ASSESSMENT OF AIR QUALITY IN 2023 AT INDUSTRIAL ZONES IN BINH DUONG PROVINCE

Lê Nguyễn Hoài An[(1)], Đào Minh Trung[(2)]
(1) Thu Dau Mot University
Corresponding author: trungdm@tdmu.edu.vn

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Abstract

The 2023 air quality assessment was conducted at five key industrial sites (Song Than II Industrial Zone, Thuan Giao Industrial Cluster, Thuong Tan Quarry, My Phuoc II Industrial Zone, Bau Bang Industrial Zone) in Binh Duong province, aiming to evaluate the potential air pollution in surrounding areas and the health impacts on workers in nearby residential areas. The survey results for several air pollution parameters, including NO2, total suspended particulates (TSP), and noise levels from the 2023 monitoring data provided by the Center for Environmental Monitoring and Technical Resources in Binh Duong province, indicated that at the Thuong Tan Quarry, TSP concentrations ranged from 26.0 to 374.8µg/Nm3, exceeding the standard by 74.8µg/Nm3 according to QCVN 05:2023/BTNMT. Noise levels at the quarry ranged from 59.7 to 72.1 dB(A), exceeding the standard by 2.1 dB(A) according to QCVN 26:2010/BTNMT. Additionally, air quality monitoring results at various industrial sites in Binh Duong indicated that the annual average levels of air pollutants at these industrial zones met the permissible limits set by QCVN 05:2023/BTNMT and QCVN 26:2010/BTNMT, with TPS concentrations ranging from 11.5 to 374.8µg/Nm3, noise levels from 57 to 72.1 dB(A), and NO2 concentrations from 18 to 85.5µg/Nm3. According to the 2023 air quality results, air quality in industrial zones has relatively improved compared to previous years, although some monitoring points still exceed the regulatory limits. Due to the different nature of production activities at the quarry compared to other industrial sites, more dust and noise are generated, necessitating management measures for production equipment and technological changes.

Keywords: air quality, Binh Duong, industrial zones, industrial air pollution

1. Introduction

Over the past decade, Binh Duong has experienced rapid industrial development, achieving the highest GDP growth rate in the country. However, alongside economic development, environmental pollution has also increased, with air pollution being a particularly pressing issue that requires strict management and control. In areas with high levels of industrial development, air quality is significantly impacted and undergoes

complex variations over time. Air pollution refers to major changes in the composition of the atmosphere caused by smoke, dust, vapours, or unusual gases introduced into the air, resulting in odours, reduced visibility, and climate change. Air pollution is a pressing issue globally, and Vietnam is no exception. According to the annual Environmental Performance Index (EPI) report conducted by the American Environmental Organization, Vietnam is ranked among the top 10 most air-polluted countries in Asia, with significant levels of particulate matter pollution (PM 10, PM 2.5) (Zhongshan Yang et at., 2017; Vietnam Communist Party Online Newspaper, 2021).

Binh Duong is one of the key industrial development areas in southern Vietnam. According to the Management Board of Binh Duong Industrial Zones, by the end of 2023, the province had established 29 industrial zones, with a total planned area of over 12,700 hectares. Of these, 28 industrial zones are operational, covering over 10,000 hectares. These zones have a land lease occupancy rate of over 90%, primarily attracting investment, especially from foreign direct investment (FDI) enterprises in the manufacturing and processing industries. The province is planning an additional 15 industrial zones, with a total area of 10,200 hectares, to meet the demand for attracting and allocating investment projects (Vietnam Communist Party Online Newspaper, 2023). With the multi-sector development in these industrial zones, a significant amount of waste is released into the atmosphere, causing air pollution. This pollution is identified through the analysis of several key parameters, including TSP concentration, noise levels, and NO_2.

Each year, the Center for Environmental Monitoring and Technical Resources in Binh Duong monitors environmental indicators at various typical industrial zones, such as Song Than II Industrial Zone, Victory Company (located 300 meters from Thuan Giao Industrial Cluster), the quarry area in Thuong Tan commune (Bac Tan Uyen district), My Phuoc II Industrial Zone, and the Bau Bang Urban-Industrial Zone. These industrial zones house a wide range of industries, from garment manufacturing, dyeing, automotive component production, and food processing to heavy industries such as quarrying. Each industry generates its specific type of waste, all of which impacts air quality. Monitoring air quality in these industrial zones is crucial because, according to annual monitoring results, dust and noise levels at certain points exceed the permissible limits set by QCVN 05:2023/BTNMT and QCVN 26:2010/BTNMT in some months, although not continuously. This is a concerning trend. Without control measures, the number of months exceeding the limits will likely increase, further impacting overall air quality throughout the year (Vietnam Communist Party Online Newspaper, 2021, 2023).

To assess the level of air pollution at industrial zones in Binh Duong, the study "assessment of air quality in 2023 at industrial zones in Binh duong province" must be conducted annually.

2. Research methodology

2.1. Research content

Content 1: Statistical analysis and assessment of air quality at industrial zones in Binh Duong province.

Objective: To compile and analyze air pollution parameters in comparison with QCVN 05:2023/BTNMT and QCVN 26:2010/BTNMT.

Methodology:

○ Compile monitoring data on TSP concentration, NO2 concentration, and noise levels from December 2022 to December 2023, provided by the Center for Environmental Monitoring and Technical Resources of Binh Duong province.

○ Represent the trend of pollution levels for each parameter through charts created in Excel.

 Content 2: Propose solutions for improving air quality management.

Objective: To propose suitable solutions for improving air quality and its management.

Methodology:

○ Study state and technical management methods.

○ Propose optimal solutions that can be implemented in both the short and long term.

2.2. Research area

Binh Duong's terrain is relatively flat, consisting of narrow plains along the Dong Nai and Saigon rivers, ancient alluvial terraces, and some remaining hilly areas, including steep, isolated peaks rising prominently amid the flat terraces, such as Chau Thoi Mountain (Dĩ An) at 82 meters, Ong Mountain (Dau Tieng) at 284.6 meters, and Cau Mountain (Dau Tieng) at 155 meters. Currently, air quality monitoring in Binh Duong is conducted by the Center for Environmental Monitoring and Technical Resources, as per Decision No. 918/2012/QD-UBND dated April 6, 2012, by the People's Committee of Binh Duong Province, which approved the provincial environmental monitoring network plan. This network includes 16 monitoring points with a frequency of once a month for 12 months a year (Vietnam Communist Party Online Newspaper, 202). Five of these points are located in industrial zones (Table 1).

TABLE 1. Air Quality Monitoring Locations at Industrial Sites in 2023

Code	Coordinates		Location
	Latitude (Y[m])	Longitude (Y[m])	
CN1	692031,997	1204772,562	Song Than II Industrial Zone, Di An Town
CN2	688094,444	1213568,859	Near Thuan Giao Industrial Cluster, Thuan An City
CN3	706571,700	1220624,930	Thuong Tan Quarry, Bac Tan Uyen District
CN4	678344,288	1230998,006	My Phuoc II Industrial Zone, Ben Cat Town
CN5	678184,286	1243472,264	Bau Bang Industrial Zone, Bau Bang District

(2023 Air Quality Monitoring Report by the Center for Environmental Monitoring and Technical Resources of Binh Duong Province)

2.3. Research Methods

Data Collection and Analysis Methods

The data was collected from the monitoring results of the Center for Environmental Monitoring and Technical Resources of Binh Duong Province for the purpose of analyzing and assessing air quality. The data was collected continuously from December 2022 to December 2023. The monitored parameters included TSP (total suspended particulates) concentration, noise levels, and NO_2 concentration. The sampling method was carried out according to standards (TCVN 6663-1:2011, TCVN 6663-3:2008, TCVN 6663-6:2008); preservation and transportation of samples followed the standard (TCVN 6663-14: 2000).

TABLE 2. List of Monitoring Equipment

No	Equipment Name	Equipment model	Manufacturer	Calibration frequency
1	Dust Sampling and Atmospheric Pressure Device	HV - 500R	Japan	1 year
2	SKC NO2 Sampler	224 - PCXR8	USA	1 year
3	Noise Meter RION - 21	NL - 21	Japan	1 year

(2023 Air Quality Monitoring Report by the Center for Environmental Monitoring and Technical Resources of Binh Duong Province)

Statistical Method: Microsoft Excel software was used to compile the data and visually represent air pollution levels.

Comparison Method: The results were compared with QCVN 05:2023/BTNMT (National Technical Regulation on Air Quality) and QCVN 26:2010/BTNMT (National Technical Regulation on Noise).

3. Results and Discussion

3.1. Results of Air Quality Assessment Due to Industrial Activities Based on TSP Concentration in Binh Duong Province

Monitoring results from December 2022 to December 2023 indicate that TSP (total suspended particulates) concentrations ranged from 11.5 to 374.8µg/Nm³. The highest dust concentration was recorded in March 2023, reaching 374.8µg/Nm³ at location CN3, while the lowest concentration was recorded in March 2023 at location CN4. Over this period, 4 out of 13 months (from December 2022 to March 2023) exceeded the QCVN 05:2023/BTNMT standard (300µg/Nm³), with levels ranging from 326.8 to 374.8µg/Nm³, primarily at location CN3. The trends in TSP pollution levels at industrial monitoring points in 2023 are shown in Figure 1.

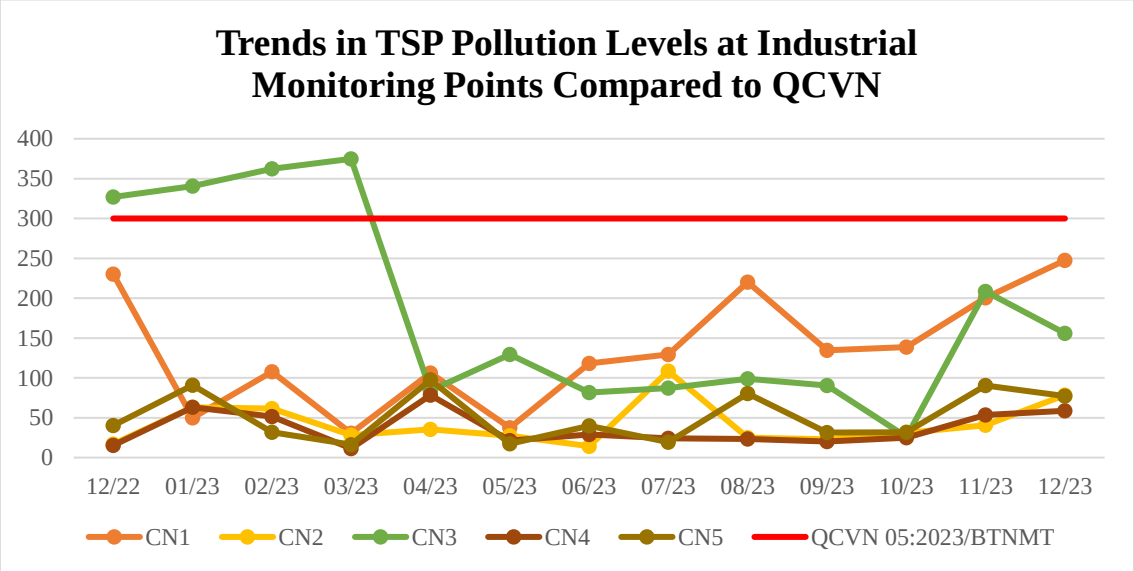

Figure 1. Chart of TSP Pollution Trends at Industrial Monitoring Points Compared to QCVN 05:2023/BTNMT

3.2. Results of Air Quality Assessment Due to Industrial Activities Based on NO2 Concentration in Binh Duong Province

Most of the monitoring locations did not exceed the QCVN 05:2023/BTNMT standard (200µg/Nm³) during the monitoring period. However, based on the NO_2 pollution trend chart shown in Figure 2, it can be observed that towards the end of the year, NO_2 concentrations tended to gradually increase, ranging from 18 to 85.5µg/Nm³. The highest NO_2 concentration was recorded in December 2023, reaching 85.5µg/Nm³ at location CN2 (near Thuan Giao Industrial Cluster, Thuan An City). In December 2022, NO_2 concentration at CN4 (My Phuoc II Industrial Zone, Ben Cat Town) was only 22µg/Nm³, which was not the lowest of the year. However, within just one year, NO_2 concentrations had increased by 3.8 times compared to the beginning of the year, as shown in Figure 2.

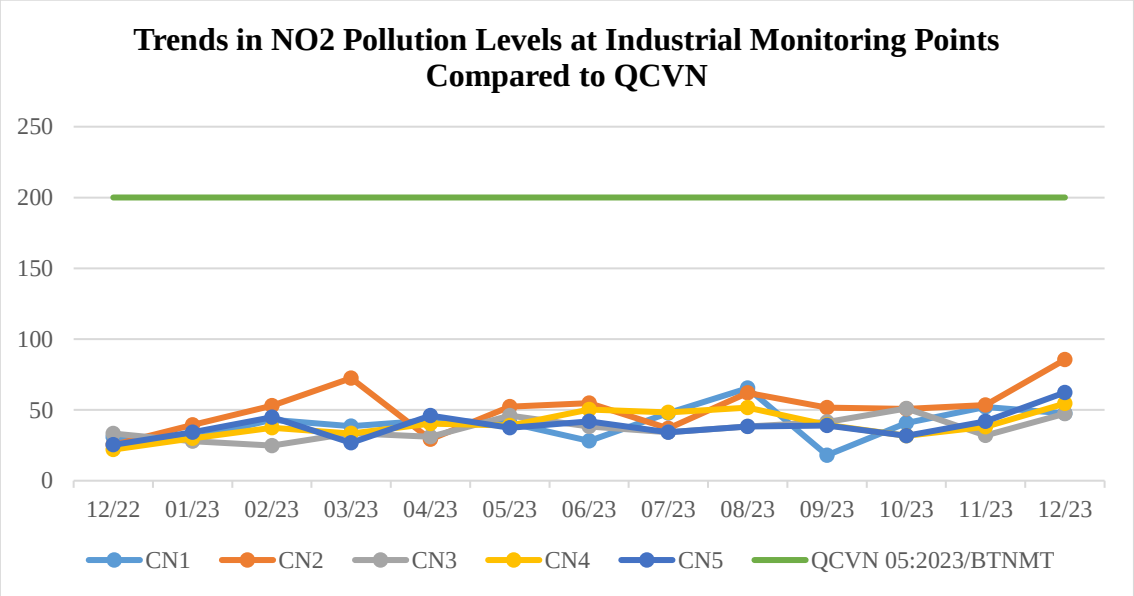

Figure 2. Chart of NO2 Pollution Trends at Industrial Monitoring Points Compared to QCVN 05:2023/BTNMT.

Compared to the projected NO_2 pollution scenario at Thuong Tan Quarry, Bac Tan Uyen District, which ranged from 0 to 35.8µg/m³ in 2019 (Bui Ta Long et al., 2019), the NO2 concentration in 2023 has increased by 2.3 times. This indicates a gradual rise in NO_2 concentrations due to industrial activities.

3.3. Results of Air Quality Assessment Due to Industrial Activities Based on Noise Levels in Binh Duong Province

From December 2022 to December 2023, noise levels ranged from 57 to 72.1dB(A). Specifically, the highest noise level was recorded in January 2023, reaching 72.1dB(A) at location CN3 (Thuong Tan Quarry, Bac Tan Uyen District), and the lowest noise level was recorded in March 2023, reaching 57 dB(A) at location CN5 (Bau Bang Industrial Zone, Bau Bang District). During the monitoring period, only one month (March 2023) exceeded the QCVN 26:2010/BTNMT standard (70dB(A)). Although the number of months exceeding the standard was low, most of the monitored locations recorded noise levels close to the QCVN 26:2010/BTNMT threshold, which is a cause for concern. Without proper control measures, noise levels could potentially exceed the threshold in the future. The trends in noise pollution are shown in Figure 3.

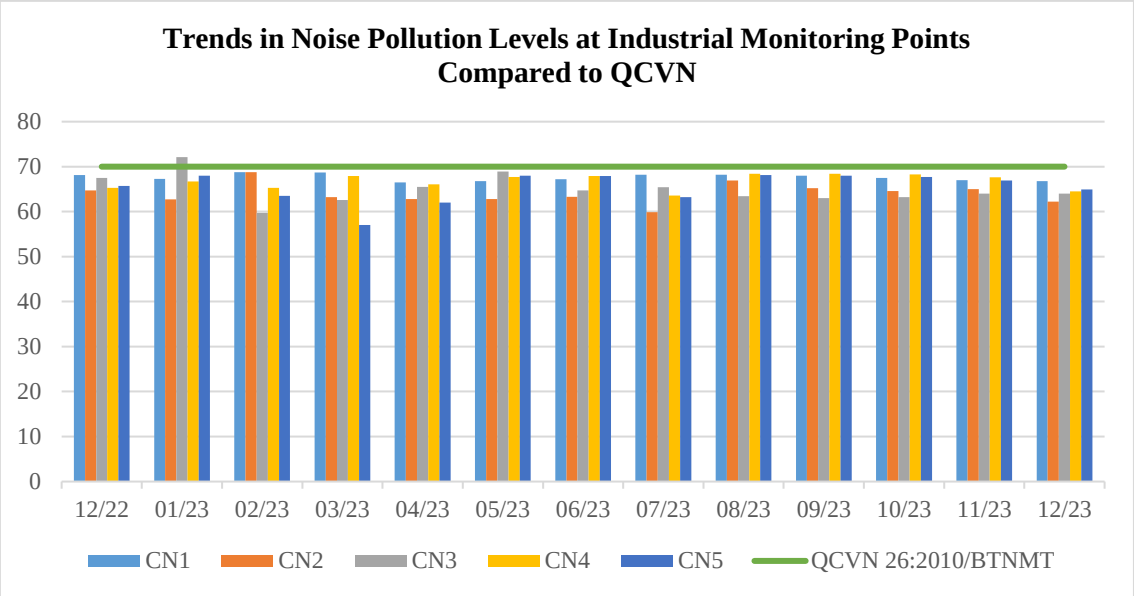

Figure 3. Chart of Noise Pollution Trends at Industrial Monitoring Points Compared to QCVN 26:2010/BTNMT.

Based on the monitoring results and data analysis, it was observed that dust concentrations tend to increase during the dry season, from November to April of the following year, as the hot and dry weather provides favorable conditions for suspended particles to spread. NO_2 concentrations show an upward trend in August, as this period is the peak of stable production, leading to increased production demand and higher workforce numbers. In terms of noise, pollution levels remain close to the regulatory threshold set by the state. The concentrations of pollutants vary depending on changes in temperature and humidity and tend to rise sharply during peak production periods.

3.4. Proposed Solutions

Based on the monitoring results for TSP concentrations, noise levels, and NO_2 concentrations, it is evident that air quality is gradually deteriorating due to rapid industrial development. To improve air quality, several solutions need to be implemented as follows:

• Technical Measures: Install emission treatment systems such as chemical vapor recovery systems and on-site emission treatment systems to ensure that emissions meet the QCVN 05:2023/BTNMT standards. Replace and upgrade outdated machinery with modern production lines; improve production technology and equipment.

• Management Measures: Issue legal documents on air environmental protection; the government should establish strict regulations regarding air quality in industrial zones. Regularly inspect and monitor air quality at factories and pollution-emitting points and apply appropriate penalties for violations.

4. Conclusion

The research results indicate that TSP concentrations at industrial monitoring points met the standard, except for the Thuong Tan Quarry in the first three months of 2023, where levels exceeded the standard by 74.8µg/Nm³ compared to QCVN 05:2023/BTNMT.

Noise pollution was found to exceed the limit at Thuong Tan Quarry in January 2023, surpassing the standard by 2.1dB(A) compared to QCVN 26:2010/BTNMT. NO2 concentrations at monitoring points remained within permissible limits, meeting the QCVN 05:2023/BTNMT standards.

The data analysis shows that dust concentrations tend to increase during the dry season due to the current climate change, which is causing longer periods of hot weather in Binh Duong, likely leading to increased concentrations in the coming years. Therefore, to improve air quality at industrial monitoring points, it is necessary to strictly implement legal and technical management measures at production facilities.

The study was conducted at five monitoring points from December 2022 to December 2023, thus covering a limited number of locations and a short period of time. As a result, it has not yet been possible to identify the industries or regions that significantly impact air quality in the province. Therefore, longer-term research (3 to 5 years) with more monitoring points is required to conduct a detailed assessment and identify the root causes of air pollution, thereby proposing suitable solutions.

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