A Study on the Development of Complex Artificial Sidewalk Blocks Recycling Various Waste Resources such as Waste Stone Powder, Fly Ash, Waste Plastic and Coconut Shells

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폐석분, 플라이애쉬, 폐플라스틱 및 코코넛 껍질 등 다양한 폐자원을 재활용한 복합인공 보도블럭 개발에 관한 연구

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Abstract

Carbon neutrality is aimed at preventing the concentration of greenhouse gases in the atmosphere from further increasing due to human activities, minimizing carbon dioxide(CO_2) emissions, and increasing CO_2 absorption to achieve zero net emissions. In order to achieve 2050 carbon neutrality, the recycling of waste resources has become increasingly important. Recycling and reusing waste resources can reduce the development of new materials and the use of energy, thereby reducing greenhouse gas emissions. According to statistical data, recycling 1 kg of waste plastic can reduce 1 kg of CO_2 emissions. Therefore, the recycling and utilization of waste plastics is the simplest and most effective method to reduce CO_2 emissions. Plastic plays an important role in our lives, and people's daily lives seem to be inseparable from plastic, including from drinking water bottles to tableware, and from office supplies to household utensils. However, with the rapid development of society, plastic production has surged since the 1950s. In 2021, the global plastic production reached an astonishing level of 390.7 million tons. This results in approximately 350 million tons of plastic waste being generated annually in countries around the world. The difficult decomposition and biodegradability of plastics can cause serious pollution to air, water, and soil due to their large emissions. Therefore, plastic pollution has become one of the most important environmental problems facing the world today. According to the Institute for Foreign Economic Policy (KIEP), the production of plastic at the world economic center has significantly increased from 234 million tons in 2000 to 460 million tons in 2019. During the same period, plastic waste generation more than doubled from 156 million tons to 353 million tons[1]. However, the global recycling rate of plastic waste is only 9%. Another solid waste is waste stone powder, which mainly comes from the mining of stone mines and the stone processing process. With the rapid development of the domestic construction industry, the demand for basic materials has sharply increased. A large number of stone mountains are mined and processed by stone processing enterprises, and about 30% to 60% of the stones and aggregates are turned into waste stones or waste stone powder and sludge. Only a portion of these wastes are reused as artificial marble or lightweight bubble concrete, while the majority are piled up or unplanned landfilled. These treatment methods have caused serious air, water, and soil pollution, and have caused serious damage to the living environment of surrounding residents. In South Korea, up to 15 million tons of waste stone powder are generated annually during the processing of aggregates or stones, most of which are used as soil materials for construction and civil engineering, road base materials, and landfill materials for covering soil. According to the Waste Management Law, stone powder can be classified as waste from business premises or can be reused.

Therefore, in this study, we innovatively propose to prepare high-value products by recycling and reusing various solid wastes such as waste plastics, waste stone powder, fly ash, and coconut shell fibers. These waste materials were successfully prepared into composite artificial sidewalk blocks using high-temperature and high-pressure compressors at different mixing ratios.

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References

[1] RATNAWATI, Ratnawati; WULANDARI, Retno; ISTIQOMAH, Amalia. Biodegradable Plastics from PVA/Starch/Lignin Blend: Mechanical Properties, Water Absorption, and Biodegradability. International Journal of Chemical and Biochemical Sciences, 2023, 24.4: 224-231.