DEGRADATION OF SULFAMETHOXAZOLE USING A HYBRID CuO_x-$BiVO_4$/SPS/SOLAR SYSTEM

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ABSTRACT

In recent years advanced oxidation processes (AOPs) have raised great interest towards complete elimination of emerging contaminants in aqueous media [1]. The term AOPs defines technologies based on the generation of strong oxidative chemical species (ROS) such as hydroxyl radicals (•OH) characterized by a particularly high oxidation potential (2.8 V vs NHE, pH ~ 6). Characteristic examples of AOPs are ozonation (O_3, O_3/UV-B, O_3/H_2O_2), photooxidation (UV-B,C/H_2O_2), heterogeneous photocatalysis (TiO_2/UV-A), Fenton reagent and photo-Fenton (homogeneous photocatalysis), liquid oxidation, electrochemical oxidation, use of ultrasound etc. A majority of scientitists believe that one of the main reasons that hinders their accumulation in practical applications is the low efficiencies recorded. This can be partially attributed to reactive oxygen species (ROS) scavenging from real water matrices constituents [2]. A promising way to increase the efficiency of the whole process in a cost and energy effective way seems to be the simultaneous use of different AOPs [3].

Herein, photocatalysis and sodium persulfate activation (SPS) were used simultaneously for sulfamethoxazole (SMX) degradation in real water matrices, such as bottled water (BW) and wastewater (WW). In specific copper promoted $BiVO_4$ (photo)catalysts with variable CuO_x (0.75 - 10 % wt.) content were synthesized in powder form and characterized by means of XRD, DRS and HRTEM. Interestingly, when 0.75% CuO_x/$BiVO_4$ photocatalyst was added in BW, only 40% SMX degradation took place in 120 min under simulated solar irradiation alone, while in the solar/SPS/CuO_x/$BiVO_4$ system complete elimination was achieved after 60 min. The improved efficiency of solar/SPS/ system is mainly deriving from the simultaneous activation of SPS by solar irradiation and CuO_x/$BiVO_4$ photocatalyst. Similar results were obtained for all CuO_x loadings examined. Moreover, simultaneous activation of SPS with CuO_x/$BiVO_4$ photocatalysts and solar light irradiation resulted in ~37%, 45% and 66% synergy in case of 0.75% CuO_x, 3%CuO_x and 10% CuO_x/$BiVO_4$ respectively, in WW.

The above results showed that when catalytic SPS activation and solar photocatalysis were used simultaneously, faster SMX degradation in a synergistic rather than cumulative way is achieved.

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KEYWORDS: photocatalysis, sodium persulfate, antibiotics, water treatment, hybrid system

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