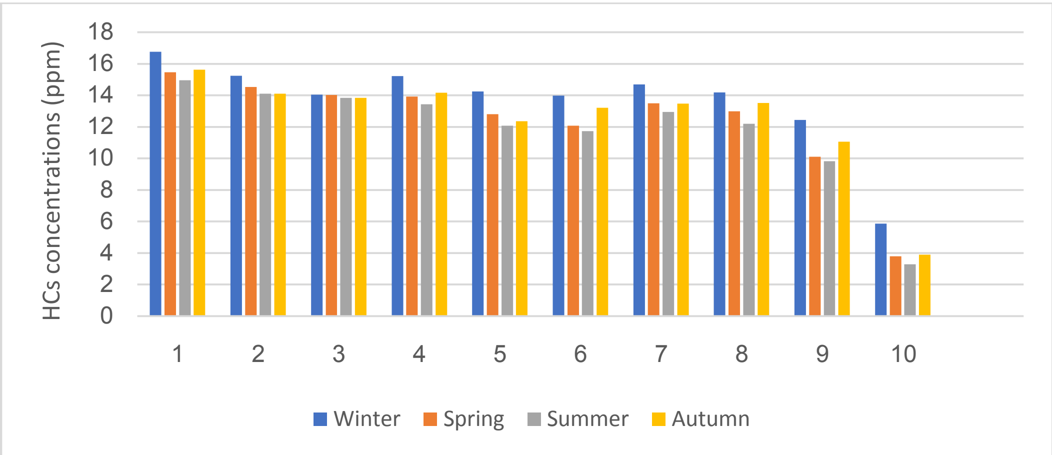

Figure 8: Seasonal concentrations of HCs (ppm) gases at West Qurna-1 oil field

O_3

Seasonal variations of O_3 gas observed in this study. The highest seasonal mean concentration (0.16ppb) was detected during Spring season while lowest seasonal mean concentrations (0.097ppb) was noticed during Summer season (Table 8 and Fig. 9).

Table 8: Seasonal variations of O_3 (ppb) gas with mean in West Qurna1 oil field

Location	Winter	Spring	Summer	Autumn	mean	±SD
1	0.16	0.32	0.1	0.13	0.17	0.099
2	0.13	0.21	0.1	0.1	0.13	0.051
3	0.1	0.21	0.1	0.1	0.12	0.055
4	0.1	0.2	0.1	0.15	0.13	0.047
5	0.1	0.12	0.1	0.1	0.10	0.010
6	0.12	0.11	0.1	0.1	0.10	0.009
7	0.13	0.2	0.1	0.1	0.13	0.047
8	0.13	0.2	0.1	0.12	0.13	0.043
9	0.10	0.1	0.1	0.1	0.1	1.699
10	0.07	0.02	0.07	0.06	0.05	0.023
S. Mean	0.11	0.16	0.0 97	0.10		

Sp. mean= Spatial mean, S. Mean= seasonal mean

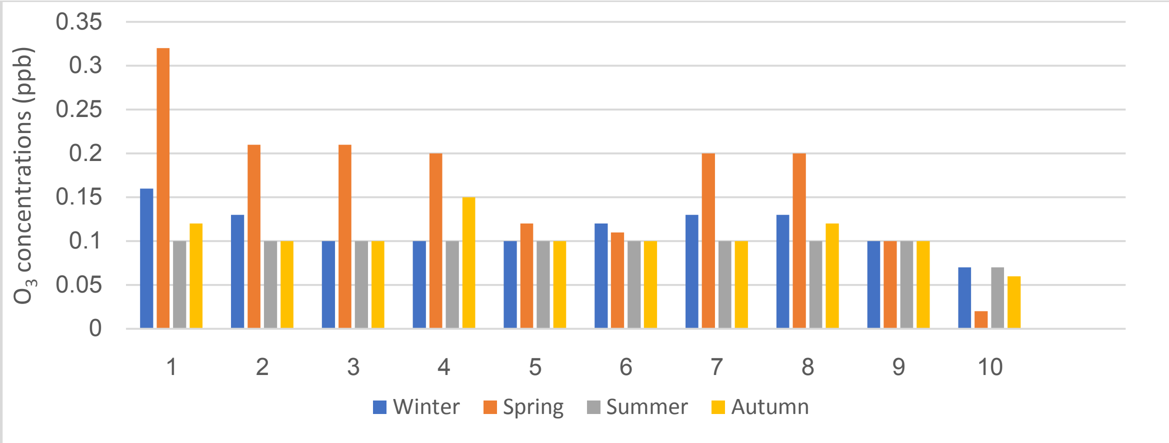

Figure 9: Seasonal concentrations of O_3 (ppb) gases at West Qurna-2 oil field

Discussion

Carbon dioxide exists in the earth's atmosphere as a trace gas at a concentration of about 0.03 percent (300 ppm) by volume. It is present in deposits of petroleum oil and natural gas [5]. NO_2 which produced under high temperature combustion are major criteria pollutants that are precursors to photo- chemical smog, ozone, and acid formation. Sulfur dioxide mostly comes from the burning of oil [6]. CH_4 is concentered in places with the petroleum industry and exploitation within the study area [5]. O_3 concentrations increasing in Winter this may be a result of the photochemical reactions of nitrogen oxides.

Generally, the concentrations of CO, NO_2, SO_2, and HCs are recorded by the previous studies for the last ten years in the region are high. Al-Mayahi [7] reports that CO concentrations range from 10 mg/l to 80 mg/l, while Al-Hassan [8] states that the average concentration of CO is 27 mg/l. Al-Saad *et al.* [9] indicated that SO_2 concentrations range from 10 mg/l to 15 mg/l. In Al-Hassan [8] study the average concentrations of CO_2 and NO_2 and round they are 300 mg/l and 3 mg/l respectively. In addition, Al-Saad *et al.* [9] and Al-Hassan [8] report that the average HCs concentrations were 5 mg/l and 2 mg/l, for each study respectively.

The results showed that there is a variation in the recorded concentrations of all the monitored gaseous pollutants. They increased from the sampling station 1 to station 9 and then significantly decreased at station 10. This is due to the distance from the flame of flare. In general, station10 records the lowers concentrations when compared to the other studied Locations. This is due existing location 10 far of the flame.

The anthropogenic source is divided into stationary and mobile sources. The Location sources in study area include minor industrial plants such as gas-fueled power Locations, gas flames, etc. These sources, in total, emit from their smokestacks into local atmosphere thousands of metric tons of gases in every day. Recently, the automobile exhausts become the predominant mobile source of gaseous emissions, because they largely increase in traffic. All of these sources cause higher emission problems to the environment, this finding was in agreement with [8].

The results indicate that the average concentrations of the monitored gaseous pollutants are higher in the Winter than those recorded in the Summer. This may be primarily attributed to the differences in weather conditions, especially wind speeds and directions, air temperature, and humidity, the present result was in agreement with Douabul *et al*. [10] who found that gaseous pollutants are higher in the Winter than those recorded in the Summer.

It ranges from minor upper respiratory irritation to chronic respiratory and heart disease, lung cancer, acute respiratory infections in children and chronic bronchitis in adults, aggravating

exposures have also been linked with premature mortality and reduced life expectancy, WHO estimates that air pollution is responsible for over a million premature deaths worldwide every year [6].

The comparative analysis reveals that the present minimum and maximum concentrations of NOx, and SOx were higher than the recommended exposure of levels for all the guidelines of WHO, USEPA, MoE. The concentrations of CO, CO_2, H_2S, HCs, and CH_4 were within the guidelines, (Table 9).

Table 9: Comparison between the results (minimum and maximum concentration) in the present study and the recommended guidelines

CO (ppm)	CO_2 (ppm)	NOx (ppm)	SOx (ppm)	H_2S (ppm)	HCs (ppm)	CH_4 (ppm)	O_3 (ppb)	Ref.
9-35	5000-30000	0.015-0.100	-	-	-	-	0.050	[11-12]
9-35	10000	0.53	0.03-0.50	-	-	-	0.075-0.12	[13]
10-35	-	0.04-0.05	0.018-0.1	4.5-9	18	18	0.06	[14]
15.35-32.02	**201.98-390.62**	**0.90-3.90**	**2.00-4.29**	**2.00-4.01**	**2.95-17.02**	**7.14-17.53**	**0.06-0.35**	**The present study**

Table (10) showed a comparison between the present study and the previous studies. The comparison demonstrates that there is significant variability in the registered values between this study and others. This may refers to the differences in the adopted measuring durations, instruments, and procedures.

Table 10: Comparisons between the results (mean concentration) of present work and those of previous studies

CO (ppm)	CO_2 (ppm)	NOx (ppm)	SO_2 (ppm)	H_2S (ppm)	HCs (ppm)	CH_4 (ppm)	O_3 (ppb)	Ref.
52.5	0.19		22.5	4	15	-	-	[7]
-	174	-	-	-	-	40.5	-	[15]
27.3	270	2.51	0.57	11	22	-	0.16	[8]
7.37	280	0.35	0.36	-	-	-	-	[16]
11	255	0.9	0.65	-	0.8	-	-	[10]
25.4	221.87	1.49	3.67	2.45	18.97	12.81	0.08	[17]
15.30	235.61	1.15	2.18	2.19	14.01	12.58	0.08	[5]
18.20-28.03	266.6-322.3	1.00-2.98	2.10-3.44	2.21-3.87	10.12-14.66	11.25-15.08	0.07-0.11	[2]
15.35-32.02	**201.98-390.62**	**0.90-3.90**	**2.00-4.29**	**2.00-4.01**	**2.95-17.02**	**7.14-17.53**	**0.06-0.35**	**The present work**

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