

Research on patent development of Recycled concrete in China

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ABSTRACT

Based on the definition, research significance and social value of recycled concrete, this paper deeply analyzes the development trend of recycled concrete patents in China from four aspects: types of recycled concrete patents, annual number of patent applications, patent applicants and hot spots of recycled concrete technology.

KEYWORDS

China; recycled concrete patent; development situation

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INTRODUCTION

With the acceleration of the world's urbanization process, a large number of old buildings (structures) are demolished, transformed or abandoned every year, resulting in the annual construction waste accounted for about 40% of the industrial solid waste, of which the waste concrete is the largest proportion of construction waste emissions. How to dispose of these abandoned concrete has become a difficult problem concerned by all countries in the world. If such a large amount of abandoned concrete is simply piled up near the roads, rivers, farmland and gullies in the suburbs of the city, or the traditional digging and burying treatment, it will not only occupy a large amount of increasingly valuable land resources, but also bring unpredictable secondary pollution to the land and groundwater. It is obvious that the simple disposal method of traditional discarding or digging and burying cannot meet the requirements of environmental protection and social sustainable development.

The recycling of waste concrete has become an urgent problem in today's society. Due to the composition of waste concrete is mainly of sand and gravel aggregate, if this part can be sand aggregate recycling use, such not only can save a lot of natural sand and gravel aggregate, protect the ecological environment of natural sand the original site, but also can solve the waste concrete due to pile up, buried land resource waste and environmental pollution problem. Therefore, recycling of waste concrete is regarded as one of the important ways to develop green concrete, which has good social, economic and environmental benefits, and is of great practical significance to build a conservation-oriented sustainable development society. After being processed, broken and classified, the waste concrete blocks are mixed in a certain proportion to form Recycled Aggregate. Some or all of the replacement of natural coarse Aggregate (Original Aggregate) prepared by the new Concrete is called Recycled Aggregate Concrete (RCA) commonly known as Recycled Concrete (Recycled Concrete).

By searching the database on the official website of the State Intellectual Property Office, it is found that as of November 20, 2021, There are 2,880 recycled concrete technology patents in China, and their analysis is as follows:

PATENT TYPE ANALYSIS OF RECYCLED CONCRETE

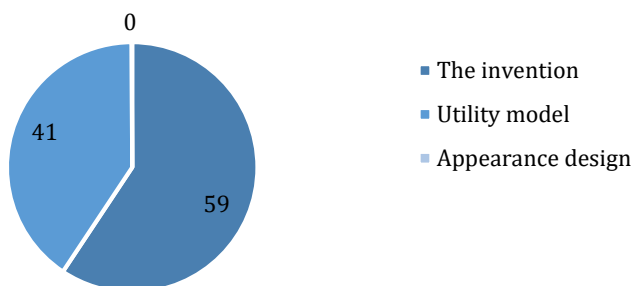


FIGURE 1: Composition of reclaimed concrete patent types

As shown in Figure 1, recycled concrete professional patents are mainly composed of invention patents and utility model patents, and there are only 2 appearance design patents, which can be ignored. This is in line with the characteristics of recycled concrete technology, because the innovation of this technology is mainly concentrated in the field of technical scheme and practical value, basically does not involve the appearance design. This also reflects the high content of reclaimed concrete patent technology from the side, which has a significant innovation drive.

ANALYSIS OF ANNUAL PATENT APPLICATIONS OF RECYCLED CONCRETE

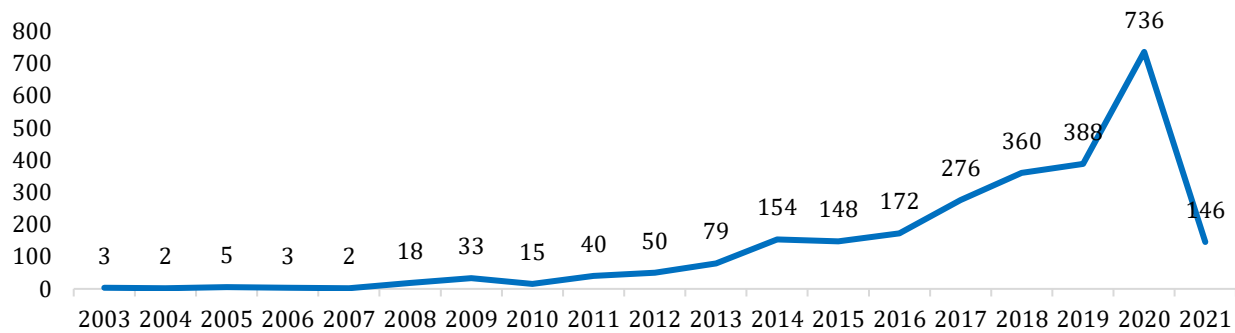


FIGURE 2: Annual patent applications of recycled concrete

As shown in Figure 2, the patent application of reclaimed concrete has roughly gone through four stages: From 2003 to 2007, the number of patent applications for recycled concrete was in single digits, indicating that the technology was in its infancy in this period. The raw materials of concrete mainly rely on natural sand and stone, and recycled coarse aggregate is less concerned at this stage, and its corresponding recycled coarse aggregate process or technical output is also low.

From 2008 to 2013, recycled concrete patents experienced a slow development period, and the number of patent applications increased from 18 to 79. The development of recycled concrete technology benefits from the rapid development of China's economy, a large number of waste buildings need to be demolished, and recycled coarse aggregate has gradually attracted people's attention. How to effectively use the residual value of waste buildings has become a topic of concern for many universities and research institutes.

From 2014 to 2019, recycled concrete patents experienced a period of rapid development. After only a few years of development, the annual application number of recycled concrete patents exceeded 300 in 2018, and the application number reached 388 in 2019.

The rapid development of recycled concrete technology patent not only benefits from the rapid development of China's economy, but also benefits from the national and local government's continuous attention to environmental protection. For example, the Shanghai Municipal Administration Measures for Recycling and Utilization of Construction Waste Concrete jointly issued by multiple departments at the end of 2018 stipulates the mandatory use system of recycled products. The replacement rate of recycled aggregate for C25 and below strength grade concrete shall not be less than 15%, and the replacement rate of recycled aggregate for transportation infrastructure projects shall not be less than 30%. All these will greatly promote the development of recycled concrete technology and give birth to a large number of recycled concrete patents.

Since 2020, reclaimed concrete patents have ushered in a technological explosion period, and the number of patent applications in 2020 has reached an astonishing 736. As patent applications require a long period of time (generally 18 months), the data in 2021 are only for reference. Recycled concrete technology has attracted more and more attention from universities and research institutes, and the corresponding RESEARCH and development forces have been gathering, and the patent output has also been reaching new highs

RESEARCH ON PATENT APPLICANTS OF RECYCLED CONCRETE

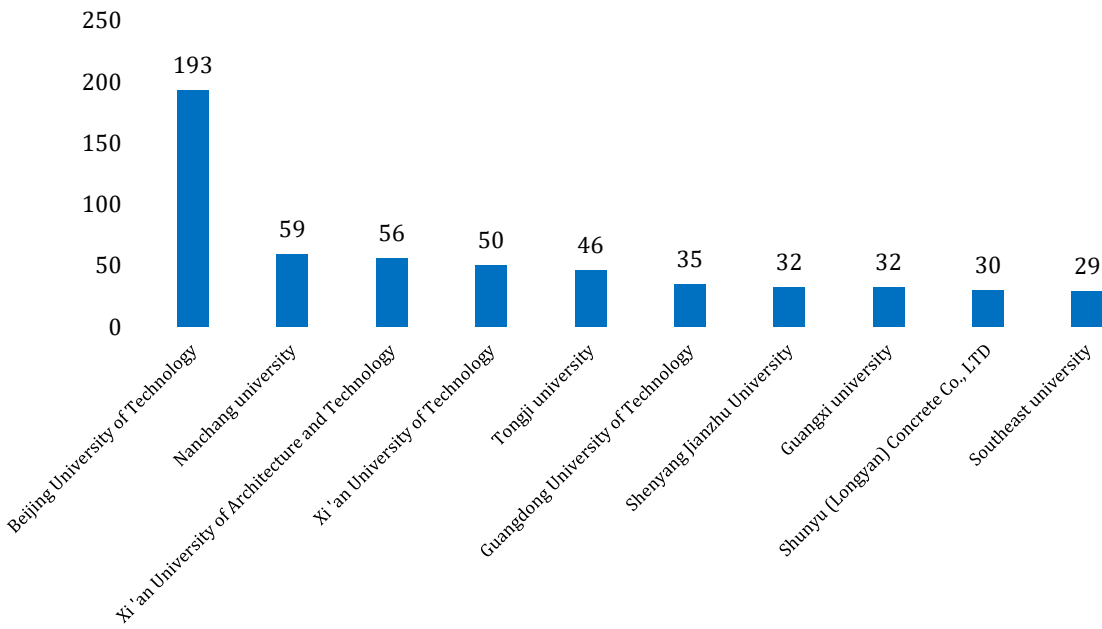


FIGURE 3: Distribution of the top ten patent applicants for recycled concrete

As can be seen from Figure 3, patent applicants for recycled concrete have two characteristics: first, universities are the main force of patent applications for recycled concrete, accounting for nine out of the top ten, and all of these universities have strong schools of civil engineering or building materials related disciplines as important technical support for their research. Beijing University of Technology, the no.1 patent applicant for recycled concrete, has national key disciplines such as materials Science and structural engineering, and first-level doctoral programs such as civil engineering and materials Science and Engineering.

Its scientific research strength is strong, and it is normal for recycled concrete technology to rank among the top in China. Second, the number of patents owned by reclaimed concrete patent applicants is generally low. The total number of patents owned by the top ten patent applicants is only 562, accounting for 19.7% of all patents. Neither technological monopoly nor technological oligopoly has been formed. The scattered distribution of patents indicates that there are no outstanding patent applicants in China and the core value of patents has not been fully expressed.

HOT SPOT ANALYSIS OF RECYCLED CONCRETE TECHNOLOGY

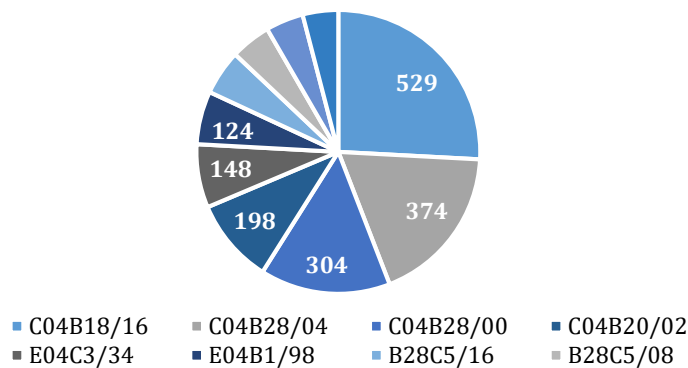


FIGURE 4: Distribution of the top ten hot spots of recycled concrete technology

As can be seen from Figure 4, the distribution of the top ten technology hotspots of reclaimed concrete is mainly concentrated in the use of waste or waste as mortar, concrete or artificial stone filler. Sintering materials or waste materials specially used to improve their filling performance in mortar, concrete or artificial stone or waste treatment, etc. And recycled concrete technology hot spots are relatively concentrated, the top ten hot spots account for about 70% of all patents, and C04B (lime; Magnesium oxide; Slag; Cement; Its composition is the most prominent technical link in the research hotspot.

The recycling of waste concrete has become an urgent problem in today's society. Due to the composition of waste concrete is mainly of sand and gravel aggregate, if this part can be sand aggregate recycling use, such not only can save a lot of natural sand and gravel aggregate, protect the ecological environment of natural sand the original site, but also can solve the waste concrete due to pile up, buried land resource waste and environmental pollution problem. Therefore, recycling of waste concrete is regarded as one of the important ways to develop green concrete, which has good social, economic and environmental benefits, and is of great practical significance to build a conservation-oriented sustainable development society.

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