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PHOTODEGRADATION OF PHENOL USING TiO_2, ZnO AND TiO_2/ZnO CATALYSTS IN AN ANNULAR REACTOR

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In recent years the incorporation of ZnO as a semiconductor into other catalysts, for enhancing photodegradation processes, has gained attention. This paper describes the synthesis of a blend of metal oxide (TiO_2 /ZnO) photocatalyst and subsequent testing of the catalyst for the degradation of phenol in an annular photoreactor. The concentration of phenol before and after degradation was determined using Ultra-Violet-Spectroscopy (UV-Vis). Calcined TiO_2 /ZnO composite material with a mass loading ratio of 1:1 exhibited the highest percentage phenol removal compared to the unblended TiO_2 and ZnO systems at pH 7.2 and temperature of 25°C. It was shown that about 98% phenol degradation could be achieved at initial phenol concentration of 10; 20 and 50 ppm, except for 100 ppm which gave less than 50% degradation. Thus, TiO_2 /ZnO blend as photocatalyst can be used for degradation of phenol in water. The pseudo-first order reaction kinetics fitted well the Langmuir-Hinshelwood model in almost all concentration ranges tested.

Keywords: annular reactor, phenol, photocatalytic degradation, semiconductors.

1. Introduction

Phenol and its derivatives such as chlorophenol, nitrophenols and bisphenol are usually discharged from industrial effluents and wastewater plants [1, 2]. Of major concern is the fact that phenolic compounds found in both ground and surface water are characterized as carcinogenic, mutagenic and teratogenic [3, 4]. According to World Health Organization (WHO) [5], phenol concentration should not exceed 1 ppm on receiving streams.

Heterogeneous and homogenous advanced oxidation processes (AOP), have proven to be reliable and viable for the removal of synthetic organic species resistant to conventional methods [6]. The vital feature of AOP is the

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