Green sustainable method for water and soil purification: Photo-degradation of soil- and water- organic contaminants using semiconductor nano-particles

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Abstract

Different methods and strategies were followed for water and soil purification, the best one is the one with higher efficiency and low cost. Photodegradation is one of the most attractive methods. It involves excitation of the suitable semiconductor by light, before degradation of water or soil organic contaminants occurs. TiO_2 nano- and micro-particles have been used for photo-degradation of widely spread water organic contaminants. Due to its wide band gap (~3.2 eV) TiO_2 photo-catalytic activity is limited to shorter wavelengths only (UV region). As only ~4% of the solar spectrum falls in the UV region, smaller band gap semiconductors (e.g. CdS, with 2.3 eV) are used to sensitize TiO_2 particles. The TiO_2/CdS system has been used as catalyst in water purification by photo-degradation of organic contaminants such as methyl orange and Phenazopyridine (Medically active compound). However, the TiO_2/CdS system is unstable under photodegradation conditions yielding hazardous Cd^{2+} ions. Alternative ZnO nanoparticles naked and substrate to different materials like (clay, sand, and activated carbon) were used in photodegradation process. Also natural dyes (anthocyanin & Curcumine) were used as sensitizer for the TiO_2 nanoparticles. The different prepared nano-catalyst systems were used to photo-degrade various contaminants of water and soil, such as methyl orange, phenazopyridine, paracetamol, phenols, and halo-phenols, with solar radiation. Furthermore, the ZnO nanoparticles were used in water purification and disinfection (from bacteria) by complete mineralization under solar light. Different reaction parameters (such as catalytic efficiency, effects of catalyst concentration, catalyst recovery, contaminant concentration, temperature, pH and complete mineralization) will be discussed.

Keywords: Photodegradation, Nanoparticles, TiO_2, Sensitization, water purification