

RINGKASAN

Limbah penatu yang mengandung surfaktan dan fosfat melebihi ambang batas baku mutu menjadi permasalahan serius karena mencemari perairan, memicu pertumbuhan alga berlebih dan menurunkan kadar oksigen. Eko enzim merupakan hasil fermentasi limbah organik yang mengandung enzim seperti protease, lipase, dan amilase yang berpotensi menjadi solusi dengan memecah zat pencemar secara biologis. Penelitian ini bertujuan menganalisis efektivitas variasi dosis eko enzim dalam menurunkan kadar surfaktan dan fosfat pada air limbah Penatu menggunakan Rancangan Acak Lengkap (RAL) dengan dosis 0%, 1%, 3%, 5%, dan 10%, diuji selama lima hari dengan tiga kali pengulangan. Terdapat dua jenis eko enzim yang digunakan, yaitu eko enzim A (hasil fermentasi mandiri) dan eko enzim B (hasil fermentasi komunitas). Pengukuran kadar surfaktan dilakukan dengan metode MBAS (*Methylene Blue Active Substances*), sementara kadar fosfat dianalisis menggunakan spektrofotometri sesuai dengan standar SNI 06-6989.31-2005.

Hasil penelitian menunjukkan bahwa eko enzim B lebih efektif dalam menurunkan kadar surfaktan dibandingkan eko enzim A. Pada dosis 5%, eko enzim B mampu menurunkan kadar surfaktan dari 50,10 mg/L menjadi 34,76 mg/L. Sebaliknya, eko enzim A tidak menunjukkan pola penurunan yang konsisten, dan pada dosis 3% justru terjadi peningkatan kadar surfaktan hingga 177,3 mg/L. Sementara itu, penambahan eko enzim tidak menurunkan kadar fosfat, melainkan meningkatkannya. Pada dosis 10%, kadar fosfat meningkat dari 2,24 mg/L menjadi 9,88 mg/L untuk eko enzim A, dan dari 0,28 mg/L menjadi 7,75 mg/L untuk eko enzim B.

Berdasarkan hasil tersebut dapat disimpulkan bahwa analisis menggunakan *One Way* ANOVA menunjukkan bahwa variasi dosis eko enzim berpengaruh signifikan terhadap penurunan kadar surfaktan dan fosfat, hasil *p*-value sebesar 0,001 ($p < 0,05$), sehingga hipotesis nol (H_0) ditolak dan hipotesis alternatif (H_1) diterima. Berdasarkan hasil tersebut, eko enzim B terbukti lebih efektif dalam menurunkan kadar surfaktan, meskipun penurunan yang dicapai belum berada di bawah baku mutu, sehingga diperlukan peningkatan variasi dosis. Sementara itu, penggunaan eko enzim belum menunjukkan efektivitas dalam menurunkan kadar fosfat pada air limbah penatu, sehingga dibutuhkan penelitian lanjutan untuk memahami mekanisme interaksi serta potensi perbaikannya.

SUMMARY

Laundry waste containing surfactants and phosphates exceeding the standard quality threshold is a serious problem because it pollutes waters, triggers excessive algae growth and reduces oxygen levels. Eco-enzymes are the result of organic waste fermentation containing enzymes such as protease, lipase, and amylase which have the potential to be a solution by breaking down pollutants biologically. This study aims to analyze the effectiveness of variations in eco-enzyme doses in reducing surfactant and phosphate levels in laundry wastewater using a Completely Randomized Design (CRD) with doses of 0%, 1%, 3%, 5%, and 10%, tested for five days with three repetitions. There are two types of eco-enzymes used, namely eco-enzyme A (independent fermentation results) and eco-enzyme B (community fermentation results). Measurement of surfactant levels was carried out using the MBAS (Methylene Blue Active Substances) method, while phosphate levels were analyzed using spectrophotometry in accordance with SNI 06-6989.31-2005 standards.

The results showed that eco-enzyme B was more effective in reducing surfactant levels than eco-enzyme A. At a dose of 5%, eco-enzyme B was able to reduce surfactant levels from 50.10 mg/L to 34.76 mg/L. In contrast, eco-enzyme A did not show a consistent pattern of decrease, and at a dose of 3% there was an increase in surfactant levels to 177.3 mg/L. Meanwhile, the addition of eco-enzyme did not reduce phosphate levels, but increased their concentration. At a dose of 10%, phosphate levels increased from 2.24 mg/L to 9.88 mg/L for ecoenzyme A, and from 0.28 mg/L to 7.75 mg/L for ecoenzyme B.

Based on these results, it can be concluded that the analysis using One Way ANOVA shows that variations in ecoenzyme doses have a significant effect on reducing surfactant and phosphate levels, the p -value result is 0.001 ($p < 0.05$), so the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. Based on these results, ecoenzyme B is proven to be more effective in reducing surfactant levels, although the reduction achieved is not yet below the quality standard, so an increase in dose variation is needed. Meanwhile, the use of ecoenzyme has not shown effectiveness in reducing phosphate levels in laundry wastewater, so further research is needed to understand the interaction mechanism and its potential for improvement.