Green Method to Lower the 8%: Facile and Sustainable Preparation of Superhydrophobic Concrete/Brick Surface

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Concrete/brick is the most widely used construction material, but manufacture of them contributes to 8% of global CO2 emissions. Rainwater accumulated in the concrete/brick pores can form damaging ice in the winter and cost the world $ 1 billion for conservation each year. Superhydrophobic modification can make concrete/brick significantly water-repelling, extending the service life of such structures and reducing cement/brick usage. However, “conventional” preparation of superhydrophobic surface involves eco-unfriendly and costly surfactants in complicated methods. It is known that superhydrophobic surface has two components: nanometer-sized surface structure, and low-surface energy coating. Therefore, this study aims at a green, facile method to introduce these components to brick surface simultaneously. To do so, edible biowax, which is an inexpensive green material with low surface energy, can be processed into surfactant-free water/ethanol-based emulsion using TiO2 nanoparticles (TiO2-NPs). However, commercial TiO2-NPs are hydrophilic and do not generate stable wax-in-water/ethanol emulsion. To solve this issue, this study proposes to pre-treat the TiO2-NPs with “sticky” tannic acid-Fe3+ complex (TA/Fe3+) which is based on inexpensive natural products. The concrete/brick can be simply treated with the wax emulsion stabilized by TiO2-NPs@ TA/Fe3+ using spray-coating. After a convenient heat treatment using hair dryer, the concrete/brick surface becomes superhydrophobic, and demonstrates great performance in surface water gathering and surface decontamination tests. It is envisaged that this green, affordable, and facile method can help to protect concrete structures, leading to less cement consumption, and therefore sustainable reduction of global CO2 emissions.

Awards Won: