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# Development and Evaluation of Economical Self-cleaning Cement

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**Abstract :** Now a day, the key issue for the scientific community is to devise the innovative technologies for sustainable control of urban pollution. In urban cities, a large surface area of the masonry structures, buildings, and pavements is exposed to the open environment, which may be utilized for the control of air pollution, if it is built from the photocatalytically active cement-based constructional materials such as concrete, mortars, paints, and blocks, etc. The photocatalytically active cement is formulated by incorporating a photocatalyst in the cement matrix, and such cement is generally known as self-cleaning cement In the literature, self-cleaning cement has been synthesized by incorporating nanosized-$TiO_2$ (n-$TiO_2$) as a photocatalyst in the formulation of the cement. However, the utilization of n-$TiO_2$ for the formulation of self-cleaning cement has the drawbacks of nano-toxicity, higher cost, and agglomeration as far as the commercial production and applications are concerned. The use of microsized-$TiO_2$ (m-$TiO_2$) in place of n-$TiO_2$ for the commercial manufacture of self-cleaning cement could avoid the above-mentioned problems. However, m-$TiO_2$ is less photocatalytically active as compared to n- $TiO_2$ due to smaller surface area, higher band gap, and increased recombination rate. As such, the use of m-$TiO_2$ in the formulation of self-cleaning cement may lead to a reduction in photocatalytic activity, thus, reducing the self-cleaning, depolluting, and antimicrobial abilities of the resultant cement material. So improvement in the photoactivity of m-$TiO_2$ based self-cleaning cement is the key issue for its practical applications in the present scenario. The current work proposes the use of surface-fluorinated m-$TiO_2$ for the formulation of self-cleaning cement to enhance its photocatalytic activity. The calcined dolomite, a constructional material, has also been utilized as co-adsorbent along with the surface-fluorinated m-$TiO_2$ in the formulation of self-cleaning cement to enhance the photocatalytic performance. The surface-fluorinated m-$TiO_2$, calcined dolomite, and the formulated self-cleaning cement were characterized using diffuse reflectance spectroscopy (DRS), X-ray diffraction analysis (XRD), field emission-scanning electron microscopy (FE-SEM), energy dispersive x-ray spectroscopy (EDS), X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), BET (Brunauer–Emmett–Teller) surface area, and energy dispersive X-ray fluorescence spectrometry (EDXRF). The self-cleaning property of the as-prepared self-cleaning cement was evaluated using the methylene blue (MB) test. The depolluting ability of the formulated self-cleaning cement was assessed through a continuous NOX removal test. The antimicrobial activity of the self-cleaning cement was appraised using the method of the zone of inhibition. The as-prepared self-cleaning cement obtained by uniform mixing of 87% clinker, 10% calcined dolomite, and 3% surface-fluorinated m-$TiO_2$ showed a remarkable self-cleaning property by providing 53.9% degradation of the coated MB dye. The self-cleaning cement also depicted a noteworthy depolluting ability by removing 5.5% of NOx from the air. The inactivation of B. subtiltis bacteria in the presence of light confirmed the significant antimicrobial property of the formulated self-cleaning cement. The self-cleaning, depolluting, and antimicrobial results are attributed to the synergetic effect of surface-fluorinated m-$TiO_2$ and calcined dolomite in the cement matrix. The present study opens an idea and route for further research for acile and economical formulation of self-cleaning cement.

**Keywords :** microsized-titanium dioxide (m-$TiO_2$), self-cleaning cement, photocatalysis, surface-fluorination
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