

Phytoremediation of Urban Air Pollution

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Abstract: With the rapid progress of society and economic growth, more and more factories are put into construction, although to a certain extent to promote the development of our country's economy, but the waste gas and waste water produce also harm the environment. Among them, air pollution causes great damage to the environment and harms human health. In order to protect people's safety and health, people began to look for some measures to control air pollution, one of the most effective way is to plant more green plants, using plants for air purification.

Key Words: urban air pollution; phytoremediation; effective measures

1. Preface

In recent years, with the development of urbanization in our country, our living environment is gradually occupied by high-rise buildings, everywhere is full of towering modern buildings. Without the shelter of green plants, atmospheric problems in the environment are becoming more and more serious^[1]. With the deepening of urbanization and the improvement of economic strength, China's industrialization and transportation industry are speeding up. Dust, particulate matter and some harmful gases generated by them are discharged into the air, causing air pollution. Air pollution is a major hidden danger facing the world that needs to be solved urgently. It not only harms people's health, but also damages the sustainable development of human society. Therefore, it is urgent to rectify air pollution. One of the most effective and environmentally friendly ways to clean up air pollution is to use the respiration and photosynthesis of green plants to purify the air^[2].

This paper starts from the aspect of phytoremediation of air pollution to illustrate the important role of green plants in controlling air pollution.

2. The current situation of air pollution

At present, common air pollution can be divided into three types, namely physical air pollutants, chemical air pollutants and biological air pollutants. The appearance of these pollutants makes the environment worse and worse, affects people's life and health, and restricts the sustainable development of social economy to some extent. These pollutants, which are deposited in the atmosphere due to human improper behaviors, have become a major hidden danger of human development and need to be checked and solved urgently.

Although plants will also be affected by air pollution, but it has its own ability to resist, as well as a strong absorption and purification ability, so in the measures to improve the atmospheric environment, the use of plants is indispensable^[3]. But in recent years, people focus on the management of water environment, but neglect the management of the atmosphere. In addition, the atmospheric governance has certain difficulties, so the atmospheric environment is more and more severe^[4].

3. Research status of phytoremediation of air pollution

The concept of phytoremediation was proposed by Raskin in 1991. Cunningham and Berti used this term in the relevant technical

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literature published in 1993, suggesting that phytoremediation can effectively improve air pollution. Omasa was the first to discover super-assimilating plants with the ability to absorb and metabolize air pollutants, which can promote their growth by absorbing and assimilating air pollutants as nutrients.

Lumin^[5] et al. studied the purification ability of 28 garden plants to sulfur dioxide by short-time fumigation test. It was found that 12 species of trees with high sulfur dioxide absorption capacity were poplar, Manchurian ash and *Ailanthus altissima*, 7 species with moderate sulfur absorption capacity were sand pine, red poplar and birch, and 7 species with low sulfur absorption capacity were *Pinus bungeana*, *Ginkgo biloba*, *Pinus sylvestris* var. *mongolica* and other plants, and broad-leaved trees (poplar willow, prickly plum) absorb sulfur dioxide ability is higher than coniferous trees (*Pinus tabulaeformis*, *Pinus conifera*).

In addition, many landscape plants can absorb ozone, among which more than 10 trees such as *Ginkgo biloba*, *Cryptomeria fortunei* and *Quercus glauca* have the strongest ability to absorb ozone. The uptake of nitrogen dioxide, sulfur dioxide and ozone by urban greening plants in one day was about 4.2, 3.7 and 10.8 tons, respectively, and they also play a good buffer effect on acid rain deposition^[6].

4. Purification effect of plants on atmospheric particulate matter

The physical particulate matter that causes air pollution generally refers to dust, such as dust generated after coal combustion and dust generated after garbage incineration. These fine particles can enter the lungs through human respiration, and then cause a lot of diseases related to the respiratory tract and eventually endanger human health and even life. After a long time of observation and study, we found that plants have adsorption effect on atmospheric particles, can adsorb particles in the atmosphere. People began to plant plants in cities to reduce air pollution in the environment. Since the beginning of the 20th century, many experts have started to study

the ability of different plants to absorb dust in the air^[7].

According to the research of researchers, trees have the strongest effect on dust absorption, while shrubs and lawns have lower dust absorption ability. In addition, the researchers found that areas with more vegetation had lower levels of particulate pollution. Therefore, we can increase the green area to reduce the physical particulate pollution in the atmosphere. For example, increase the construction area of parks in cities, and plant more trees and other green plants in parks to increase the green plant coverage. Roadside shrubs and lawns can be used to decorate the city, not only to beautify the environment, but also to remove dust from the atmosphere^[8].

5. The purification effect of plants on chemical air pollutants

In addition to some visible and invisible physical particles floating in the air, there are some chemical air pollutants^[9]. These chemical pollutants generally refer to toxic and harmful gases and liquids, such as sulfur dioxide, carbon monoxide, photochemical smog and so on. These chemical gases and liquids are extremely dangerous to humans.

5.1 Absorption and adsorption

Plant surface has the function of absorbing and absorbing harmful pollutants. The leaves and branches of plants can absorb and absorb gas molecules, solid particles and some ions in solution, such as sulfur dioxide and hydrogen oxide. Studies have shown that most plants can absorb and absorb these chemical air pollutants^[10]. And with the increase of humidity, the degree of absorption and adsorption of chemical air pollutants by plants also increases with the increase of humidity. Therefore, we should pay attention to the regular watering of the plants in the city, increase the humidity of the plants themselves and the humidity of the air, so that the effect of the plant purification of the atmosphere can be more significant^[11].

5.2 Degradation of harmful chemical air pollutants through metabolism

All species undergo metabolism, as do plants, so plants can degrade harmful chemical pollutants in the atmosphere through their own metabolism, or plants can use the power of other microorganisms to break down substances that are harmful to the atmosphere. Photosynthesis also absorbs carbon dioxide from the atmosphere, releasing oxygen^[12].

5.3 Neutralization and buffering effect

Broad-leaved plants with large leaves can absorb acid and reduce the harm of acidic harmful substances to the environment by purifying and buffering themselves. Generally speaking, coniferous broad-leaved forest can play a better role in purifying the atmosphere^[13]. We can use this method when building city afforestation, create more coniferous broad-leaved forest to purify the city environment that we live on.

6. Purification effect of plants on heavy metals in cities

With the acceleration of urbanization and the development of some industrial sectors, the degree of heavy metal pollution in the world has been greatly improved. Because of the long-term, latent and irreversible nature of heavy metal pollution, it has become a major hidden danger of human development^[14]. In recent years, researchers have begun to study how to mitigate the damage of heavy metal pollution to the environment, but many measures are only applicable to the ground environment, and no in-depth research and discussion has been made on air pollution.

However, through some studies, we can find that plants can well absorb some heavy metal elements such as lead and lithium in the atmosphere, so it can be concluded that plants can also play a good role in the purification of heavy metal pollutants in the atmosphere.

7. Influencing factors of phytoremediation

7.1 The nature of the plant

Such as leaf morphology, roughness, surface secretion, etc. For example, if the plant is a hairy leaf, the adsorption of dust will block the stomata on the plant surface, thereby reducing the absorption of other pollutants. The different purification ability of plants at different ages is an important limiting factor in the application of plant purification^[15].

7.2 Soil and climatic conditions

Because the seasonal climate and soil can directly affect the physiological conditions of plants, they are the key factors affecting the absorption of pollutants. Generally speaking, the absorption capacity of plants is weak in winter and summer.

7.3 Blade surface wetting degree

As the solubility of pollutants in water increases, so does the rate at which plants absorb them. Wet plant surfaces can significantly increase the absorption of water-soluble pollutants.

7.4 Nature of the pollutant

The physical and chemical properties of pollutants, such as molecular weight, solubility, volatility, polarity, vapor pressure and octanol - water distribution coefficient, directly affect the absorption of plants. Other factors^[16]. Plant height and meteorological conditions such as wind direction and wind speed. But these are secondary factors.

Due to plant purification restricted by many factors, so the use of plants to purify the air pollutants, the need for different climate and soil conditions, considering the plants to atmospheric pollutants adsorption, absorption, transformation, assimilation, degradation and other ability, scientific and reasonable collocation of plant species, constructing the combination of different ecological function of plant, so as to set up different types of artificial plant community, in order to achieve the best plant purification effect.

8. Monitoring effect of plants on air pollution

Monitoring air pollution by plants is an economical and simple technology. It was monitored that alfalfa exhibited visible symptoms after exposure for 1 hour at a concentration of 3.4mg/m³. When the concentration of sulfur dioxide was higher than 0.154×10^{-6} ug/m³, the moss would cause acute damage. Spinach, cucumber and oat were injured by sulfur dioxide of 0.05×10^{-6} ~ 0.5×10^{-6} ug/m³ for 8 hours or 1×10^{-6} ~ 4×10^{-6} ug/m³ for 30 minutes^[7]. By exploring the comprehensive reaction characteristics of plants to atmospheric pollutants and the accumulation of pollutant components in plants, the study on the ability of plants to absorb pollutants has reference significance for effectively degrading atmospheric pollutants in urban greening.

9. Conclusion

Plant atmosphere restoration has many advantages such as environmental friendliness, green environmental protection, low cost and low technical requirements, so it is increasingly favored by environmental protection technicians. Of course, phytoremediation also has many problems. For example, it takes a long time and is limited by biomass, growth cycle, geographical environment, weather and other factors^[18]. The absorbed pollutants may be re-released into the environment to cause secondary pollution or pollution through biological amplification of the food chain. With the deepening of research and the emergence of advanced technologies, the application of plants in air pollution control has been greatly promoted. We have reason to believe that with the improvement of phytoremediation technology, phytoremediation will have more and more broad application prospects in the prevention and control of air pollution.

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