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Assessment of air quality and community health risks in Di An city - Binh Duong province

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ABSTRACT

Based on research methods such as data collection and processing, air quality index calculation methods, and public health risk assessment methods to assess air quality and effects of substances on the health of people in Di An city. The data for the calculation are inherited from the environmental monitoring report of the Department of Natural Resources and Environment of Di An City in the period of 2019. The calculation results show that the air quality in the city is. Di An is fluctuating at an average-poor level (especially in the Cay Lon junction area with the highest index of 150), the health risk assessment results show that when exposed to dust, the total group of people Adults (Women and Men) had a high fluctuating cancer risk index with the highest index of 2 subjects being in the first quarter 0.310, 0.295, in the second quarter 0.269, 0.282, in the third quarter 0.296, 0.282, Fourth quarter 0.289, 0.275. As for other indicators, the subjects assessed when exposed to substances in the air environment in Di An city can be affected their health, of which the group of adults is still the group of people. Women and men) are the most affected group.

Keywords: *AQI, Di An, health risk assessment*

1. Introduction

Air is one of three important environmental groups that contribute greatly to the development of humans and animals. However, at present, the process of

industrialization - modernization plus human activities has degraded the air quality, making air pollution tend to increase, causing the greenhouse effect. acid rain and climate change photo

Air pollution brings many bad effects on the surrounding environment, especially human health. Continuous inhalation of polluted air slows down the natural cleaning process of the lungs, allowing more pollutants to reach the lungs. Air pollutants damage the lungs, slow this process and increase the risk of respiratory diseases such as bronchitis, emphysema, and cancer.

Di An City located in Binh Duong province owns many industrial parks and businesses, so it attracts many labor sources to live and work, so the quality of the environment, including the air, is also affected. benefit from these activities. Especially traffic - transportation activities. The assessment shows that in 2018 and 2019, the environment of Di An town still has several problems, including dust pollution in areas with concentrated traffic density continues to remain at a high threshold (Aria Gusti, 2019).

Faced with that problem, the topic *"Assessment of air quality and public health risks in Di An city - Binh Duong"* was selected for implementation.

2. Contents and methods of research

2.1. Research Contents

- Assessment of quality of air in Di An city
- Assessment of public health risks in Di An City

2.2. Methods

2.2.1 Methods of data collection and Documentation

The data and document collection method is a method of collecting data and documents related to the research work based on the collected data to build arguments to prove the hypotheses. In this study this method is used to collect data such as the socio-economic of Di An city, data on the environmental status of Di An city from environmental monitoring reports and articles research reports related to the research.

2.2.2 Research method on a theoretical basis

Theoretical basis research method: is a method of collecting and filtering the information collected from the collected documents to complete the research content. In this study, the method of theoretical basis research Theory is used to collect data and coefficients such as air environment monitoring data from the environmental monitoring report of Di An city, data on reference doses of substances, calculation formulas on average daily absorbed dose, toxicity index, and air quality calculation.

2.2.3 Data collection and processing methods

Data synthesis and processing method: this is a method of studying available documents and documents. By analyzing the documents into parts, each small piece to understand what the document says helps a little in the research and discovers the most suitable calculation method from which to synthesize. The data sources have been collected and used Excel to make statistics and evaluate the results.

Recalculate data on reference dose, average concentration, air quality index obtained from measurement application, etc. by Excel software.

Summing up the results through Microsoft Office Word software. Select the collected information and express it clearly to put it into practice.

Means of implementation: computer, Microsoft Office Word, and Excel software. Calculation results are the air quality index, average dose, and toxicity index of Di An City. For the results calculated in Excel software, the decimal number will be rounded to the 3rd number.

2.2.4 Calculation method of air quality index

$$AQI_x^h = \frac{TSx}{QCx}100 \quad (3)$$

Where

TS_X: Average hourly observed value of parameter x

QC_X: Value in the hourly average norm of parameter x

AQI(h/x): Hourly AQI value of parameter X

After calculating the AQI (h/x) hourly AQI value of each parameter, select the maximum AQI value of the parameters in a time to take as the hourly value.

Reasons for choosing

The AQI index is divided into two types, hourly AQI and daily AQI, to determine the daily AQI index, it is necessary to continuously collect the values of the parameters in 24 hours from which to determine the AQI value in 1 day because the study uses the results of air monitoring of Di An city as a basis for calculation, the hourly AQI indicator was chosen because there are not enough data to determine the AQI value in 1 day. After calculating the AQI value based on the classification table, we can evaluate the air quality of the calculated area.

TABLE 1. Air quality rating according to AQIS

Index Value	Name	Colour	Advisory
0 to 50	Good	Green	None
51 to 100	Moderate	Yellow	Sensitive group ***should*** limit their time outside
101 to 150	Unhealthy for Sensitive Groups	Orange	Sensitive group ***need to*** limit their time outside
151 to 200	Unhealthy	Red	***Holy senstive group out.***
201 to 300	Very Unhealthy	Purple	Others are ***restricted to the outside***
301 to 500	Hazardous	Maroon	Everyone ***should stay at home***

(Source: Cao, 2019)

2.2.5 Health risk assessment method

Calculating the body dose of chemicals under continuous exposure.

$$CDI = \frac{C * CR * EF * ED}{BW * AT} \qquad (8)$$

Where :

CDI: The average daily dose (mg/kg/day)

C: The average concentration of air pollution (mg/m3)

CR: The average value inhalation rate (m3/ day or m3/ hour)

EF: The average value exposure of pollution (hour/day)

ED :

BW: The average weight

A: The average period (days)

TABLE 2. Parameters used to assess risks to public health

Index	Assessment Object				Source
	Men	Women	Children	Teenager	
CR : (m^3/day)	15,7	12,8	6	11.04	Lê., 2017 & Lê., 2008
EF : (day/year)	365				-----
ED : (Year)	70				Lê., 2008
AT : (Day)	25550				Lê., 2008
BW : (Kg)	58	45	29	50	Lê., 2017 & Lê., 2008

2.2.6 Calculation of the risk of non-carcinogenic substances

$$HI = \frac{CDI}{RfD} \qquad (8)$$

Where

HI: The risk quotient

RfD: Reference concentration (mg/kg/day)

CDI: The average daily dose (mg/kg/day)

If HI > 1: the non-carcinogenic substance under consideration has the potential to cause adverse health effects from exposure to it

If HI < 1: Does not affect health;

2.2.7. Calculation of the risk of carcinogens

Where

RISK: The carcinogenic risk

Sf: Carcinogenicity factor

CDI: The average daily dose (mg/kg/day)

TABLE 3. Risk Rating Scale

	Risk Rating Scale
$R < 10^{-6}$	Low, tolerable cancer risk
$10^{-6} \leq R < 10^{-4}$	Average risk of cancer, with or without risk reduction decisions and decisions should be based on additional research
$10^{-4} \leq R < 10^{-2}$	High risk of cancer, need to take measures to reduce
$R \geq 10^{-2}$	The risk of cancer is very high; it is imperative to take measures to minimize the risk

(Source: Lê,008)

TABLE 4. Reference dosages of substances

Name	**Sf and RfD**	**Unit**	**Source**
Total suspended dust (TSP)	2,42	mg/kg/day	(Aria Gusti, 2019)
Sulfur dioxide (SO_2)	0,03	mg/kg/day	(Aria Gusti et al., 2017)
Nitrogen dioxide (NO_2)	0,02	mg/kg/day	
Carbon monoxide (CO)	23	mg/m3	Deddy et al.,

Parameter conversion

Since the standard unit of the reference dose is mg/kg. day, however, the unit of carbon monoxide is mg/m3, so it is necessary to convert it to the standard unit.

$$RfD(1) = \frac{RfD(2)}{BW * IR}$$

Where

RfD (1): The reference dose converted units (mg/kg/day)

RfD (2): Reference dosage units (mg/m3)

CR: The average value inhalation rate (m3/ day or m3/ hour)

BW: The average weight

TABLE 5. The reference dose of Carbon monoxide has been converted

Carbon monoxide	Men	Women	Children	Teennager	Unit
Not converted	23				mg/m3
Converted	0.025	0.040	0.130	0.132	mg/kg/day

3. Results and discussions

3.1. Air quality assessment in Di An city

3.1.1. Results of air quality monitoring in Di An city

To grasp the annual environmental situation in the region, in the period of 2019, Di An City's Department of Natural Resources and Environment conducted a poll of 18 air monitoring points covering the city to capture the air quality situation of the area. Samples are taken every quarter starting from March 2019 to the end of November 2019.

The 18 monitoring points that Di An city selected for implementation based on the following criteria: densely populated areas, areas with a high number of factories, areas with high traffic volume, areas where commerce and trade are concentrated, areas where state management agencies are concentrated, and areas where many schools are located.

TABLE 6. Location of air monitoring in 2019 of Di An city

Symbol	**Location**	**Symbol**	**Location**
K1	550 crossroads, Di An, Binh Duong, Viet Nam	K10	Chutex traffic roundabout,Di An, Binh Duong, Viet Nam
K2	Mồi crossroads, Di An, Binh Duong, Viet Nam	K11	Bình Trị crossroads, Di An, Binh Duong, Viet Nam
K3	Sóng Thần overpass, Di An, Binh Duong, Viet Nam	K12	Dĩ An market,Di An, Binh Duong, Viet Nam
K4	Bình Thung crossroads, Di An, Binh Duong, Viet Nam	K13	Go supermarket,Di An, Binh Duong, Viet Nam
K5	Hoàn Hảo Hospital,Di An, Binh Duong, Viet Nam	K14	620 crossroads, Di An, Binh Duong, Viet Nam
K6	Ông Thập junction, Di An,Binh Duong, Viet Nam	K15	Núi nhỏ quarrty,Di An, Binh Duong, Viet Nam
K7	Tân Đông Hiệp industrial park,Di An,Binh Duong,Viet Nam	K16	Cây Lơn junction, Di An,Binh Duong, Viet Nam
K8	Cây Điệp junction, Di An,Binh Duong, Viet Nam	K17	Bình Thắng Committee,Di An,Binh Duong, Viet Nam
K9	Tân Đông Hiệp cemetery, Di An,Binh Duong, Viet Nam	K18	Tân Vạn junction, Di An,Binh Duong, Viet Nam

(Source: Environmental monitoring report of Di An City in the period ,2019)

The air monitoring points of Di An City in the period of 2019 mainly focus on major traffic intersections with a total of 14/18 monitoring points located on roads and the remaining 4/18 points located in residential areas.

TABLE 7. Air monitoring results in the period of 2019 of Di An city

Units: mg/m3 and Dexiben (dB)

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	QCVN	Time
TSP	0.36	0.22	0.35	0.37	0.36	0.32	0.35	0.28	0.32	0.42	0.36	0.35	0.31	0.33	0.25	0.45	0.34	0.32	0,3	
Noise	79.8	73.6	77.9	75.6	72.3	81.3	80.6	81.2	78.1	81.2	79.5	76.7	83.1	78.6	78.5	76.5	81.2	83.7	70	
SO_2	0.136	0.078	0.142	0.082	0.11	0.068	0.135	0.112	0.13	0.135	0.144	0.082	0.102	0.102	0.11	0.13	0.11	0.09	0,35	Quater 1
NO_2	0.12	0.07	0.132	0.075	0.1	0.06	0.129	0.102	0.115	0.116	0.138	0.075	0.088	0.086	0.096	0.12	0.09	0.08	0,2	
CO	4.56	4.55	5.35	4.67	4.68	4.98	5.42	4.34	4.35	5.12	5.02	5.36	4.14	5.28	8.34	5.69	4.65	5.25	30	
TSP	0.38	0.29	0.29	0.35	0.28	0.26	0.28	0.25	0.27	0.37	0.29	0.32	0.27	0.28	0.21	0.41	0.31	0.28	0,3	
Noise	79.3	81.2	75	83.6	77.8	82.3	80.7	79.8	82.5	79.3	74.6	76.4	82.4	83.1	82.8	79.3	82.9	80.1	70	
SO_2	0.142	0.144	0.145	0.096	0.126	0.075	0.13	0.12	0.124	0.143	0.129	0.096	0.126	0.124	0.102	0.15	0.1	0.1	0,35	Quater 2
NO_2	0.136	0.135	0.128	0.087	0.107	0.068	0.12	0.112	0.113	0.134	0.117	0.089	0.112	0.112	0.093	0.14	0.09	0.09	0,2	
CO	5.12	4.83	5.1	4.95	5.03	4.83	4.95	4.63	4.93	5.51	5.71	4.79	4.25	5.34	4.95	5.55	4.86	4.86	30	
TSP	0.31	0.25	0.32	0.39	0.33	0.29	0.37	0.3	0.29	0.35	0.38	0.28	0.34	0.24	0.27	0.43	0.36	0.32	0,3	
Noise	71.6	68.4	68.9	67.1	69.3	72.5	67.8	66.7	67.2	69.6	66.1	69.3	68.5	70.2	73.6	71.9	67.5	68.7	70	
SO_2	0.118	0.105	0.129	0.112	0.136	0.099	0.153	0.131	0.138	0.157	0.143	0.107	0.119	0.146	0.122	0.14	0.13	0.12	0,35	Quater 3
NO_2	0.107	0.096	0.121	0.103	0.129	0.091	0.145	0.126	0.13	0.149	0.137	0.098	0.11	0.139	0.115	0.13	0.12	0.10	0,2	
CO	4.93	5.08	5.46	5.21	5.16	5.04	5.25	4.98	5.29	5.37	5.43	5.05	4.54	5.09	5.11	5.36	5.02	5.06	30	
TSP	0.36	0.22	0.38	0.31	0.37	0.24	0.42	0.39	0.34	0.3	0.36	0.25	0.38	0.33	0.2	0.35	0.31	0.38	0,3	
Noise	69.2	67.7	70.2	66.5	71.5	71.9	68.2	67.8	68.9	69.6	66.1	69.3	68.5	70.2	73.6	71.9	67.5	68.7	70	
SO_2	0.125	0.095	0.132	0.102	0.12	0.092	0.166	0.112	0.12	0.157	0.16	0.115	0.108	0.122	0.105	0.14	0.13	0.14	0,35	Quater 4
NO_2	0.112	0.086	0.125	0.092	0.11	0.083	0.155	0.102	0.11	0.142	0.15	0.106	0.098	0.108	0.093	0.16	0.12	0.14	0,2	
CO	4.72	5.63	5.1	4.85	4.66	5.26	5.44	5.37	5.55	5.12	5.66	5.05	4.75	5.21	5.46	5.85	5.72	4.98	30	

(Source: Environmental monitoring report of Di An City in the period ,2019)

The results of ambient air quality monitoring in Di An City in the period of 2019 show that most substances such as CO, SO_2, and NO2 are within the allowable limits of Vietnamese technical regulations. QCVN 05:2013/BTNMT), however, the 2 indicators are good sound and 3.2.1. Total suspended dust (TSP) has exceeded the allowable limit many times, in which area **K16 (Cay Lon junction)** is the area with the frequency of exceeding the limit. The main reason may be that this is a major traffic route located on National Highway 1A, so the traffic volume in this area is relatively high, thus affecting the air quality in this area.

3.1.2 Assessment of air quality in Di An Street

The Air Quality Index is an air quality index, which is used daily as a measure to know whether the air quality is polluted or not. No pollution. This index measures 5 parameters such as ground ozone, and molecular pollution (evaluated by dust PM 2.5, PM 10, or 3.2.1. Total suspended dust, CO, SO2, NO2, with 6 scales with different colors. To evaluate the quality. To calculate the air quality index in Di An City, the research uses the formula to estimate the air quality in 1 hour to calculate

TABLE 8. AQI in Di An City in the period of 2019

Area	AQI in Di An city in the period of 2019			
	Quarter I	Quarter II	Quarter III	Quarter IV
K1	120	126,7	103,3	120
K2	73,3	96,7	83,3	73,3
K10	140	123,3	116,7	100
K12	116,7	106,7	93,3	83,3
K7	116,7	93,3	123,3	140
K8	93,3	83,3	100	130
K9	106,7	90	96,7	113,3
K6	106,7	86,7	96,7	80
K11	120,0	96,7	126,7	120
K13	103,3	90,0	113,3	126,7
K16	150,0	136,7	143,3	116,7
K3	116,7	97	106,7	127
K5	120,0	93,3	110,0	123,3
K4	123,3	116,7	130	103,3
K14	110	93,3	113,3	110
K15	83,3	70	80	66,7
K17	113	103	120	103
K18	107	93	107	127

The results of the calculation of the AQI index in Di An City in the period of 2019 show that the city's air quality fluctuates at an average - poor level and the fourth quarter is the time the highest AQI index in the period. In the period 2019, in which the area K16 (Cay Lon junction) K1 (550 crossroads) and K17 (area Binh Thang Committee) is the area with the highest index of the points.

3.2 Assessment of health risks from exposure to substances

3.2.1. Total suspended dust

Total suspended dust (TSP) is a fairly common pollution parameter caused mainly by industrial and transportation activities, etc. increased respiratory risks such as respiratory infections, asthma, angioedema, cardiovascular diseases, and more seriously causing cancer.

TABLE 9. Total suspended dust exposure risk index in 2019 in Di An city

Area	Total suspended dust exposure risk index															
	Quarters 1				Quarters 2				Quarters 3				Quarters 4			
	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager
K1	0.236	0.248	0.180	0.192	0.249	0.262	0.190	0.203	0.203	0.213	0.155	0.166	0.236	0.248	0.180	0.192
K2	0.144	0.151	0.110	0.118	0.190	0.200	0.145	0.155	0.164	0.172	0.125	0.134	0.144	0.151	0.110	0.118
K12	0.229	0.241	0.175	0.187	0.210	0.220	0.160	0.171	0.183	0.193	0.140	0.150	0.164	0.172	0.125	0.134
K10	0.275	0.289	0.210	0.224	0.242	0.255	0.185	0.198	0.229	0.241	0.175	0.187	0.197	0.207	0.150	0.160
K7	0.229	0.241	0.175	0.187	0.183	0.193	0.140	0.150	0.242	0.255	0.185	0.198	0.275	0.289	0.210	0.224
K8	0.183	0.193	0.140	0.150	0.164	0.172	0.125	0.134	0.197	0.207	0.150	0.160	0.255	0.268	0.195	0.208
K9	0.210	0.220	0.160	0.171	0.177	0.186	0.135	0.144	0.190	0.200	0.145	0.155	0.223	0.234	0.170	0.182
K6	0.210	0.220	0.160	0.171	0.170	0.179	0.130	0.139	0.190	0.200	0.145	0.155	0.157	0.165	0.120	0.128
K11	0.236	0.248	0.180	0.192	0.190	0.200	0.145	0.155	0.249	0.262	0.190	0.203	0.236	0.248	0.180	0.192
K4	0.242	0.255	0.185	0.198	0.229	0.241	0.175	0.187	0.255	0.268	0.195	0.208	0.203	0.213	0.155	0.166
K14	0.164	0.172	0.125	0.134	0.138	0.145	0.105	0.112	0.177	0.186	0.135	0.144	0.216	0.227	0.165	0.176
K15	0.216	0.227	0.165	0.176	0.183	0.193	0.140	0.150	0.157	0.165	0.120	0.128	0.131	0.138	0.100	0.107
K17	0.223	0.234	0.170	0.182	0.203	0.213	0.155	0.166	0.236	0.248	0.180	0.192	0.203	0.213	0.155	0.166
K18	0.210	0.220	0.160	0.171	0.183	0.193	0.140	0.150	0.210	0.220	0.160	0.171	0.249	0.262	0.190	0.203
K3	0.229	0.241	0.175	0.187	0.190	0.200	0.145	0.155	0.210	0.220	0.160	0.171	0.249	0.262	0.190	0.203
K5	0.236	0.248	0.180	0.192	0.183	0.193	0.140	0.150	0.216	0.227	0.165	0.176	0.242	0.255	0.185	0.198
K13	0.203	0.213	0.155	0.166	0.177	0.186	0.135	0.144	0.223	0.234	0.170	0.182	0.249	0.262	0.190	0.203
K16	0.295	0.310	0.225	0.240	0.269	0.282	0.205	0.219	0.282	0.296	0.215	0.230	0.229	0.241	0.175	0.187

Through the calculation results of the carcinogen index (RISK) when exposed to Total suspended dust (TSP) in the surrounding air in Di An city and compared with the risk scale of the US organization The EPA (U.S. Environmental Protection Agency) found that all 4/4 of the subjects assessed had a high-RISK index (high cancer incidence when exposed to dust) on the EPA scale because Therefore, there is a need for options to control the Total suspended dust (TSP). Among the assessed subjects, the adult group (Men and Women) is the group that has a higher RISK index than the other group. In addition, the risk index (RISK) of the subjects tended to vary from time to time: In the first 2 quarters, the risk index (RISK) of the subjects was located (Q1 and Q2). However, in the third quarter, this index tends to increase strength and is the time with the highest index, however, in the fourth quarter, the risk index tends to reduce.

3.2.2. Exposure to Sulfur Dioxide (SO_2)

As a derivative product of sulfur, sulfur dioxide (SO2) is found in a lot of nature, industries, domestic activities, transportation, etc., due to the use of fossil fuels. In the natural environment, they can combine with water vapor in the air, and rainwater to form the corresponding acid compound and cause acid rain, which has serious effects on the ecosystem. On the other hand, exposure to sulfur dioxide in the air also causes serious problems for human health causing coughing, reduced lung function, increased respiratory problems such as asthma, and inflammation of the bronchi, …

TABLE 10. Hazard index of exposure to sulfur dioxide in 2019 in Di An city

Area	Hazard index (HI) of exposure to sulfur dioxide															
	Quarters 1				Quarters 2				Quarters 3				Quarters 4			
	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager
K1	1.227	1.289	0.938	1.001	1.281	1.346	0.979	1.045	1.065	1.119	0.814	0.868	1.128	1.185	0.862	0.920
K2	0.704	0.740	0.538	0.574	1.299	1.365	0.993	1.060	0.947	0.996	0.724	0.773	0.857	0.901	0.655	0.699
K12	0.740	0.777	0.566	0.604	0.866	0.910	0.662	0.707	0.965	1.015	0.738	0.788	1.038	1.090	0.793	0.846
K10	1.218	1.280	0.931	0.994	1.290	1.356	0.986	1.052	1.417	1.489	1.083	1.156	1.417	1.489	1.083	1.156
K7	1.218	1.280	0.931	0.994	1.173	1.233	0.897	0.957	1.381	1.451	1.055	1.126	1.498	1.574	1.145	1.222
K8	1.011	1.062	0.772	0.824	1.083	1.138	0.828	0.883	1.182	1.242	0.903	0.964	1.011	1.062	0.772	0.824
K9	1.173	1.233	0.897	0.957	1.119	1.176	0.855	0.913	1.245	1.308	0.952	1.016	1.083	1.138	0.828	0.883
K6	0.614	0.645	0.469	0.500	0.677	0.711	0.517	0.552	0.893	0.939	0.683	0.729	0.830	0.872	0.634	0.677
K11	1.299	1.365	0.993	1.060	1.164	1.223	0.890	0.949	1.290	1.356	0.986	1.052	1.444	1.517	1.103	1.178
K4	0.740	0.777	0.566	0.604	0.866	0.910	0.662	0.707	1.011	1.062	0.772	0.824	0.920	0.967	0.703	0.751
K14	0.993	1.043	0.759	0.810	0.920	0.967	0.703	0.751	1.101	1.157	0.841	0.898	0.947	0.996	0.724	0.773
K15	0.920	0.967	0.703	0.751	1.119	1.176	0.855	0.913	1.317	1.384	1.007	1.075	1.101	1.157	0.841	0.898
K17	0.956	1.005	0.731	0.780	0.893	0.939	0.683	0.729	1.128	1.185	0.862	0.920	1.200	1.261	0.917	0.979
K18	0.767	0.806	0.586	0.626	0.857	0.901	0.655	0.699	1.047	1.100	0.800	0.854	1.281	1.346	0.979	1.045
K3	1.281	1.346	0.979	1.045	1.308	1.375	1.000	1.067	1.164	1.223	0.890	0.949	1.191	1.252	0.910	0.972
K5	0.993	1.043	0.759	0.810	1.137	1.195	0.869	0.927	1.227	1.289	0.938	1.001	1.083	1.138	0.828	0.883
K13	0.920	0.967	0.703	0.751	1.137	1.195	0.869	0.927	1.074	1.128	0.821	0.876	0.974	1.024	0.745	0.795
K16	1.191	1.252	0.910	0.972	1.371	1.441	1.048	1.119	1.254	1.318	0.959	1.023	1.281	1.346	0.979	1.045

The results of the calculation of the hazard index for non-carcinogenic substances (HI) and comparison with the scale of US EPA (US Environmental Protection Agency) show that. When exposed to sulfur dioxide (SO2) in the surrounding air, 4/4 of the assessed subjects had the HI hazard index exceeding the limit according to the US EPA scale. However, in some areas, this index is still within the limits of the scale. Besides, the calculated results also show that the toxicity index of subjects when exposed to sulfur dioxide tends to increase specifically in the first 3 quarters of 2019 the hazard index tends to increase and The third quarter of 2019 is the time when the index is the highest in four quarters, but in the fourth quarter, this index tends to reduce.

3.2.3. Xposure to Nitrogen dioxide (NO_2)

Nitrogen dioxide is also a product generated from the processes of using fossil fuels in industry, as well as in human daily life. Besides, they are also found in the natural environment due to the biogeochemical cycle of nitrogen. Similar to sulfur dioxide, when nitrogen dioxide comes in contact with water vapor in the air, rainwater, etc., it can form acids, which causes acid rain. When exposed to NO2 in the air they can also cause symptoms of pneumonia, damage to the trachea, respiratory infections, and lung damage, more seriously can be fatal depending on the concentration of exposure. They cause different symptoms.

TABLE 11. Hazard index of exposure to Nitrogen dioxide in 2019 in Di An city

Area	Hazard index (HI) of exposure to Nitrogen dioxide															
	Quarters 1				Quarters 2				Quarters 3				Quarters 4			
	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager
K1	1.624	1.707	1.241	1.325	1.841	1.934	1.407	1.501	1.448	1.522	1.107	1.181	1.516	1.593	1.159	1.236
K2	0.947	0.996	0.724	0.773	1.827	1.920	1.397	1.490	1.299	1.365	0.993	1.060	1.164	1.223	0.890	0.949
K12	1.015	1.067	0.776	0.828	1.205	1.266	0.921	0.983	1.326	1.394	1.014	1.082	1.435	1.508	1.097	1.170
K10	1.570	1.650	1.200	1.281	1.814	1.906	1.386	1.479	2.017	2.119	1.541	1.645	1.922	2.020	1.469	1.568
K7	1.746	1.835	1.334	1.424	1.624	1.707	1.241	1.325	1.963	2.062	1.500	1.601	2.098	2.204	1.603	1.711
K8	1.381	1.451	1.055	1.126	1.516	1.593	1.159	1.236	1.705	1.792	1.303	1.391	1.381	1.451	1.055	1.126
K9	1.556	1.636	1.190	1.270	1.529	1.607	1.169	1.248	1.759	1.849	1.345	1.435	1.489	1.564	1.138	1.214
K6	0.812	0.853	0.621	0.662	0.920	0.967	0.703	0.751	1.232	1.294	0.941	1.005	1.123	1.180	0.859	0.916
K11	1.868	1.963	1.428	1.524	1.584	1.664	1.210	1.292	1.854	1.948	1.417	1.512	2.030	2.133	1.552	1.656
K4	1.015	1.067	0.776	0.828	1.178	1.237	0.900	0.960	1.394	1.465	1.066	1.137	1.245	1.308	0.952	1.016
K14	1.299	1.365	0.993	1.060	1.259	1.323	0.962	1.027	1.556	1.636	1.190	1.270	1.259	1.323	0.962	1.027
K15	1.164	1.223	0.890	0.949	1.516	1.593	1.159	1.236	1.881	1.977	1.438	1.535	1.462	1.536	1.117	1.192
K17	1.164	1.223	0.890	0.949	1.191	1.252	0.910	0.972	1.584	1.664	1.210	1.292	1.651	1.735	1.262	1.347
K18	1.042	1.095	0.797	0.850	1.164	1.223	0.890	0.949	1.394	1.465	1.066	1.137	1.841	1.934	1.407	1.501
K3	1.787	1.877	1.366	1.457	1.732	1.820	1.324	1.413	1.638	1.721	1.252	1.336	1.692	1.778	1.293	1.380
K5	1.353	1.422	1.034	1.104	1.448	1.522	1.107	1.181	1.746	1.835	1.334	1.424	1.489	1.564	1.138	1.214
K13	1.191	1.252	0.910	0.972	1.516	1.593	1.159	1.236	1.489	1.564	1.138	1.214	1.326	1.394	1.014	1.082
K16	1.624	1.707	1.241	1.325	1.949	2.048	1.490	1.590	1.787	1.877	1.366	1.457	2.098	2.204	1.603	1.711

The calculation results of the index of non-carcinogenic substances (HI) show that all 4/4 of the assessed subjects have a hazard index (HI) that exceeds the limit of the US EPA's scale. US Environmental Protection Agency) ie when exposure to NO2 in the air around them can cause health effects, among the assessed subjects, the Adult group (Men and Women) are 2 subjects with a higher hazard index than the other group. Besides, the calculation results also show that the hazard index (HI) of the subjects has a specific increase in the 3 quarters of 2019, and the hazard index (HI) of the subjects tends to increase. increase in which the third quarter of 2019 is the time when the HI index is the highest, however, in the fourth quarter, there is an uneven increase and decrease.

3.2.4. Exposure to Carbon Monoxide (CO)

Carbon Monoxide is a derivative of Carbon in nature, they often combine with oxygen in the air to form CO2 and is one of the causes of the current greenhouse effect similar to sulfur and nitrogen dioxide. CO2 also can react with water vapor in the air to form the corresponding acid, but due to its unstable nature, it often decomposes to become CO2 and water. In the current context, CO is emitted mainly from activities that use fossil fuels, incomplete combustion activities, and especially transportation activities. Exposure to CO in the air can cause symptoms such as headaches, dizziness, and effects on the heart. In addition, they have an affinity for hemoglobin and can displace oxygen in the blood.

TABLE 12. Hazard Index of Exposure to Carbon Monoxide in 2019 in Di An City

Area	Hazard index (HI) of exposure to Carbon Monoxide															
	Quarters 1				Quarters 2				Quarters 3				Quarters 4			
	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager	Men	Women	Children	Teenager
K1	49.374	32.427	7.257	7.628	55.437	36.409	8.149	8.564	53.380	35.058	7.846	8.247	51.106	33.564	7.512	7.895
K2	49.266	51.769	37.655	40.186	52.297	34.347	7.687	8.079	55.004	36.124	8.085	8.497	60.959	40.036	8.960	9.417
K12	58.036	38.116	8.531	8.966	51.864	34.062	7.623	8.012	54.679	35.911	8.037	8.447	54.679	35.911	8.037	8.447
K10	55.437	36.409	8.149	8.564	59.660	39.182	8.769	9.217	58.144	38.187	8.546	8.983	55.437	36.409	8.149	8.564
K7	58.686	38.542	8.626	9.066	53.597	35.200	7.878	8.280	56.845	37.333	8.355	8.782	58.902	38.684	8.658	9.100
K8	46.992	30.862	6.907	7.260	50.132	32.924	7.369	7.745	53.921	35.413	7.926	8.330	58.144	38.187	8.546	8.983
K9	47.100	30.933	6.923	7.276	53.380	35.058	7.846	8.247	57.278	37.618	8.419	8.849	60.093	39.467	8.833	9.284
K6	53.921	35.413	7.926	8.330	52.297	34.347	7.687	8.079	54.571	35.840	8.021	8.431	56.953	37.404	8.371	8.799
K11	54.354	35.698	7.989	8.397	61.826	40.604	9.088	9.551	58.794	38.613	8.642	9.083	61.284	40.249	9.008	9.468
K4	50.565	33.209	7.432	7.812	53.597	35.200	7.878	8.280	56.412	37.049	8.292	8.715	52.514	34.489	7.719	8.113
K14	90.302	59.307	13.273	13.951	53.597	35.200	7.878	8.280	55.329	36.338	8.133	8.548	59.119	38.827	8.690	9.133
K15	57.170	37.547	8.403	8.832	57.819	37.973	8.499	8.932	58.036	38.116	8.531	8.966	56.412	37.049	8.292	8.715
K17	50.348	33.067	7.401	7.778	52.622	34.560	7.735	8.129	54.354	35.698	7.989	8.397	61.934	40.676	9.103	9.568
K18	56.845	37.333	8.355	8.782	52.622	34.560	7.735	8.129	54.788	35.982	8.053	8.464	53.921	35.413	7.926	8.330
K3	57.928	38.044	8.515	8.949	55.221	36.267	8.117	8.531	59.119	38.827	8.690	9.133	55.221	36.267	8.117	8.531
K5	50.673	33.280	7.448	7.828	54.463	35.769	8.005	8.414	55.870	36.693	8.212	8.631	50.457	33.138	7.416	7.795
K13	44.826	29.440	6.589	6.925	46.017	30.222	6.764	7.109	49.157	32.284	7.225	7.594	51.431	33.778	7.560	7.945
K16	61.609	40.462	9.056	9.518	60.093	39.467	8.833	9.284	58.036	38.116	8.531	8.966	63.341	41.600	9.310	9.785

The results of calculating the index of non-carcinogenic substances (HI) of 4/4 assessed subjects showed that the toxicity index (HI) of 4 subjects all exceeded the threshold limit of the US EPA scale. US Environmental Protection Agency) i.e. when exposed to CO in the air around them has the potential to cause adverse health problems in which the target group of Adults (Men and Women) are 2 subjects. has only the highest poison. In addition, the calculated results also show that the toxicity index (HI) of the subjects tended to increase and decrease unstable in the first 3 quarters of 2019, but in the fourth quarter, there were signs of an increase. strong.

Eventually, Fine dust plus a lot of CO or SO2, NO2 will prevent hemoglobin from combining with oxygen, causing cells to lack oxygen, causing irritation to the eyes, nose, throat, and lungs, coughing, sneezing... and respiratory diseases. In addition, toxins in dust entering the human body will cause chronic obstructive pulmonary disease (COPD). With many initial studies, with 4 exposure indicators such as TSP, SO2, NO2, and CO. TSP index is the most mentioned index today.

Especially, PM2.5 is also known as the "silent killer" because it can promote cirrhosis and increase the risk of metabolic diseases and liver dysfunction. PM2.5 causes insulin resistance, inflammation, and increased diabetes complications. Fine dust also attacks the alveoli, crosses the gas-blood barrier to enter the circulatory system, and causes disease, affecting the nervous system. To protect themselves, adults as well as children should wear masks when going out, limit circulation at times of busy traffic, and avoid areas that are often polluted such as industrial parks, and highways.... Use a specialized mask to prevent the harmful effects of ultrafine dust.

4. Conclusion

Research results show that the concentration of substances in the surrounding air of Di An City is still within the limits of Vietnamese technical regulations on ambient air (QCVN 05:2013/BTNMT). However, 2 indicators, namely total dust (TSP) and noise, still exceed the limit of technical regulations. In addition, the calculated results of the Air Quality Index (AQI) also show that the air quality in Di An City has been fluctuating at a poor average level with the highest index of 150 in the first quarter of this year. I am in area K16 (Cay Lon junction) in Dong Hoa ward. Regarding the results of the health risk assessment for subjects, it was shown that when exposed to dust, the total group of adults (Women and Men) had a high level of carcinogenic risk index with the index being The highest of the two subjects in the first quarter 0.310, 0.295, in the second quarter 0.269, 0.282, in the third quarter 0.296, 0.282, in the fourth quarter 0.289, 0.275.

For other indicators, the calculation results show that the subjects assessed when exposed to substances in the air environment in Di An city can be affected to health, in which the

adult target group (Women and men) is the highest affected group out of the 4 assessed subjects. But when exposed to Carbon Monoxide, male subjects tend to be affected more.

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