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Analysis Of The Change Law Of The Concentration Of Major Atmospheric Pollutants In Mian Yang

*Zhao Xirui, He Feng, Zhou Peng**

Zhao Xirui (1999-), Female, B.S., working in chemistry research. College of Science, Tibet University, Lhasa, Tibet 850000. E-mail: 1952992733@qq.com

He Feng, Male, College of Science, Tibet University, Lhasa, Tibet 850000.

Zhou Peng (1992-), Male, Assistant Professor, Master of Science, mainly engaged in environmental quality assessment research. College of Science, Tibet University, Lhasa, Tibet 850000. E-mail: 944623291@qq.com

**Corresponding author: Zhou Peng*

Abstract: By analyzing the monitoring data of the main pollutants (NO2, CO, SO2, O3, PM2.5, PM10) in the atmosphere of Mian yang from 2017 to 2021, this paper reveals the changes in the annual and seasonal concentrations of various pollutants during this period, and proposes measures to control air pollution, to provide a preliminary reference for improving the air quality of Mian yang.

Keywords: Mian Yang, Atmospheric Pollutants, Concentration Change, Regular Analysis

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1 INTRODUCTION

More scholars have found that the southwest region is the area with high value of particulate matter concentration in China, among which the Sichuan basin is a high incidence of haze in China. In the winter of 2017, A regional heavy air pollution event occurred in the Sichuan basin and lasted for fifteen days, making two major cities in Sichuan province on the "$PM_{2.5}$ improvement plan not completed" eco-environmental bulletin list for that year, one of which was Mian yang[1]. Mian yang, the second second-largest city in Sichuan Province, is located in the northwestern part of the Sichuan Basin at latitude 30°42′-33°03′ N and longitude 103°45′-105°43′ E. It has a subtropical humid monsoon climate. With the implementation of a series of energy conservation and emission reduction measures and other related controls by the Mianyang government, air quality in the region has improved to some extent, but there is still a need to continue to improve the system and find ways to improve air quality locally.

2 DATA AND METHODS

2.1 Data Source

The meteorological data for 2017-2021 used in this paper are obtained from the climate data of the Mian yang site of the China Meteorological Data Network, and the monitoring indicators include O_3, $PM_{2.5}$, PM_{10}, NO_2, CO, and SO_2, covering the basic pollutant monitoring data of Mian yang city from 2017 to 2021.

2.2 Analysis Method

This paper, based on technical specifications such as "Technical Specifications for Ambient Air Quality Evaluation" (Trial)[3] and "Technical Provisions for Ambient Air Quality Index (AQI)" (for trial implementation)[4], uses arithmetic averaging and other methods to evaluate and analyze the relevant indicators, and plots the annual and seasonal variation characteristics of each indicator concentration by Excel software. Among them, January to March is spring, April to June is summer, July to September is autumn, and October to December is winter.

3 RESULTS AND ANALYSIS

3.1 Change in Annual Average Concentration

The analysis results show that during the period 2017-2021, the average concentrations of $PM_{2.5}$ in Mian yang is 44.5 $\mu g \cdot m^{-3}$, PM_{10} is 69.9 $\mu g \cdot m^{-3}$, NO_2 is 42.1 $\mu g \cdot m^{-3}$, CO is 0.8 $\mu g \cdot m^{-3}$, SO_2 is 7.6 $\mu g \cdot m^{-3}$, and O_3 is 87.6 $\mu g \cdot m^{-3}$. According to the Technical Specification for Ambient Air Quality Evaluation (Trial), the concentration limits for secondary standards for PM_{10}, NO_2, SO_2, and $PM_{2.5}$ are 70 $\mu g \cdot m^{-3}$, 40 $\mu g \cdot m^{-3}$, 60 $\mu g \cdot m^{-3}$, and 35 $\mu g \cdot m^{-3}$, respectively. In

2021, the annual average concentrations of PM_{10}, NO_2, SO_2, and $PM_{2.5}$ in Mian yang will be 59.3 $\mu g \cdot m^{-3}$, 35.3 $\mu g \cdot m^{-3}$, 5.7 $\mu g \cdot m^{-3}$, and 39.2 $\mu g \cdot m^{-3}$, where the annual average concentration of SO_2 is below the primary concentration limit (20 $\mu g \cdot m^{-3}$) and the concentration values of PM_{10} and NO_2 are also below the secondary concentration limit in the ambient air quality standard, all are to meet the national requirements standards. The annual average concentration of $PM_{2.5}$. however, has exceeded the secondary concentration limit of the ambient air quality standards and requires focused prevention and control. And Between 2017 and 2021, the annual average concentrations of $PM_{2.5}$ and PM_{10} show a decreasing trend and gradually equalize, Annual average concentrations of SO_2 and NO_2 are decreasing year by year.

3.2 Seasonal Concentration Variation

3.2.1 Changes in seasonal concentrations of $PM_{2.5}$ and PM_{10}

As shown in Figure 1, during 2017-2021, seasonal concentrations of both $PM_{2.5}$ and PM_{10} perform as spring > winter > summer > autumn. Reasons for higher concentrations in spring and winter include: October - March period, due to cold weather, will form an inversion layer, resulting in horizontal diffusion of atmospheric pollutants and vertical convection is more difficult, and then the formation of heavy pollution; People use more coal for heating, thus forming more particulate matter; Less rainfall in the cold season, less effective in flushing pollutants from the air. During this period, the $PM_{2.5}$ and PM_{10} concentrations decreased most significantly in the spring, followed by winter, while the $PM_{2.5}$ and PM_{10} concentrations in summer and autumn tended to be stable.

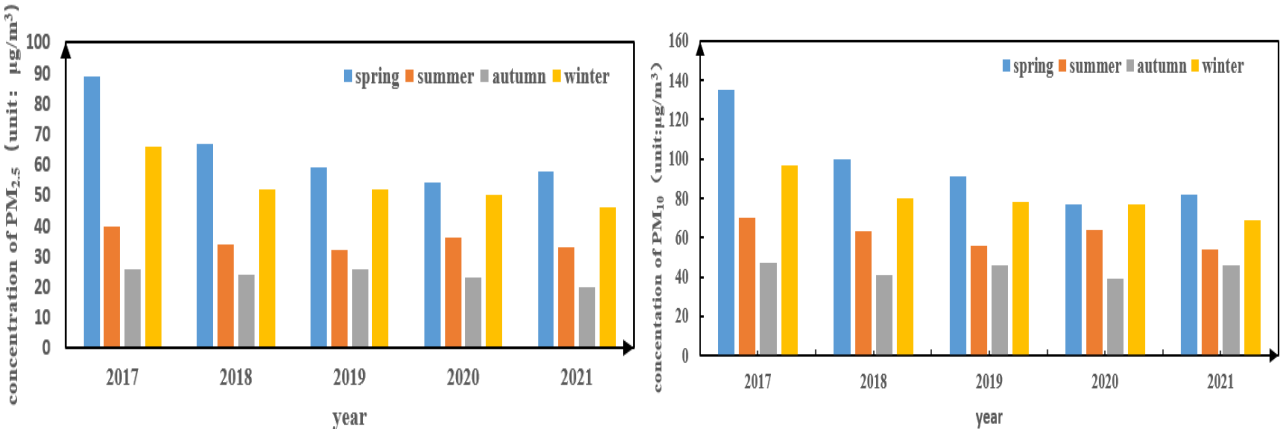

FIG.1 SEASONAL VARIATION OF $PM_{2.5}$ AND PM_{10} CONCENTRATION IN MIAN YANG FROM 2017-2021

3.2.2 Seasonal concentration changes of SO_2 and NO_2

As shown in Figure 2, the decreasing trend of SO_2 concentration from 2017-2021 is obvious and the concentration of SO_2 is better controlled in each season, which is due to the efforts of Mian yang City to prevent and control SO_2 pollution after many years. The decreasing trend of NO_2 concentration is also obvious, but the concentration of NO_2 in spring and winter is still high, which is the key season for future control. The main reason is that from October to March,

the use of coal increases due to heating, and motor vehicle emissions increase, which leads to an increase in NO_2 content and increases the formation of haze. And when the humidity increases, the diffusion conditions are more favorable, so in summer and autumn, the NO_2 content will be reduced.

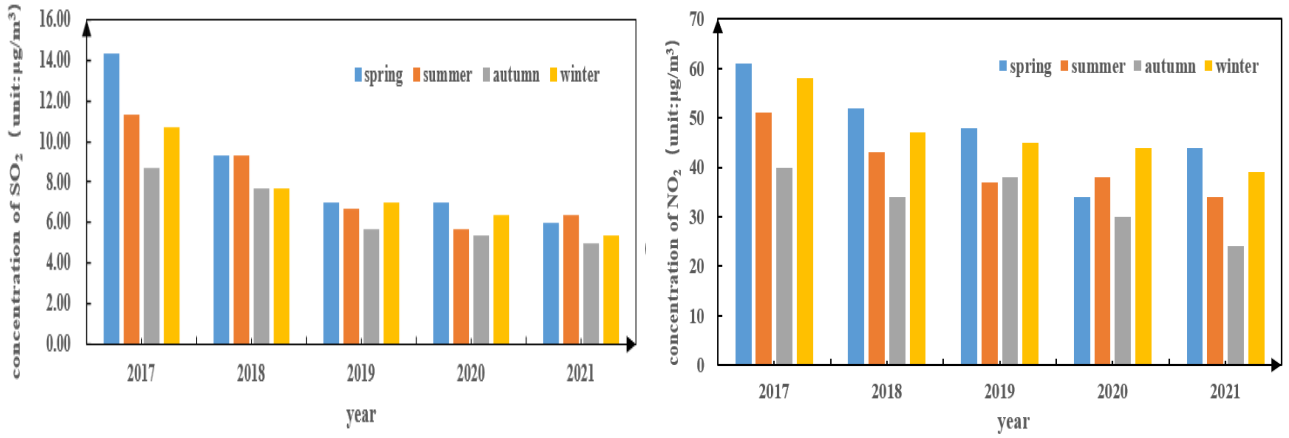

FIG.2 SEASONAL VARIATION OF SO_2 AND NO_2 CONCENTRATION IN MIAN YANG FROM 2017-2021

3.2.3 Changes in seasonal concentrations of O_3 and CO

As shown in Figure 3, In 2017-2021, seasonal concentrations of O_3 exhibit significantly higher concentrations in summer (April-June) and autumn (July-September) than in spring (January-March) and winter (October-December), where spring concentrations are higher than winter concentrations. The main reason is that when the temperature is low and the solar radiation is low, the photochemical reaction is not active and less ozone is produced. As global warming continues, the photochemical reactions become more active as temperatures rise and solar radiation intensifies, thus increasing the concentration of ozone production[5]. As a typical pollutant in the troposphere, CO can undergo photochemical reactions to produce ozone and thus form secondary pollution[6]. The results of the analysis showed that the concentration of CO was significantly higher in spring than in the other three seasons. The change in CO concentration in spring showed a decreasing trend, and the high CO concentration in spring was partly due to the high cumulative concentration of CO emitted in the cold season under unfavorable diffusion conditions. The change in CO concentration tends to be stable in summer and autumn.

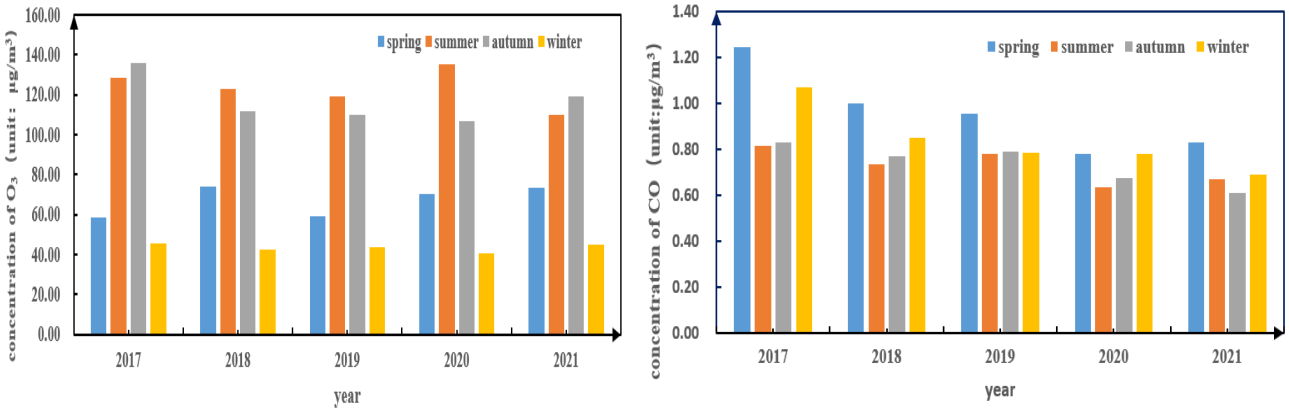

FIG.3 SEASONAL VARIATION OF O_3 AND CO CONCENTRATION IN MIAN YANG FROM 2017-2021

4 AIR QUALITY EVALUATION

TABLE.1 MIAN YANG CITY AIR QUALITY INDEX BY THE YEAR 2017-2021

Year \ Type	Severe pollution	Moderate pollution	Light pollution	Good	Excellent
2017	0	0	2	8	2
2018	0	0	1	9	2
2019	0	0	0	10	2
2020	0	0	0	10	2
2021	0	0	0	11	1
Total	0	0	3	48	9
Proportion	0	0	5%	80%	15%

From 2017-2021, the air quality reached light pollution for 3 months, accounting for 5%; reached good for 48 months, accounting for 80%; and the air quality reached excellent for 9 months, accounting for 15%.

According to the urban air quality standards and the ecological effects of each pollutant and its impact on human health, urban air quality can be classified into 5 levels[7]: level 1 is excellent, with AQI values of 0-50; level 2 is good, with AQI values of 51-100; level 3 is mild pollution, with AQI values of 101-200; level 4 is moderate pollution, with AQI values of 201-300; and level 5 is severe pollution, with AQI values greater than 300. As can be seen from Figure 7, the number of days with mildly polluted air quality is gradually decreasing, and the proportion of good air quality is gradually increasing from 2017-2021. As can be seen from Figure 8, during these years, a large part of the air quality was concentrated in good areas, with AQI values between 0 and 50, which shows that the air quality situation in Mian yang has been gradually improving.

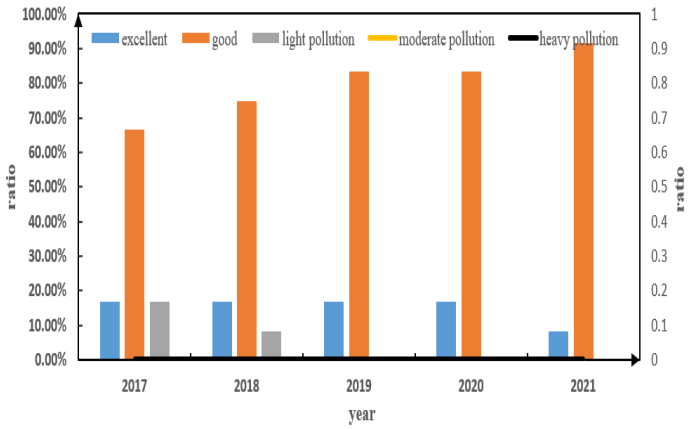

FIG.4 CHANGES IN AIR QUALITY BY

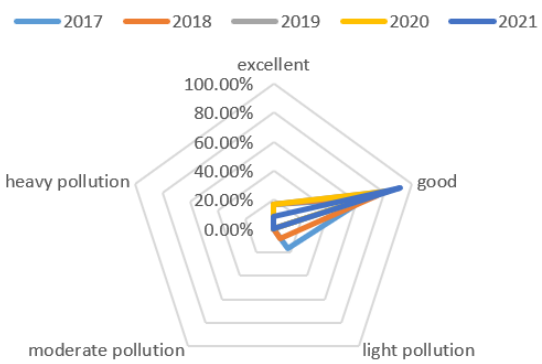

FIG.5 AIR QUALITY RATIO

5 PREVENTION AND CONTROL MEASURES FOR ATMOSPHERIC POLLUTION

5.1 Improve Laws and Regulations, Increase Government Regulation and Punishment

Mian yang City has introduced laws and regulations on the implementation of dust remediation, ecological protection red line, and environmental quality bottom line in 2020 and 2021[8,9], and notified for related issues, a move that has contributed to the modernization of environmental governance system and governance capacity significantly. The analysis results show that $PM_{2.5}$ in Mian yang City exceeds the secondary concentration limit of the ambient air quality standard (GB3095-2012), and its concentration is especially high in spring and winter. The causes of high $PM_{2.5}$ concentrations are inextricably linked to activities such as straw burning, construction site work, and mining. Therefore, these problems can be solved by further improving relevant laws and regulations, increasing penalties, and strengthening the government's enforcement efforts.

5.2 Pollution Source Control

The root of air pollution control is to reduce the emission of pollutants from the source[10], so enterprises should achieve energy saving and emission reduction, improve the efficiency of desulfurization and denitrification equipment, and carry out innovation of production processes, such as process innovation to avoid secondary pollution. Winning the blue sky defense war is a major decision and deployment made by the 19th Party Congress[11]. To improve the air quality in Mian yang, the government should strongly support the development of green environmental industries, thus reducing the disorganized emissions of pollutants. Some pollutants have obvious seasonal characteristics, so measures should be taken for different seasons. For example, energy use is higher in winter, thus generating more air pollutants, measures can be taken to optimize the energy structure and adjust the industrial layout to reduce the concentration of pollutants.

5.3 Improve Monitoring System of Pollutant Data

Pollutant monitoring data is a key basis for analyzing a city's air quality changes. Because with these data as a basis, we can better improve air quality and control air pollution. For example, Measures such as expanding the scope of satellite monitoring and improving the accuracy of monitoring can be taken to monitor the burning of straw, etc. The monitor should find scientifically effective and low-cost methods to monitor the changes in the concentration of various pollutants according to local conditions.

5.4 Raising Awareness of Environmental Protection

Individuals and companies should always remember: "Minimize pollutant emissions". Enterprises should change their business philosophy in time and coordinate economic development with environmental protection to better promote sustainable development of environmental protection. Individuals should start with small things and live as low-carbon as much as possible, such as going out by public transportation or by bicycle, etc. At the same time, we should self-restrain our behavior and resolutely resist any behavior that damages the environment.

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