Novel Photocatalytic Pervious Composites for Removing Multiple Classes of Toxins from Water

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Water is an indispensable resource essential for the survival of all species; however, 780 million people in the world lack access to clean water. Due to rising population, industrial development and economic growth, fresh water demand for domestic use, agriculture, and industries is increasing significantly. The goal of this research was to develop a safe, cost-effective, and eco-friendly technique for water purification. The innovative methodology developed in this study integrates an enhanced photocatalytic advanced oxidation process (AOP) with filtration using novel pervious composites. Silver (Ag) doped photocatalytic pervious composites were synthesized using uniformly graded sand, Portland cement, titanium dioxide and silver nitrate. The ratio of titanium dioxide: cement: sand was 1: 5: 20 by weight and the optimum amount of Ag was 0.04% by weight of the composite. This composition was determined from photodegradation studies of the organic dye methylene blue using UV-Vis spectroscopy. The photodegradation of methylene blue conformed to pseudo-first order kinetics according to the Langmuir–Hinshelwood model. Bacterial inactivation studies with the Ag-doped photocatalytic pervious composite showed 98% reduction in total coliform bacteria immediately after filtration. Subsequent exposure of the filtered water to sunlight inside a beaker containing an Ag-doped photocatalytic composite disc resulted in 100% inactivation of total coliform bacteria in just 15 minutes. This project opens numerous possibilities for green, sustainable, and economically viable water purification.

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his Companions Foundation for Giftedness and Creativity: $1,000 will be awarded to the winner's school.