

Effectiveness of ozonation with zirconium and tin tetrachloride for stabilised anaerobic landfill leachate treatment

ABSTRACT

Landfill leachate can threaten the environment and human life. Therefore, this study aims to investigate the efficiency of ozone (O_3), O_3 with zirconium tetrachloride ($O_3/ZrCl_4$) and O_3 with tin tetrachloride ($O_3/SnCl_4$) in remediating the stabilised anaerobic landfill leachate (SAL) from Alor Pongsu, Perak. Hydroxyl radical ($OH\bullet$) is an important oxidising agent in the ozonation process. Its presence was tested using tert-Butyl alcohol. Results showed that using $ZrCl_4$ and $SnCl_4$ in ozonation boosted the generation of hydroxyl radical, thereby enhancing the oxidation process and pollutant removal inside the sample. The $O_3/ZrCl_4$ mix at chemical oxygen demand (COD) to $ZrCl_4$ ratio of 1:1.5, pH 8–9 and 90 min reaction time resulted in the highest reduction rates of COD and colour at 91.9% and 99.6%, respectively. All results demonstrated that the optimum performance occurred at alkaline conditions (pH > 8), proving that OH radicals primarily oxidised the pollutants through an indirect reaction pathway. The biodegradability (biochemical oxygen demand/COD) ratio was also considerably improved from 0.02 (raw) to 0.37 using $O_3/ZrCl_4$, compared with using O_3 alone and using $O_3/SnCl_4$, which only recorded 0.23 and 0.28, respectively, after the treatment. The study demonstrated that $O_3/ZrCl_4$ was the most efficient combination.