The importance and challenges of air pollution control

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Abstract. Air pollution poses a serious threat to human health and the natural environment. Therefore, controlling air pollution is of vital importance. This article will explore the hazards of air pollution, the importance of air pollution control, the challenges faced, and possible solutions. At the same time, air pollution also has a significant impact on climate change.

1 Hazards of Air Pollution

The annual exhaust gas emissions in China are approximately 650 million tons, of which 450 million tons are generated by coal-fired power generation, 150 million tons are from automobile exhaust emissions, and 50 million tons are from industrial exhaust gas emissions. The daily exhaust gas emissions in China are about 178,000 tons.

It is reported that up to 7 million people die from air pollution every year. Air pollution caused by the use of fossil fuels can cause symptoms such as asthma, lung cancer, and stroke. 7 million people worldwide die from this every year, and about 60.65 billion yuan is spent on treating these diseases every year. Therefore, in order to address the problem of global warming and reduce the use of fossil fuels[1], it can not only improve the problem of air pollution, but also save many lives.

Air pollution can cause various harms to human health, the environment, and the ecosystem, including but not limited to the following aspects:

Health problems: Particulate matter and harmful gases in air pollution can enter the human respiratory system, causing health problems such as asthma, lung cancer, and stroke. 7 million people worldwide die from this every year, and about 60.65 billion yuan is spent on treating these diseases every year. Therefore, in order to address the problem of global warming and reduce the use of fossil fuels[1], it can not only improve the problem of air pollution, but also save many lives.

Environmental damage: Air pollution causes damage to the natural environment, such as acid rain damaging plants and aquatic ecosystems and destroying soil quality.

Climate change: Certain air pollutants, such as carbon dioxide and other greenhouse gases, are one of the main factors causing global climate change.

Economic impact: Air pollution may cause reduced crop yields, accelerated corrosion of buildings, increased energy consumption, and other economic losses.

These damages highlight the importance of air pollution control. Taking effective measures to reduce air pollution is crucial for protecting human health, the environment, and the sustainable development of the ecosystem[3].

2 The Importance of Air Pollution Control

The importance of carrying out air pollution control is, first of all, an important measure to promote the construction of ecological civilization. Blue sky and white clouds are the most simple understanding of ecological civilization by the broad masses of the people. Without blue sky and white clouds, the comprehensive building of a moderately prosperous society, the construction of a beautiful China with ecological civilization, and the realization of the Chinese Dream of the great rejuvenation of the Chinese nation will be out of the question. It is necessary to use the breakthrough of comprehensive air pollution control to vigorously promote the construction of ecological civilization. Secondly, it is an inevitable requirement to solve the problems of the people's livelihood and the environment. An environment that does not harm the health of the people and is beautiful and livable is a public good and basic service that governments at all levels must provide[4]. By solidly promoting the comprehensive prevention and control of air pollution, significantly reducing heavy pollution weather, and gradually improving air quality, people can see hope and gain the trust of the people. Finally, it is a powerful grip to create a upgraded version of the Chinese economy. Our country's extensive development model of high input, high consumption, high pollution, and low efficiency has not been fundamentally changed, which is the fundamental cause of severe air pollution. Deepening the prevention and control of air pollution is the inherent requirement for changing the development mode and adjusting the economic structure, and it is an important measure to improve the quality and efficiency of economic growth.

This is the statistics of the major air pollutants in our country from January to April 2022.
Complex sources of pollution: Air pollution comes from a variety of sources, such as industrial waste gas, traffic emissions, coal-fired power plants, and agricultural activities. The complexity of pollution sources makes it difficult to identify the main sources of pollution and formulate effective control strategies. The concentration of pollution in the air may be associated with better air quality. However, the relatively high concentration of PM10 may suggest that there is still a certain degree of particle pollution in the air. These particles may come from sources such as combustion, traffic emissions, and industrial activities.

High concentrations of ozone may have adverse effects on health, especially on the respiratory system. The concentration of ozone may be affected by meteorological conditions, industrial activities, and traffic emissions.

Sulfur dioxide mainly comes from the combustion of fossil fuels and industrial processes. Although the concentration is low, it may still be related to certain industrial emissions or coal-burning activities.

Taken together, these data indicate the presence of a certain degree of pollutants in the air.

3 Challenges in Air Pollution Control

Here are some challenges in air pollution control:

Balance between economic development and environmental protection: In many areas, there is a contradiction between economic development and air pollution control. Some industries may be crucial to the economy, but they also produce a large amount of pollutants. Finding a balance between economic development and environmental protection is a challenge.

Technological and cost limitations: Air pollution control requires advanced technologies and equipment, but the research and development and application of these technologies may be limited by costs. Some pollution control technologies may be expensive, posing an economic burden on businesses and governments.

Energy structure adjustment: The energy structure in many areas is dominated by fossil fuels such as coal and oil. Reducing dependence on these energies and shifting to clean energy requires large-scale infrastructure renovation and policy support.

Cross-regional and global issues: Air pollution is not limited by geographical boundaries and may affect surrounding areas or even the entire planet. Solving cross-regional and global air pollution problems requires international cooperation and coordination.

Public awareness and behavioral change: Raising public awareness of air pollution and prompting them to adopt more environmentally friendly lifestyles and consumption habits is an important aspect of air pollution control. Changing people’s behaviors and concepts requires time and effective publicity and education.

Implementation of policies and regulations: Formulating and implementing strict air quality standards and pollution emission regulations is crucial, but in practice, it may face difficulties in law enforcement, violations, and lack of effective supervision.

Impact of climate change: Climate change may lead to changes in weather patterns, such as longer hot seasons and more frequent extreme weather events, which may exacerbate air pollution and affect the control effect.

Emergence of emerging pollutants: With the development of industry and technology, new pollutants may constantly emerge, posing new threats to air quality and human health.

Monitoring and data quality: Accurate air quality monitoring and data analysis are essential for formulating effective control measures, but the coverage of the monitoring network and the accuracy of the data may have limitations.

To overcome these challenges, comprehensive approaches are needed, including technological innovation, policy formulation, public education, and international cooperation. At the same time, continuous research and learning are also required to adapt to the changing environment and emerging issues. Only through global joint efforts can we effectively address the challenges of air pollution control, improve air quality, and protect human health and the environment.

4 Solutions to Air Pollution Control

Air pollution poses a serious threat to human health and the natural environment, becoming one of the significant challenges faced globally. With the rapid development of industrialization and urbanization, the problem of air pollution has become increasingly acute. Therefore, it is crucial to adopt effective measures to control air pollution.

Automobile exhaust is one of the main sources of urban air pollution. To reduce automobile exhaust emissions, we can encourage the use of public transportation, walking, or cycling, and other green travel methods. For example, many cities have established bike-sharing systems, providing convenient bike rental services, and encouraging people to choose environmentally friendly travel methods. In addition, promoting the use of electric and new energy vehicles is also an important measure to reduce exhaust pollution.

Industrial emissions are another important source of air pollution. Factories and enterprises should take responsibility for reducing pollution. For example, some factories have adopted advanced pollution control equipment, such as flue gas desulfurization and denitrification devices, effectively reducing the emissions.
of sulfur dioxide and nitrogen oxides. In addition, the government can strengthen environmental supervision, formulate stricter emission standards, and impose severe penalties for illegal emissions.

In addition to transportation and industry, some behaviors in daily life can also lead to air pollution. For example, burning garbage and straw will release a large amount of particulate matter and harmful gases. To reduce this pollution, we can advocate waste sorting and recycling to reduce waste generation. At the same time, farmers can adopt more environmentally friendly ways to handle straw, such as returning straw to the field or making it into organic fertilizers.

Air pollution control requires the joint efforts of the government, enterprises, and the public. The government can formulate and implement relevant laws and regulations, strengthen environmental monitoring and supervision. Enterprises should actively take environmental protection measures to reduce pollution emissions. The public can contribute to air pollution control by changing their lifestyles and choosing environmentally friendly products and services[11].

The emission of air pollutants is generally calculated using the formula:

\[ E = Q \times C \times T \times 10^{-9} \]

E is the actual emission of pollutants in the air, tons; Q is the flue gas flow rate, m³/h; C is the emission concentration of the pollutant, mg/m³; T is the emission time of the pollutant, hours.

5 The impact of air pollution on climate change

The impact of air pollution on climate change is an issue that is receiving increasing attention. Air pollutants caused by human activities, such as carbon dioxide, methane, nitrous oxide and other greenhouse gases, as well as aerosols, not only pose a threat to air quality and human health, but also have a significant impact on the global climate[12].

Firstly, greenhouse gases in air pollution contribute to climate warming. These gases can block the heat released from the Earth's surface, causing the temperature of the Earth's surface to rise. The most significant greenhouse gas is carbon dioxide, and its increasing concentration is one of the main causes of global climate warming. Since the industrial era, human beings have emitted a large amount of carbon dioxide through the use of fossil fuels, resulting in a sharp increase in the concentration of carbon dioxide in the atmosphere. This has triggered a series of phenomena of climate change, such as the rise in the global average temperature, the melting of glaciers, and the rise in sea levels[13].

Secondly, aerosols in air pollution also have an impact on climate change. Aerosols refer to tiny particles suspended in the air, including dust, smoke, sulfates, nitrates, etc. Aerosols can scatter and absorb solar radiation, thereby affecting the Earth's energy balance. On the one hand, aerosols can reduce the solar radiation reaching the Earth's surface by reflecting sunlight, resulting in a decrease in ground temperature, which is called the cooling effect of aerosols. On the other hand, some aerosols can also absorb long-wave radiation emitted from the Earth's surface, resulting in a warming of the atmosphere, which is called the heating effect of aerosols. The impact of aerosols on the climate depends on their type, concentration, and distribution, as well as other factors, so the overall impact of aerosols on climate change is complex.

The impact of sulfate aerosols on the climate. Sulfate aerosols mainly come from coal-fired and industrial activities, as well as natural sources such as volcanic eruptions. Sulfate aerosols can reflect solar radiation, thereby reducing the temperature of the Earth's surface. However, when sulfate aerosols combine with water vapor to form clouds, they can change the properties and lifespan of the clouds, thereby affecting the reflection and absorption of solar radiation by the clouds. This may lead to a decrease in the reflection ability of the clouds, allowing more solar radiation to reach the Earth's surface, thereby exacerbating climate warming[14].

In addition, air pollution can indirectly affect the climate by affecting the atmospheric circulation and water cycle. For example, the presence of aerosols can affect the formation and properties of clouds, thereby changing the absorption and reflection of solar radiation. This may lead to changes in cloud cover, changes in precipitation patterns, and other aspects of the climate system.

To address the challenges of air pollution and climate change, the international community is taking a series of measures, including reducing greenhouse gas emissions, improving the energy structure, increasing energy efficiency, and promoting clean transportation. At the same time, individuals can also contribute to reducing air pollution and addressing climate change by changing their lifestyles, such as reducing energy consumption, using public transportation, and encouraging low-carbon travel.

6 Conclusion

In conclusion, air pollution control is a key task for protecting human health, the environment, and sustainable development. The benefits of air pollution control include[15]:

Reducing the emissions of pollutants makes the air fresher, which is beneficial to people's respiratory health. Air pollution control helps to protect the living environment of plants, animals, and other organisms, and maintains ecological balance.

Reducing air pollution can reduce the occurrence of health problems related to pollution, such as respiratory and cardiovascular diseases.

Good air quality can improve people's quality of life and create a more comfortable living and working environment.

Controlling air pollution contributes to the rational use of resources and the sustainable development of the environment.

We can take the following measures:

Formulate and implement stricter pollution emission standards, forcing enterprises to adopt clean production technologies.
Increase the use of renewable and clean energy and reduce dependence on fossil fuels.

Encourage the use of public transportation and promote electric vehicles to reduce vehicle exhaust emissions.

Require industrial enterprises to install pollution control equipment, improve production processes, and reduce waste gas emissions.

Strengthen the monitoring and law enforcement of pollution emissions, and severely punish violations.

Through education and publicity activities, raise public awareness of air pollution issues and prompt them to take environmental protection actions.

Respond to transboundary air pollution problems through international cooperation, and share experiences and technologies.

The comprehensive implementation of these measures can effectively control air pollution, bringing cleaner air and a healthier environment. At the same time, air pollution control is a long-term and continuous process that requires the joint efforts and active participation of all parties.

References


