



## Immobilized *Chlorella vulgaris* for efficient palm oil mill effluent treatment and heavy metals removal

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### ABSTRACT

In this study, a microalgae *Chlorella vulgaris* was immobilized in alginate beads for the enhancement of palm oil mill effluent (POME) remediation. After the treatment, gel beads were simply collected via filtration and thereby simplifying the harvesting process. The effect of POME composition with fresh-water (1, 5, 10, 15, and 20% v/v) on *C. vulgaris* cell growth rate, lipid content, and POME remediation was investigated. The cell growth rate (0.142–0.151 d<sup>-1</sup>), doubling time (4.59–4.88 d<sup>-1</sup>), and lipid content (27.64%–31.67%) were achieved at 10% v/v of POME after 14 d of cultivation for both freely suspended and immobilized *C. vulgaris*, respectively. Meanwhile, cultivation of immobilized *C. vulgaris* in POME also enhanced the bioremoval of Fe(II) and Mn(II), chemical oxygen demand (95%–99.9%), biochemical oxygen demand (97%–99.9%), total nitrogen (78%–98%), and total phosphate (79%–98%). The Fourier transform infrared spectroscopy and X-ray photoelectron spectroscopy spectra of *C. vulgaris* indicated the presence of characteristic functional groups involved in the bioaccumulation process of heavy metals.

*Keywords:* Microalgae; *Chlorella vulgaris*; Immobilization; Palm oil mill effluent; Bioremediation

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