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Removal of selected Pharmaceuticals from aqueous solutions using heterogeneous photocatalysis

Samer Khalaf

Al-Quds University, Palestine

Pharmaceutical compounds (PhCs) in general characterized by their low biodegradability and high chemical stability, making conventional treatment technologies incapable to eliminate such kinds of recalcitrant compounds. In the current study, removal of two non-steroidal anti-inflammatory drugs (NSAID) from aqueous phase has been investigated through employing photolysis and heterogeneous photocatalysis processes.

Mefenamic acid (MEF) and diclofenac sodium (DCF) are commonly used as analgesic and inflammatory drugs and they are widely present in sewage systems. In this study, experements were divided into two parts: Photolysis and heterogeneous photocatalysis. Concerning photocatalysis experiments, TiO_2 as a catalyst has been used in two forms: (i) as dispersed powder; (ii) immobilized on the surface of blue slabs. Obtained results showed that photolysis had low efficacy toward degradation of MEF (half-life (t1/2) 1442 min). While, using TiO_2 as dispersed powder during the photocatalytic process enhanced the process dramatically and reduced half-life (t1/2) to 90 min, furthermore, it is possible to reach the complete mineralization after approximately 3 hours, whereas addition of TiO_2 through immobilized system led to a little improvement in the photodegradation process behavior (t1/2 =1140 min.). For DCF photocatalysis by using TiO_2 dispersed powder shows the fastest extent of degradation with 54.6 min of half-life (t1/2), while direct photolysis and photocatalysis using TiO_2 immobilized system showed approximately comparable results (71 and 79 min respectively).

Kinetic studies for both drugs were accomplished and photoproducts were identified using liquid chromatography coupled with mass spectrometry system (LC-MS) (Fig.1).

The overall results suggested that using heterogeneous photocatalysis with TiO_2 dispersed powder accelerate degradation process than TiO_2 immobilized system. In spite of this, using TiO_2 supported on glass substrates appears to be a promising alternative to conventional TiO_2 suspension, since it is able to provide a clean method through saving a post treatment stage for recovering the catalyzer powder.