Comparative study of different solar-based photo catalytic reactors for disinfection of contaminated water

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ABSTRACT

In this work, two solar-based photo catalytic reactors having different geometries and configurations for the disinfection of contaminated water were designed and tested. These solar-based reactors are stair-type open exposure and parabolic trough concentrator (PTC). For the first type, the stairs were coated with TiO₂ using sol-gel method, whereas the parabolic type concentrator used a titania-coated rod. For monitoring of disinfection process, the parameters such as solar irradiation exposure time and bacterial deactivation counts were investigated carefully. On contrary to commercial slurry-based photo reactor reported in the literature, thin film titania-coated reactor’s performance was investigated in this work. Moreover, detailed designed aspects of the reactors, process parameters, and reactor operation are presented and discussed. The target aqueous matrix was drinking water developed in laboratory having 10⁶ CFU/mL bacterial strain. Experimental results revealed that during 20 min of solar radiation exposure, 28 and 75% of the initial bacterial strain disinfection was recorded in staircase and PTC photo reactor, respectively. Moreover, results revealed that 1.75 kJ/L of UV energy is required in PTC photo reactor to achieve 75% reduction of initial bacterial population, whereas 4.1 kJ/L of UV is required to produce the same result in staircase photo reactor. The PTC showed more effective inactivation of E. coli bacteria than the staircase-type photo reactors. This study is highly significant for designing of large-scale PTC reactors for clean water supplies for rural population and remote locations.

Keywords: Stair case photo reactor; Parabolic trough concentrator photoreceptor; Titania thin films; Solar disinfection

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