Analysis on the pollution status and improvement strategy of PM2.5 in China

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Abstract: In recent years, due to the serious harm to human health and air environment, PM2.5 has become a heated issue in Chinese government and society. The definition and hazards of PM2.5 is introduced briefly in this paper. Combined with the relevant PM2.5 research data, the Chinese overall PM2.5 pollution status is also discussed, which pointed out that the major sources of pollution and the existence of major problems. Finally, the effective measures to prevent and control PM2.5 pollution are recommended from the technology dimension, the policy dimension, the education dimension as well as the personal behavior aspect.

Keywords: PM2.5, pollution, human health.

1. INTRODUCTION

PM2.5 refers to particulate matter (PM) in air that is less than 2.5μm in aerodynamic diameter [1].” It is so small that you can’t see it. If you compare it with a human hair, it is almost thirty times smaller than its width [2]. Even its small size, you cannot neglect its influence. It can bring huge damage to both human and air environment.

The harm of PM2.5 pollution mainly includes two aspects, one is the harm to the air environment and the other is the harm to human health.

To the air environment, PM2.5 is the main cause of smog [3]. Smog can reflect a large amount of visible light and lead to a low visibility because of the small particle size. Smog really does great harm to the environment. It can disturb transport systems and intervene in the city and also pose a huge threat to the traffic safety and the aircraft take-off and landing [4].

To the health impact， toxic chemical components and pathogenic organisms on particles can cause further harm to the human body with acute and chronic effects. For sensitive people in the population who have chronic respiratory inflammation, fine particles impact the respiratory system, exacerbate inflammation of the respiratory tract and affect the entire cardiovascular system. Tiny particles correlate with a higher chance of heart failure due to reduced cardiac blood supply.

2. PM2.5 IN CHINA

As a country with a rapidly developing economy, China has suffered from a serious air pollution problem in recent years due to substantial increases in energy consumption and other related production of large amounts of aerosols and precursor gas emissions[5].

2.1 Concentration Distribution of PM2.5

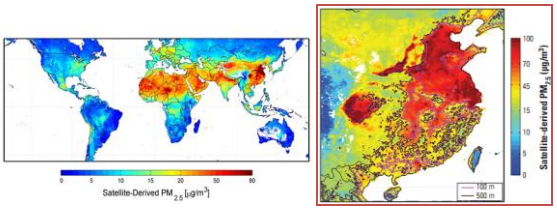

Figure 1 The averaged PM2.5 concentrations (μg/m3) in the world[6]

Figure 1 shows the Concentration distribution of PM2.5 in the world derived from NASA between 2001 and 2006. It shows that the Concentration distribution of PM2.5 in China is much higher than in other countries and heavily focused on the developed area, such as the southeast of China [6].

2.2 Daily average limits for the concentration of PM2.5

According to the latest scientific research, WHO(World Health Organization) has proposed guideline values and three transitional period goals to provide references for each countries make their own national ambient air quality standard. “Chinese environmental air quality standards” require that the yearly average limits for the concentration of PM2.5 is 35 μg/m³, the daily average limits for the concentration of PM2.5 is 75 μg/m³, which merely reached the minimum standard of WHO[7].

Peking University, the good air quality days in Beijing from 2010 to 2014 didn’t change so much. Using China’s air quality standard as the criterion, gives that more than half of the days are unqualified. And if using air quality standard from USA as the criterion, the unqualified days in Beijing will increase 80-100 days each year

2.3 Air pollution linked to lung cancer

Economic development has increased life expectancy

in China and has brought more ways to recover from illness. But the risks that come from air pollution have become obvious. In the past 30 years, the death rate from lung cancer in China has increased by 456%[8]. Even though smoking and an aging society are major factors in this statistic, the risk of developing lung cancer associated with particulate matter is receiving increased attention.

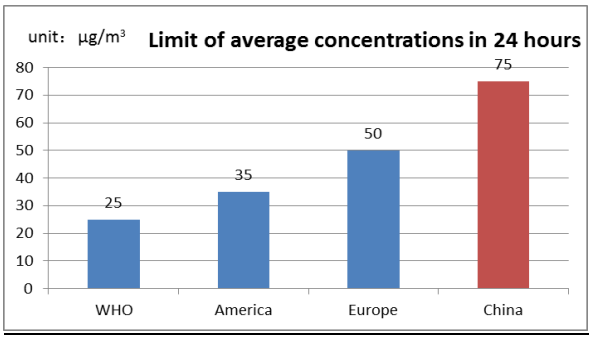

Figure2 Limit of average concentrations and measured data in 24 hours[7]

Even so, according to the sampling results from the

3. MAIN POLLUTION SOURCES

According to the data from Chinese Academy of Science, PM2.5 comes from burning coal, burning oil, burning organic materials industry, farming, chemical fertilizers, dust emission and so on [9]. Most of these causes are due to human activity. After analyzing these factors, it was found that 60% of the PM2.5 in China comes from burning coal and oil, which mean the burning of fossil fuels. China, the second largest economy in the world [10], has made historic progress in development. Its rapid development has led to burning large amount of both types of fossil fuels.

3.1 Coal

Mainly due to the huge consumption of civil and industrial coal consumption in China, the value of PM2.5 has increased dramatically. According to the calculation, Beijing consumes 23 million tons of standard coal per year, Tianjin municipality is 70 million tons, while Hebei province is even up to 2.7 billion tons of standard coal. The coal that China has burned almost as much as the rest of the world combined, the last time a country had this kind of consumption was England in 1860, and they paid a heavy price for it [11].

In China, although the installation rate of desulfurization equipment of thermal power industry has reached 87%.In fact, a lot of thermal power plants do not put these devices into operation in order to save their running costs. This is why the SO2 emissions from per ton coal consumption is still as high as 0.0063 tons, which equivalent to the level of Germany in 1994[12].

In recent years, China faces huge air pollutant problems caused by a long time use of contaminated low quality coals. This problem had a negative impact on China's commercial interests and air environment. There are two reasons of using low-quality coals: 1. the sampling and sample preparation of coal is not strict. 2. The identification of quality on the coal market is not standardized.

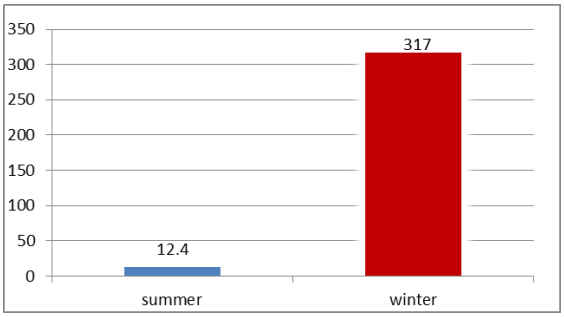

Figure3 The toxicity of PM2.5 in winter and summer.

Such as brown coal, the youngest coal in the world, the level of coalification is extremely low. Half of the composition is useless ash. Because of the insufficient high-quality coal, brown coal has become the main coal in China. According to the statistics, there are dozens of boilers burning brown coal for heating without any cleaning measurement in winter, occupied 20% of the country ś total emission. In addition, the sulfur dioxide emit from these boilers is equivalent to the emissions from all the rest of the power plants together. In Beijing, the toxicity of PM2.5 during winter is far greater than in summer because of heating, the carcinogen content in winter is 25 times higher than in summer. Burning brown coal is the primary cause for this air pollution .

3.2 Traffic pollution

At present, the emission of automobile exhaust is undoubtedly an important part of PM2.5. Chinese government is trying to develop the public transportation to ease the pressure on the environment of PM2.5. However, combined with the degree of transportation development, the development of China's existing public transportation cannot keep up with demand. Therefore, it is quite necessary to increase the number of passenger cars to meet the total traffic demand. It is estimated that the total number of motor vehicle will reach 360 million by 2030[12]. By then, the automobile exhaust gas will be likely to bring more serious pollution to the air. Figure 3-2 shows the Chinese motor vehicle population growth curve from the year of 2003-2013, it can be seen that within ten years Chinese motor vehicles increased nearly with one hundred million.

Unit：million

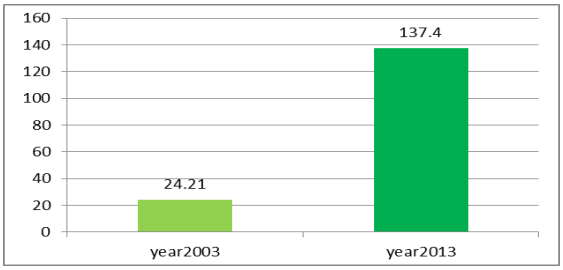

Figure 4 The total number of automobiles in China between 2003 to 2013

The large number of motor vehicles in China is not the main reason of air pollution, but the wanton emissions of motor vehicles and the unmanned supervision are the roots of the problem. For this case, there is an inescapable responsibility of the Ministry of Environmental Protection. In 2002, as "Chinese Air Pollution Prevention and control Law" –the 53th point stands, "For motor vehicles that cannot achieve the required emission standards in manufacturing, selling or importing, it should be ordered by the department exercising the power of supervision and management to stop illegal acts, confiscate the income, and penalize a fine less than one time illegal income. But still nearly 90% motor vehicles did not meet the emission standards, and even worse, there is an increasing number of motor vehicles fraud but no punishment. The reason is that the law enforcement main body of "Chinese Air Pollution Prevention and control Law" is not clear and there is probably an idle political suspicion aiming to the Ministry of Environmental Protection due to the far less stringent law enforcement, in other words, the Ministry of Environmental Protection has only the right to supervise but no executive power.

3.3 Other pollution

There are also other sources of pollution including chemical fertilizers, pesticides, smoking, paint, cooking, construction dust, straw burning and other aspects[12]. Although the PM2.5 particles emitted by these sources are less in proportion, they still reduce the regional atmospheric visibility, and endanger the health of the local residents.

4.RECOMMENDATION

The prevention of PM2.5 is not only an environmental problem, but also related to the economic prosperity, social construction, and people's life style and so on. Therefore, the prevention and control work of PM2.5 needs not only the high attention of the government, but also the active response and wide participation of the public.

4.1 Technology dimension

1. Air quality control should be implemented from the source, the energy structure should change as soon as possible. This can be achieved by developing the natural gas, geothermal energy, wind energy, solar energy, biomass and other clean energy actively and reducing the use of coal and oil as much as possible.
2. Improve the efficiency of energy cleanliness and energy utilization, improve the utilization rate of desulfurization equipment， clean the coal before using it.
3. To strengthen the supervision of high polluting vehicles, phasing out high pollution vehicles and gradually promote high quality gasoline and diesel.
4. To strengthen the control of construction dust, the cooking smoke pollution in the restaurant, enhance management of the urban greening project and the urban road cleaning.

5. ENHANCE THE RECYCLE OF RESOURCE AND ENERGY, REDUCING POLLUTION FROM THE SOURCE.

4.2 Policy dimension

1. For the oil industry, get rid of the trade monopolies and encourage the fair competition of market to build an effective market structure, so as to force the oil upgrading.
2. To promote urban green travel mode with priority to public transport and encourage residents to travel by public bikes or walking.
3. The country should give the Ministry of Environmental Protection more power, the supervisory power and the executive power should all belong to the Ministry of Environmental Protection.
4. To establish a sound legal system with clear body and responsibility.
5. To implement the environmental information disclosure system, requires enterprises to open the environmental information.

4.3 Education dimension

1. To popularize the hazards of PM2.5 to human health, make the ecological civilization idea deeply rooted in people's hearts.
2. To promote the formation of the natural, healthy and eco-friendly lifestyle.

CONCLUSION

PM2.5 has caused great damage and loss, both in terms of personal health and overall social benefits. In spite of the rapid development of Chinese economy, the degree of PM2.5 pollution has been seriously overweight. The sources of PM2.5 pollution are mainly from coal, fuel and traffic emissions.

Aimed at the serious situation of air pollution, the joint efforts should be recommended for the Chinese government and people from the technology dimension, the policy dimension, and the education dimension, especially to solve the important problems of coal desulfurization, oil upgrading, and enforcement of the Ministry of Environmental Protection. Meanwhile, it is expected that all citizens can actively support and participate in the practice of environmental prevention and control work starting from themselves and from the trivial, so as to greatly improve air condition and form a sustainable way of production and an environmentally friendly way of life.

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