ABSTARCT

Water pollution caused by industrial effluent containing various toxic organic and inorganic chemical compounds such as phenol, dye, heavy metal and fluoride ions etc., has become a global issue nowadays. Adsorption and photocatalysis have been found as very promising waste water treatment processes due to their high removal efficiencies. Preparation of such adsorbents and photocatalysts from industrial waste materials makes the treatment process even more cost effective. In this work, the potential application of LD slag, a steel industries' solid waste, as raw material for synthesis of efficient adsorbents and photocatalysts for waste water treatment is explored which may be considered as possible alternative solution for waste management.

Raw LD slag has been modified by microwave activation for preparing an efficient adsorbent from LD Slag to remove phenol from synthetic waste water. The parameters involved in microwave activation of LD slag have been optimized by 'Box Behnken design' method. Microwave Activated LD Slag (MWLDS) adsorbent has been characterized using several methods to determine the BET surface area, morphology, point at zero charge, amorphous nature of the adsorbent. The adsorptive removal of phenol by MWLDS has been carried out in a batch system by performing isotherm, kinetic and thermodynamic studies.

Raw LD slag has been utilized as a raw material for synthesis of geopolymeric adsorbent through alkaline activation method for removal of heavy metal and fluoride ions from artificial waste water. The characterization results of LD slag geopolymer adsorbent (LDSGP) shows that calcium oxide content of the raw LD slag has been found to be playing a pivotal role for geopolymerisation. The adsorptive removal of heavy metal ions i.e. nickel and zinc ions, in single element and binary element systems, by LDSGP, has been performed to evaluate its heavy metal removal efficiency. Fluoride ions have been removed using fresh and spent LD slag geopolymeric adsorbents (LDSGP, Ni-LDSGP & Zn-LDSGP) by carrying out similar experiments.

The LD slag geopolymer (LDSGP) has been further used to synthesize ZnO based nancomposite (ZnO/LDSGP) as a visible light photocatalyst, by a facile hydrothermal method, for degradation of congo red dye (CR), an azo dye containing chromophore (–N=N–) in its molecular structure. The physico-chemical and opto-electroic characterizations have been performed to determine morphology, crystallinity and bang gap etc., of the ZnO/LDSGP photocatalyst. The superior photocatalytic activity of ZnO/LDSGP nanocomposite over commercial ZnO nanoparticles have been observed by performing kinetic studies at various

experimental conditions.

A Metal-Organic Framework (MOF) nanocomposite has been prepared from LD slag, by one step solvothermal method, to degrade organic dye removal under UV irradiation. The iron oxide and silica content of the raw LD slag has been utilized to synthesize MIL-53(Fe)/SiO_2 nanocomposite with an improved photocatalytic activity for methylene blue degradation. The photodegradation mechanism by MIL-53(Fe)/SiO_2 has been proposed with help of the characterization results and kinetic studies.

Key Words: LD Slag, Adsorbent, Photocatalyst, Microwave Activation, Geopolymer, ZnO nanocomposite, MIL-53(Fe)/SiO_2.