Research on Optimization of Atmospheric Environmental Quality and Countermeasures

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Abstract: With the rapid development of economy and society, energy consumption is further accelerated, and the quality of atmospheric environment is also seriously challenged. In order to optimize the quality of the atmospheric environment, this paper preprocesses the relevant raw data of the atmospheric environment quality, analyzes the air composition through the correlation coefficient, uses the whitening function to establish the atmospheric environmental quality analysis standard, and calculates its comprehensive pollution index. The government should formulate corresponding pollution prevention and control countermeasures for industrial pollutants, motor vehicle exhaust and plant greening. The results show that the air pollution index (API) can be drastically reduced if the pollution prevention and control measures are implemented in multiple areas of a certain city.

1. Introduction
The rapid development of industry and transportation and the large-scale use of fossil fuels discharge dust, sulfur oxides, nitrogen oxides, carbon oxides, ozone and other substances into the atmosphere, seriously deteriorating the air quality [1]. The pollution sources that cause air pollution at this stage mainly include industrial "three wastes" (exhaust gas, waste water, waste residue), transportation, stove heating equipment in winter, and the extensive use of fossil fuels. The above-mentioned pollution sources can form two kinds of pollutants, one is aerosol-like pollutants, mainly including dust, suspended particles, inhalable particles[2]; the other is gas pollutants, mainly including sulfur oxygen compounds, nitrogen oxide compounds And some carbon and oxygen compounds[3]. When these pollutants are discharged into the air, it seriously threatens the survival and development of all mankind.

In order to improve the quality of the atmospheric environment, domestic and foreign scholars have proposed a variety of evaluation models, the common ones are gray clustering method, comprehensive index method and fuzzy comprehensive evaluation method. Due to the limitations of the method and the complexity of the environment, so far, there has not been a unified evaluation system and evaluation method. This paper analyzes the air composition through the correlation coefficient, uses the whitening function to establish the atmospheric environmental quality analysis standard, calculates the comprehensive pollution index and optimizes it, so as to propose more suitable and effective pollution prevention and control countermeasures.

2. Atmospheric environmental quality analysis method

2.1 Set the atmospheric environmental quality evaluation index
Based on the existing environmental quality assessment methods, this article mainly considers the sulfur dioxide content, nitrogen oxide content, and inhalable particulate matter content in the air to
evaluate the comprehensive analysis indicators of atmospheric environmental quality, and each sub-indicator is expressed in turn as $A_{SO_2}$, $A_{NO_x}$, $A_K$, $A_{CO}$, $A_{O_3}$. It also analyzes and pre-processes the atmospheric environmental quality data according to the atmospheric environmental quality evaluation index.

| Comprehensive Evaluation Index for Atmospheric Environmental Quality (API) | Sulfur dioxide | Nitrogen oxides | Inhalable particulate matter | Total suspended particles | Carbon monoxide | Ozone |
|---|---|---|---|---|---|---|

2.2 Preprocessing the original data

This paper uses the gray system to quantify the original data of the atmospheric environmental quality. Since the measurement units and expressions of each pollutant are quite different, this article will correlate the pollutants and convert the sub-indicator data into dimensionless data of roughly the same order of magnitude [4]. Suppose we collected the original atmospheric environmental pollutant sequence as:

$$O_i=\{SO_2, CO, CO_2, NO_x, IN_{pm}, S_p\}$$  \(1\)

Among them, $IN_{pm}$ and $S_p$ respectively represent the index of inhalable particles and the index of suspended particles. Initialize the original data to get the sequence $P_i$ in the same format, the expression is as follows:

$$P_i=\{P_1 (SO_2), P_2 (CO), P_3 (O_3), P_4 (NO_x), P_5 (IN_{pm}), P_6 (S_p)\}$$  \(2\)

2.3 Air composition analysis

Based on the above-mentioned raw data preprocessing results, the air composition in the atmosphere is analyzed. In the atmospheric environment, the main components of normal air are oxygen and nitrogen, along with a small part of rare gases and other impurity gases, the composition ratio of normal air is:

$$N_2: O_2: W_{\text{rare}}: W_{\text{impurities}}=78: 21: 0.939: 0.034$$  \(3\)

However, in the case of environmental pollution, the proportion of impurity gases will increase, and the proportion of carbon dioxide, nitrogen oxides and suspended particles will be larger. Therefore, the orthogonal transformation method can be used to transform the data variables into unrelated new variables, the variance is used as a measure of the amount of information, and the component with a large cumulative contribution rate is taken as the main component of the pollutant. In the process of analyzing the air composition, the oxygen, nitrogen and rare gases in the air are ignored, and only the pollutants in the air should be analyzed in detail. If any pollutant gas is expressed as $O_i$ and $P_i$ after initialization, the difference information space can be expressed by formula (4).

$$\Delta t = |O_t - A_t|$$  \(4\)

The correlation coefficient is:

$$\gamma(O_t, P_t) = \frac{\text{min}\Delta t + K \text{max}\Delta t}{\Delta t + K \text{max}\Delta t}$$  \(5\)

In formula (5), $K$ represents the resolution of pollutants, and the value is $[0,1]$, then the correlation between each pollutant can be calculated by formula (6).
\[ \gamma' = \frac{1}{n} \sum_{i=0}^{n} \gamma_i (O_i, P_i) \quad (6) \]

In formula (6), \( \gamma \) represents the types of pollutants in the atmospheric environment. Substituting the relevant data of the pollutants into the formula, according to the principle of component extraction, the component ratio and correlation coefficient of the pollutants in the air can be obtained.

### 2.4 Establish quality analysis standards

Based on the analysis of air composition, the analysis results of air composition content are divided into five levels, namely excellent, good, light pollution, moderate pollution, and heavy pollution. The whitening function is established as follows:

\[ A_i (O_i, P_i) = \frac{x_i}{\gamma_i (O_i, P_i) - 0} \quad (7) \]

In formula (7), \( A_i \) represents the analysis index value of pollutant \( i \). The atmospheric environmental quality analysis standards are shown in Table 2.

**Table 2. Atmospheric environmental quality analysis standards**

| Project | excellent | Good | Light pollution | Moderately polluted | Heavy pollution |
|---------|-----------|------|-----------------|---------------------|-----------------|
| \( ASO_2 \) | 0.05 | 0.15 | 0.8 | 1.6 | 2.1 |
| \( ANO_x \) | 0.08 | 0.12 | 0.28 | 0.56 | 0.75 |
| \( A_K \) | 0.03 | 0.06 | 0.09 | 0.12 | 0.15 |
| \( A_Z \) | 0.04 | 0.08 | 0.16 | 0.32 | 0.48 |
| \( A_{CO} \) | 0.05 | 0.15 | 0.18 | 0.21 | 0.32 |
| \( A_3 \) | 0.1 | 0.13 | 0.26 | 0.33 | 0.54 |
| API | \( \leq 1.3 \) | 1.3~1.4 | 4~8 | 8~12 | \( >12 \) |

### 2.5 Calculate the comprehensive pollution index

Calculate the comprehensive pollution index \( A_n \) of ambient air according to Table 2:

\[ A_n = \sum_{i=0}^{n} A_i \quad (8) \]

In formula (8), \( n \) represents the number of pollutants participating in the comprehensive evaluation.

The pollution load factor \( F_i \) can reflect the contribution rate of various air pollutants in the atmospheric environmental quality, and its calculation formula is:

\[ F_i = \frac{A_i}{A_n} \quad (9) \]

### 3. Pollution control measures

According to the conclusions drawn from the atmospheric environmental quality analysis method, the content of various pollutant factors in the atmospheric environment can be drawn, and corresponding pollution prevention and control countermeasures can be formulated for different environmental pollution situations.

#### 3.1 Strengthen exhaust emission control

With increasing attention to air quality, local governments should increase their investment in air pollution prevention and control. Since automobile exhaust contains various pollutants such as carbon monoxide and nitrogen oxides, automobile exhaust is one of the main sources of air pollution. The most important source of motor vehicle exhaust pollution is the combustion of motor vehicle gasoline. Carbon dioxide and carbon monoxide produced by gasoline combustion are the main sources of air pollution. For enterprises with high energy consumption, high emissions and high pollution levels, the government should strengthen management and strictly control pollution emissions. The state and relevant transportation departments plan for this, effectively limit the number of vehicles, and introduce a series of exhaust gas control policies. In addition, use new energy-saving fuel to replace the original gasoline or use electric drive to replace traditional combustion drive or install a filter device on the exhaust
emission position to transport the gas generated from the car cylinder to the intake manifold through the filter cycle. Make it fully burnt, can reduce the emission of harmful substances in gasoline tail gas. On this basis, governments can provide appropriate subsidies to vigorously promote new energy vehicles. Therefore, with active support and strict government mandatory management, the pollution of the atmosphere from industrial fuel waste can be minimized.

3.2 Control of industrial pollutant emissions
In response to the phenomenon of industrial production pollution, relevant departments should formulate relevant policies, adjust industrial structure and industrial layout, standardize industrial production standards, strengthen supervision of exhaust emissions, irregular inspections, and encourage enterprises to purchase advanced machinery and equipment and use environmentally friendly production techniques. Use reasonable industrial waste gas treatment methods, such as using activated carbon adsorption device for waste gas adsorption, which contains a large amount of silica bath soil, anthracite, etc., which can effectively adsorb organic gas molecules to achieve purification purposes. The commonly used treatment method is the combustion method, which uses high heating temperature to directly burn harmful gases, which can also achieve the purpose of exhaust gas purification. In addition, the absorbing liquid can also be used to directly adsorb harmful substances in the exhaust gas. Pollution sources should be strictly controlled, and the upgrading of industrial structure should be accelerated.

3.3 Improve environmental awareness
Enhancing people’s environmental protection awareness can better control and prevent air pollution [6]. Relevant departments should use major media platforms to popularize the importance of atmospheric protection to people, vigorously promote the harmfulness of the destruction of the atmospheric environment, increase publicity for atmospheric prevention and control, and cultivate citizens' environmental protection concepts. "Protecting the environment is everyone's responsibility". The protection of the environment is not only the government's business, but also requires everyone's joint maintenance. Everyone should save resources and use green energy as much as possible. It is best to choose buses when traveling and reduce private cars. Reduce car exhaust emissions.

3.4 Further strengthen greening work
Greening plays an important role in the treatment of industrial waste gas and automobile waste gas [5]. Plants play an important role in people's production and life. Green plants contain mitochondria and chloroplasts, which can effectively control the oxygen and carbohydrate content in the air, and absorb a large amount of substances similar to dust and harmful gases. In addition, green plants have the function of wind-proof and sand-fixing, which can effectively control the sand, stone and dust in the air. But at present, the proportion of green area is relatively low, and part of the green space has not been effectively used. Therefore, in the selection of greening varieties, it is necessary to choose tree species with strong protection against pollution and to choose tree species with high sterilization potential to effectively reduce the emission of harmful gases.

4. Conclusion
In order to solve the problems of insufficient pertinence of current air pollution control measures, this paper sets up an environmental quality evaluation index. As a kind of air environment quality analysis method, index evaluation has the characteristics of simple, effective and accurate analysis. We can use this analysis method to put forward the corresponding management countermeasures accurately, so it has high use value. On this basis, the original environmental quality data is pretreated, and the air quality evaluation standard is obtained according to the processing results and whitening function, and finally the comprehensive air pollution index is obtained, which will affect the complexity and uncertainty of atmospheric environment. For example, some uncontrollable factors such as climate and weather will affect the accuracy of analysis methods. Therefore, it is necessary to consider the complexity of the atmospheric environment itself in future research, so as to further improve the analysis efficiency of the
atmospheric environment quality analysis method.

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