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THE POTENTIAL USE OF *Tacca leontopetaloides* BIOPOLYMER FLOCCULANT(TBPF) IN REMOVAL OF POLLUTANTS LEACHATES AND SYNTHETIC HEAVY METAL VIA FLOCCULATION PROCESS

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ABSTRACT

Today's chemical polymer flocculants are known to be poisonous and have a detrimental effect on living organisms. A potential use of a new natural-based flocculant from the *Tacca leontopetaloides* plant for pollution leachate treatment and synthetic heavy metal removal via the flocculation process has been proposed in this work. The plant tuber was isolated without structure's integrated to produce *Tacca leontopetaloides* biopolymer flocculant (TBPF). The characterization of TBPF for flocculant properties were investigated, and the performance of TBPF on turbidity, TSS, COD, color, heavy metal in leachate and synthetic heavy metal removal using a standard jar test procedure through flocculation process were examined using OFAT and CCD analyses. Two factors namely pH leachate and TBPF dosages for pollutants and heavy metal leachate removal was examined. The peri-kinetic behaviour of the flocculation process during TSS removal at optimum condition was also studied through Smoluchowski theory. Four factors, including pH synthetic solution, initial Pb^{2+} concentration, initial TBPF concentration, and TBPF dosage were investigated for synthetic heavy metal removal. The characteristics of TBPF in terms of amylose/amylopectin fraction, viscosity, and zeta potential were 26:74, 0.037–0.04 Pa·s, and –13.14 mV, respectively was obtained. The presence of –COOH and –OH structure in TBPF indicates the flocculant properties. High removal of turbidity, TSS, COD and color achieved at 77%, 91%, 20% and 93%, respectively, at pH 3 leachate and 240 mg/L of TBPF dosage was obtained through OFAT analysis. However, the removal of heavy metals from leachate revealed contradictory and inconsistent results due to the unstable heavy metal ions and variation of complex ions compounds in leachate.The highest removal percentages of turbidity, TSS, COD, and color were 14%, 33%, 44%, and 69%, respectively, at pH 3 of leachate wastewater with 150 mg/L TBPF dosage found through CCD in RSM. A quadratic polynomial regression model elucidated the relationship between leachate pH and TBPF dosage and turbidity, TSS, COD, and color removal with high correlation coefficient, $R^2 > 0.95$. At this maximum removal, a second-order kinetic model ($\alpha = 2$) with regression value, $R^2 = 0.9545$ and a flocculation rate constant, $k = 9\times10^{-6}$ L/mg min were obtained. The mechanism flocculation process was charge neutralization and interparticle bridging was confirmed by the increasing zeta and size distribution at the optimum condition. In a mixed synthetic heavy metal solution, TBPF requires a pH 10 synthetic solution and 10% initial TBPF concentration at 120 mg/L of TBPF dosage to remove 80% of Pb^{2+}, whereas in a single Pb^{2+} solution, pH 6 synthetic solution and 3% initial TBPF concentration at 192 mg/L of TBPF dosage are required to remove 83% of Pb^{2+}. Meanwhile, the maximum Pb^{2+} removal obtained using CCD was 73%, at optimum condition pH 6.4 synthetic solution and 11.8 mg/L initial Pb^{2+} concentration using constant TBPF concentration and TBPF dosage. A quadratic polynomial model of $R^2 = 0.9994$, Pred. $R^2 = 0.9896$, and Adj. $R^2 = 0.9454$ was developed. Both designs approaches can be applied at the suggested design range for industrial approach by considering the factor interaction. High Pb removal using environmental friendly plant-based TBPF has a great potential for industrial heavy metal treatment, particularly at the primary stage. In addition, the designated model for pollutants leachate removal and kinetic parameters obtained can be applied as a guideline for leachate wastewater treatment.

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