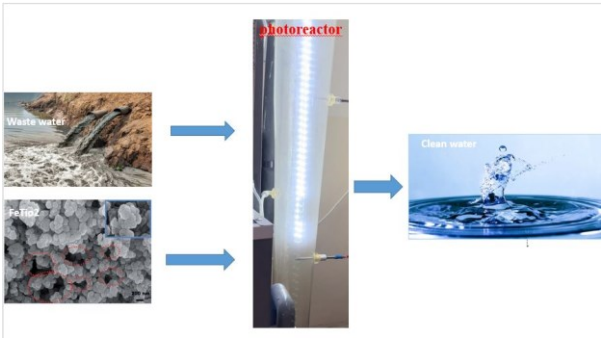
Global NEST Journal, Vol 26, No 3, 05681

Photocatalysis technology for treating petroleum wastewater and the potential application of tapered bubble column (TBC): a review

Firdos M. Abdulla[1], Z.Y. Shnain[2], A.A. Alwasiti[3], M.F. Abid[4] and N.H. Abdurahman[5]
[1,2,3]Department of Chemical Engineering, University of Technology (UOT), Baghdad, Iraq
[4]Department of Oil & Gas Refining Engineering, Al-Turath University College, Baghdad, Iraq
[5]Faculty of Chemical and Natural Resources Engineering, University Malaysia Pahang-UMP
Received: 02/02/2019, Accepted: 17/03/2020, Available online: 27/05/2020
*to whom all correspondence should be addressed: e-mail: firdos.m.abdulla@uotechnology.edu.iq
https://doi.org/10.30955/gnj.003058

Graphical abstract



Abstract

The photocatalytic oxidation of organic and petroleum wastewater treatment is an advanced oxidation process (AOP) with several benefits. It operates at normal temperatures and pressure, is inexpensive, does not produce secondary waste, and us easily accessible. Many studies have employed bubble columns, slurry bubble columns, and three-phase fluidized reactors in the photocatalytic process for wastewater treatment. Pure TiO_2 and Fe-doped TiO_2 are considered the most promising catalysts. The aim of this work is to review the main factors affecting the photocatalytic process of organic pollutants and petroleum wastewater (produced water) treatment, photocatalysts type, with a special focus on pure TiO_2 and Fe-doped TiO_2, light source, and reactor type.

Keywords: Photocatalysis, produced water, Fe doped TiO_2, Tapered bubble column.

1. Introduction

Produced water (petroleum wastewater) consists of a wide variety of pollutants, including oil and grease; alkanes; olefins; polycyclic aromatic hydrocarbons (PAHs); benzene, toluene, and xylene (BTX); mercaptans; phenol; ammonia; and many other organic compounds, in addition to a high level of total solids, and high biochemical oxygen demand (BOD) and chemical oxygen demand (COD) (Varjani *et al.* 2019; Al-Nuaim *et al.* 2022; Al-Nuaim *et al.* 2023).

Treating petroleum refinery wastewater or produced water (PW) requires numerous steps. Figure 1 shows these treatment steps with their objectives (Diya'uddeen *et al.* 2011; Varjani *et al.* 2019).

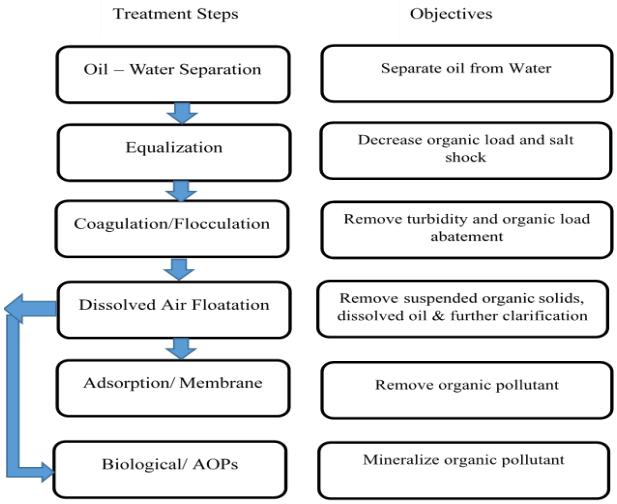


Figure 1. General steps and objectives for treating petroleum wastewater (Diya'uddeen *et al.* 2011; Varjani *et al.* 2019).

The four advanced final wastewater treatment processes are adsorption, membrane, biological, and advanced oxidation processes (AOPs). Adsorption and membrane processes transfer the pollutants to different concentrated forms, whereas biological and advanced oxidation processes can mineralize most of the pollutants (Kaur *et al.* 2016; Li *et al.* 2022; Oliveira *et al.* 2022). Table 1 likely provides a comprehensive overview of the four pollution-control methods, highlighting the advantages and disadvantages of each (Chen *et al.* 2020).

Comparing photocatalytic wastewater treatment with other processes, it is considered a promising and it has gained significant attention owing to its many advantages, making it a contemporary and environmentally friendly technology. Some key features of this approach include excellent performance, operation at ambient pressure and temperature, low costs, and the absence of secondary waste formation. Additionally, operating at ambient pressure and temperature makes it a convenient and