Development of Water-Retaining Pavement Concrete Using Bamboo Fiber to Mitigate Urban Heat Island Effects

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Abandoned bamboo forests pose a significant challenge in Japan, which requires the exploration of innovative applications for this eco-friendly resource. My recent research revealed that treating bamboo with a sodium hydroxide solution enhances its water absorbency, offering potential solutions to pressing environmental concerns. Water-retaining pavement (WRP) stands as a promising approach to mitigating urban heat island effects by facilitating surface temperature reduction through evaporation. This study sought to leverage bamboo fiber (BF) as a water-retention agent in WRP concrete. Using scanning electron microscopy (SEM), I investigated the water absorption mechanism of BF and compared it with conventional water-absorbing materials (CWMs) via absorption tests. Additionally, I evaluated the weather resistance of BF and its impact on reducing road surface temperatures one year post-treatment. Secondary effects such as changes in the coefficient of repulsion and sound properties of the WRP surface were also examined. SEM analysis revealed that treatment with aqueous sodium hydroxide solution resulted in the separation of bamboo fibers from lignin and other substances, enabling water absorption into the interstitial spaces. In absorption tests, BF exhibited comparable performance to CWMs, maintaining its efficacy over a year. Incorporating BF into WRP concrete reduced surface temperatures by approximately 5°C compared to ordinary concrete. While the coefficient of restitution showed negligible variance, BF exhibited sound absorption properties. These findings highlight the utility and sustainability of BF, underscoring its potential as a viable water-retention material for WRP systems.