# Photo-polishing of POME into $CH_4$-lean biogas over the UV-responsive ZnO photocatalyst

**Kim Hoong Ng, Chin Kui Cheng**
Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang Kuantan, Pahang, Malaysia

**ABSTRACT**
We report here the photo-polishing of POME with a concomitant production of $CH_4$-lean biogas over UV/ZnO photocatalysis system. The photoreaction results showed that the optimum ZnO loading for POME photomineralization was 1.0 g/L, with about 50% of COD removal after just 240 min of UV irradiation. It is found that all the photomineralization kinetics can be modeled to the 1st-order reaction order, with specific reaction rates ($k$) ranging from $1.022 \times 10^{-3}$ to $3.118 \times 10^{-3}$ $min^{-1}$. The highest amount of gaseous products, viz. 36,172 μmol of $CO_2$ and 333 μmol of $CH_4$, were produced at this optimum loading. Significantly, the organic removal efficiency was further enhanced when the UV exposure was prolonged to 22 h, attaining final readings of 44 ppm, 26 ppm and 20 mg/L, respectively, for chemical oxygen demand (COD), biochemical oxygen demand (BOD) and oil and grease (O&G). Furthermore, our scavenging study suggests that the photomineralization of organic pollutants in the POME occurred via attack by the highly reactive $OH^{\bullet}$ radical. In addition, we posit that the reaction took place on the surface of ZnO upon the adsorption of the organic pollutants. Our proposition was further confirmed by the presence of carbonaceous species on the surface of ZnO through a combination of spectroscopic probes, i.e. FTIR, SEM–EDX, as well as the deterioration in the BET specific surface area for the used ZnO photocatalyst. The plunge of ZnO's photodegradation performance was observed in the recyclability test. The performance has plummeted from 50% to 35% in second cycle before stabilizing at 38% in the third cycle. This can be attributed to the blockage of surface area of ZnO by the deposited organic species.

**KEYWORDS**: Biogas; Photomineralization; Palm oil mill effluent; Zinc oxide

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