

## **Research on patent information analysis of air pollution prevention and control in China**

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*The research is financed by the Humanities and Social Science Project of Education Department of Henan (No. 2019-ZZJH-087); Anyang 2020 science and technology development plan project(No. 2020-300).*

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**Abstract:** Air pollution prevention and control is closely related to life. This paper analyzes the patent status quo of air pollution prevention and control in China from the aspects of patent types, legal status, annual application quantity, technology hotspots and technology transfer, and finally gives opinions and Suggestions on the patent development of air pollution prevention and control in China based on the research results.

**Keywords:** Prevention and control of air pollution; Patent analysis; Technology of hot

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Date of Submission: 29-04-2020

Date of Acceptance: 13-05-2020

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### **I. IDENTIFICATION OF PATENT RETRIEVAL**

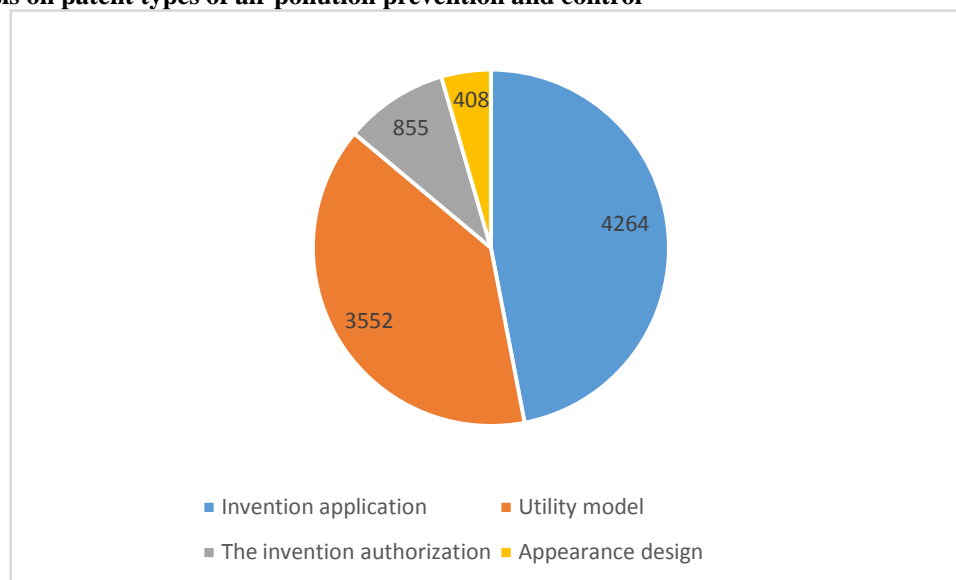
Air pollution is caused by human activities or natural processes of certain substances into the atmosphere, present enough concentration, reach enough time, and thus endanger the human body's comfort, health and the environment phenomenon. Atmospheric pollutants enter the atmosphere from man-made or natural sources (input), participate in the circulation process of the atmosphere, and after a certain detention time, they are removed from the atmosphere (output) through chemical reactions, biological activities and physical deposition in the atmosphere. The causes of atmospheric pollutants include natural factors, such as volcanic eruptions, forest disasters and rock weathering. There are also human factors such as industrial exhaust, fuel, automobile exhaust and nuclear explosions. At present, the main causes of air pollution are human factors.

At present, the situation of air pollution in China is serious, and regional air pollution problems featuring PM10 and PM2.5 are increasingly prominent, which harm people's health and affect social harmony and stability. Atmospheric pollution prevention and control technology mainly includes the power plant boiler flue gas emissions control, industrial boilers and furnaces flue gas emissions control, typical hazardous industrial waste gas purification, motor vehicle exhaust emission control, bedroom and typical air pollutant treatment in public places, unorganized emission source control, atmospheric pollution monitoring simulation and decision support, cleaner production and other key technologies in the field of eight.

According to the definition of air pollution control AND key technologies, the retrieval expression of air pollution control patent is determined as: TIAB=(haze OR haze prevention OR treatment OR (air pollution AND control) OR (air pollution AND control)). Through the Incopat patent retrieval system, a total of 9,079 Chinese related patents were retrieved (up to May1, 2020).

## II. PATENT ANALYSIS OF AIR POLLUTION PREVENTION AND CONTROL IN CHINA

### 2.1 Analysis on patent types of air pollution prevention and control

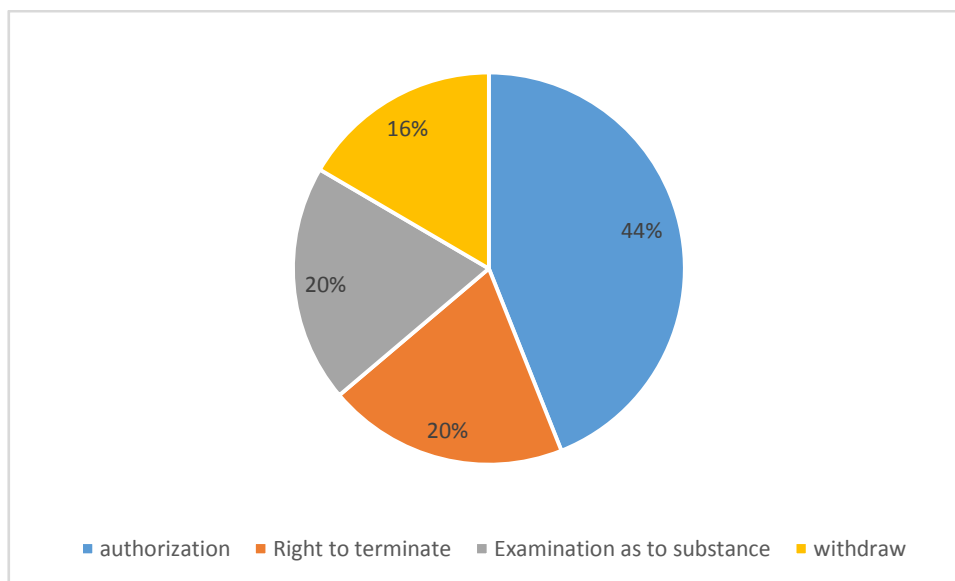


**FIG. 1 patent types of air pollution prevention and control in China**

It is found from FIG. 1 that 5119 invention patents (4,264 invention applications and 855 invention authorization) account for 56.38% of China's air pollution prevention and control patents. There were 3,552 utility model patents, accounting for 39.12% of the total; At least 408 design patents, accounting for 4.50% of the total. The emission control of fuel coal and oil can be said to be the core technology in the air pollution prevention and control program. Denitrification of coal involves technologies such as low nitrogen combustion, combustion solid flow and flue gas denitrification. And the automobile exhaust treatment includes three catalytic, fine particle emission purification, zero emission and other technologies. No doubt this needs the continuous innovation and progress of technology, in order to meet the higher and higher environmental protection requirements, which has given rise to the emergence of a large number of air pollution prevention invention patents. With the continuous development and progress of China's social economy, people's demand for air pollution prevention and control products is constantly emerging. Haze prevention products closely related to people's life, such as anti-haze masks, anti-haze window screens and air purifiers, have been innovated, which also explains why utility models account for a large proportion of air pollution treatment patents.

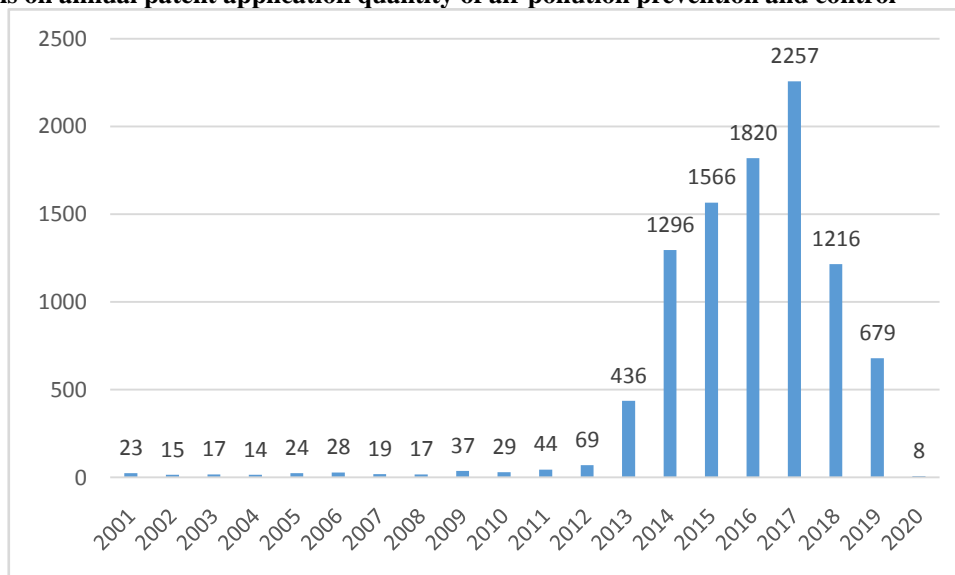
### 2.2 Analysis of patent law status of air pollution prevention and control

As can be seen from figure 2, China's air pollution prevention and control patents account for the largest proportion of authorization, reaching 44%, and there are still 20% of patents in the examination stage, which are expected to be granted effectively. But it is worth noting that there are 20% of the prevention and control of atmospheric patent rights terminated, because China's fixed number of year of the atmospheric pollution control for the most part patent application within 20 years, this phenomenon may be the cause of the patent holder voluntarily give up patent or not according to the regulation pay an annual fee, it also suggests that the efficiency of the air pollution prevention and control technology has the very significant. 16% of patents were withdrawn or rejected, suggesting that there is still a lot of low-quality patent applications out there that could be exploited in troubled waters, which should also be noted.



**FIG. 2 patent law status of air pollution prevention and control in China**

### 2.3 Analysis on annual patent application quantity of air pollution prevention and control



**FIG. 3 annual patent application trends of air pollution prevention and control in China**

Although patents for air pollution prevention and control appeared in the early part of this century, they developed slowly in the following decade, with annual applications mostly falling below 50. This is because people do not have a deep understanding of the harm of air pollution, the prevention and control technology research is not in-depth, the corresponding patent output is low. But in the years after 2013, the number of air pollution prevention patent applications surged, from 436 in 2013 to 2,257 in 2017. This is because air pollution in China was so serious in 2013 that the word "haze" even became the word of the year in 2013. Related news reports also made people quickly understand the harm of air pollution. At the same time, the government has increased policy support for air pollution prevention and control technology, and relevant enterprises and individuals have actively invested in technology research and development and product production. In this context, a large number of air pollution prevention and control patents have been generated, and the number of annual applications has been increasing year by year. Because patent applications have a long time to review (generally 18 months), the data from 2018 to 2020 are for reference only and not for analysis.

2.4 Hot spot analysis of patent technology of air pollution prevention and control

Table 1 IPC technology classification of air pollution prevention patent

IPC	Major areas	Number of patents
B01D	Gas separator	2500
A41D	Coats, protective clothing	1005
F24F	Air flow as a shielding application	845
A62B	A composition of chemical materials used in a mask, breathing apparatus or similar apparatus	537
G01N	To test or analyze a material by determining its chemical or physical properties	534
E06B	Doors and Windows etc.	516
G06T	Image data processing or generation	360
F21V	The functional characteristics	332
B01J	Catalysis or colloid chemistry	281
B03C	Magnetic or electrostatic separation of a solid material from a solid material or fluid	271

The distribution of the top 10 fields of air pollution prevention and control technology is shown in table 1. Air pollution prevention and control technology is more concentrated in B01D, A41D and F24F. Among them, the first technology is B01D technology, which is described as "separation". Most of the prevention and treatment of air pollution is to separate the dust, nitric acid and other particles in the haze, so as to get clean air. This is the most common and core technology for the prevention and treatment of air pollution, and the highest proportion is also in line with the actual situation.

The second A41D technology, whose class is described as a coat; Protective clothing. Clothing accessories, the technology is used to make anti-smog masks; Anti-smog clothing; Anti-smog headgear, etc. With the continuous improvement of people's quality of life, the protection requirements for polluted air are getting higher and higher, which leads to the birth of a large number of haze protection inventions and utility model patents. Ranked third in the F24F technology category is described as air conditioning, humidification. For the protection of haze in addition to mask clothing and other products, purifiers, air conditioners, ventilation systems and other equipment is now the field of air pollution protection and treatment of common equipment. The annual application trend of China's IPC patent for air pollution prevention and control is shown in FIG. 4.

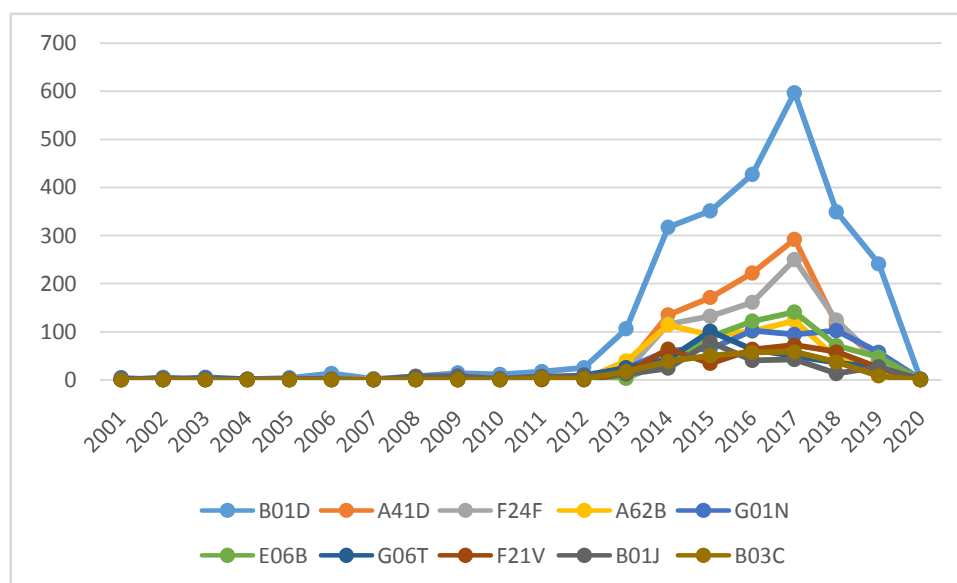


FIG. 4 annual application trend of IPC patent for air pollution prevention and control in China

## 2.5 Analysis of patent technology transfer for air pollution prevention and control

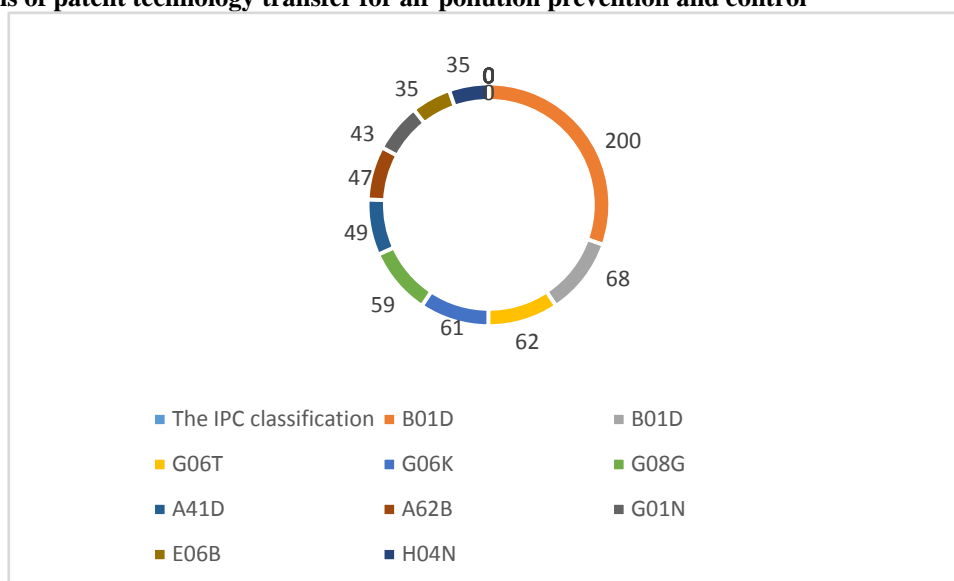


FIG. 5 composition of patent transfer technology for air pollution prevention and control in China

Compared with the huge number of applications for air pollution prevention and control patents, the volume of patent technology transfer is too small, as shown in FIG. 5. China's air pollution prevention and control patent transfer technology is the largest field of B01D, but it also only 200. This shows that the separation technology of air pollution prevention and control is not only the most common technical means, but also the most core technical performance of air pollution prevention and control. Research in this area of technology will lead to continuous innovation in the prevention and control of air pollution, while also bringing substantial benefits to patent owners.

### III. CONCLUSIONS AND RECOMMENDATIONS

Emission control of fuel coal and oil can be said to be the core technology in the air pollution prevention and control program, and the proportion of corresponding invention patents is not high at present. Therefore, the proportion of invention patents involved in air pollution prevention and control patents in China needs to be increased. The technology of air pollution prevention and control has obvious timeliness, but there are still many low-quality patent applications exist the possibility of fishing in troubled waters. Compared with the huge number of applications for air pollution prevention and control patents, the volume of patent technology transfer is too small. Government departments should guide relevant enterprises and individuals to pay attention to the technology transfer of air pollution prevention and control patents.

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