COAGULANT EFFECT OF CHITOSAN AND EMPTY FRUIT BUNCHES ASH IN PRE-TREATMENT UNIT OF PALM OIL MILL EFFLUENT ANAEROBIC-AEROBIC REACTOR

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Bogor, July 2024

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ABSTRACT

RIZKY MURSYIDAN BALDAN. Coagulant Effect of Chitosan and Empty Fruit Bunches Ash in Pre-treatment Unit of Palm Oil Mill Effluent Anaerobic-Aerobic Reactor. Supervised by ALLEN KURNIAWAN.

POME and EFB form the largest by-products of palm oil processing. This study instigates the UASB and IFCS system in ACSt reactor. Additionally, evaluating bio-coagulants chitosan and EFB ash to enhance treatment efficiency. The research aims to improve pollutant removal in ACSt reactor by adding pre-treatment processes with bio-coagulant. Laboratory tests on TSS, COD, TDS, and pH for jar tests, and oil and grease for ACSt reactor operation were conducted. Chitosan (10 mg/L) achieved 18.88% COD and 98.68% TSS removal, while EFB (1500 mg/L) showed 16.98% COD and 98.96% TSS removal. The chitosan:EFB combination (80:20) had the highest removal rates of 19.72% for COD and 99.15% for TSS. Kinetic analysis revealed the highest R^2 values (0.98 for TSS and 0.96 for TDS) using the first-order model. The Gompertz model accurately predicted pollutant removal, with R^2 up to 0.99. Adsorption isotherm studies indicated Langmuir model effectiveness for EFB (R^2 = 0.89) and Temkin for chitosan (R^2 = 0.71). The ACSt reactor showed potential in reducing COD, TSS, and oil and grease, though inconsistencies in TDS removal.

Keywords: EFB, chitosan, palm oil mill effluent, pre-treatment, bio-coagulant

ABSTRAK

RIZKY MURSYIDAN BALDAN. Coagulant Effect of Chitosan and Empty Fruit Bunches Ash in Pre-treatment Unit of Palm Oil Mill Effluent Anaerobic-Aerobic Reactor. Dibimbing oleh ALLEN KURNIAWAN.

LCKS dan TKKS merupakan produk sampingan terbesar dari pengolahan minyak sawit. Studi ini mengembangkan sistem UASB dan IFCS dalam reaktor ACSt. Selain itu, dilakukan evaluasi terhadap koagulan organik kitosan dan abu TKKS untuk meningkatkan efisiensi pengolahan. Penelitian ini bertujuan untuk meningkatkan penyisihan polutan melalui penambahan pra-pengolahan dengan bio-koagulan. Pengujian laboratorium pada TSS, COD, TDS, dan pH untuk uji jartest, serta minyak dan lemak untuk operasi reaktor ACSt dilakukan. Kitosan (10 mg/L) mencapai penyisihan COD sebesar 18,88% dan TSS sebesar 98,68%, EFB (1500 mg/L) menunjukkan penyisihan COD sebesar 16,98% dan TSS sebesar 98,96%. Kombinasi kitosan:EFB (80:20) memiliki tingkat pengurangan tertinggi yaitu 19,72% untuk COD dan 99,15% untuk TSS. Analisis kinetik menunjukkan nilai R^2 tertinggi (0,98 untuk TSS dan 0,96 untuk TDS) menggunakan model orde pertama. Model Gompertz secara akurat memprediksi efisiensi pengurangan polutan, dengan R^2 hingga 0,99. Studi isoterm adsorpsi menunjukkan efektivitas model Langmuir untuk EFB (R^2 = 0,89) dan Temkin untuk kitosan (R^2 = 0,71). Reaktor ACSt menunjukkan potensi dalam mengurangi COD, TSS, dan minyak serta lemak, meskipun terdapat ketidakkonsistenan dalam penyisihan TDS.

Kata kunci: *TKKS, kitosan, POME, pra-pengolahan, bio-koagulan*

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PREFACE

The author prays the praise and gratitude to The Almighty God, who has given the author health and blessing to properly complete the undergraduate thesis titled "Coagulant Effect of Chitosan and Empty Fruit Bunches Ash in Pre-treatment Unit of Palm Oil Mill Effluent Anaerobic-Aerobic Reactor" promptly. The thesis was created and submitted to meet the requirement for a bachelor's degree in the Department of Civil and Environmental Engineering, IPB University.

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The author has contrived the thesis as best as possible, but the author is also aware of many imperfections in both content and grammar. Consequently, the author welcomes any suggestions and constructive corrections to improve. The author wishes this thesis would be helpful in enriching readers' knowledge.

Bogor, July 2024

Rizky Mursyidan Baldan

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B	=	Constant related to the pressure
C_{I}	=	Initial concentrations of the adsorbate (mg/L)
C_0	=	Initial adsorbate concentration (mg/L)
C_{e}	=	Equilibrium concentrations of the adsorbate (mg/L)
$Efficiency_{\mathrm{p}}$	=	Prediction of pollutant removal efficiency (%)
k_1	=	Reaction rate of the pollutant decreases at first order (mg/L minute^{-1} or ppm minute^{-1})
k_2	=	Reaction rate of decreasing pollutants at second order (L/mg minute^{-1} or 1/ppm minute^{-1})
k_3	=	Reaction rate of decreasing pollutants at third order ((L/mg)$^{-2}$ minute^{-1} or (1/ppm)$^{-2}$ minute^{-1})
K_{f}	=	Adsorption capacity at constant temperature (L/mg)

K_L = Langmuir isotherm constant (L/mg)
K_T = Temkin constant at equilibrium conditions (L/mg)
n = Freundlich isotherm constant related to the strength of the adsorption
P = Maximum pollutant potential
q_e = Equilibrium adsorption capacity (mg/g or mg/ppm)
q_{max} = Theoretical maximum adsorption capacity (mg/g)
R^2 = Coefficient of determination
R_L = Favorability of the adsorption process
SSE = Sum of squares error
t = Time of precipitation (minute)
V = Solution volume (L)
W = the amount of adsorbent used (g)
λ = Lag phase of reaction
μ_m = Maximum removal efficiency percentage (%)