

**PENYISIHAN TOTAL NITROGEN DARI AIR LIMBAH
DOMESTIK MENGGUNAKAN PENGOLAHAN KOMBINASI
ANAEROB – AEROB DENGAN MEDIA LEKAT *POLYVINYL
CHLORIDE* DAN *POLYETHYLENE TEREPHTHALATE***

TUGAS AKHIR

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis efektivitas penyisihan total nitrogen dari air limbah domestik menggunakan sistem kombinasi pengolahan biologis anaerob-aerob dengan media lekat berbahan *Polyvinyl Chloride* (PVC) dan *Polyethylene Terephthalate* (PET). Proses pengolahan dilakukan dalam skala laboratorium menggunakan reaktor sistem kontinu dengan variasi Hydraulic Retention Time (HRT) 36, 24, dan 12 jam. Air limbah yang digunakan merupakan limbah artifisial yang mengacu pada karakteristik air limbah asli Instalasi Pengolahan Air Limbah Kampung Duri, Kecamatan Pauh, Kota Padang, Sumatera Barat. Reaktor anaerob menggunakan media sarang tawon (PVC), sedangkan reaktor aerob menggunakan potongan botol plastik bekas (PET) sebagai media tumbuh mikroorganisme. Selama proses pengolahan, dianalisis parameter seperti pH, suhu, *Dissolved Oxygen* (DO), *Chemical Oxygen Demand* (COD), *Volatile Suspended Solids* (VSS), dan total nitrogen. Proses seeding dilakukan hingga konsentrasi VSS mencapai 2500–4000 mg/L. Analisis total nitrogen menggunakan metode spektrofotometri UV berdasarkan *Standard Methods for the Examination of Water and Wastewater* tahun 2017. Hasil menunjukkan efisiensi penyisihan total nitrogen tertinggi pada HRT 36 jam sebesar 62,50%, diikuti HRT 24 jam sebesar 58,29%, dan HRT 12 jam sebesar 54,63%. Pengamatan morfologi menunjukkan keberadaan bakteri Gram positif berwarna ungu dan berbentuk batang (basil). *Uji One Way ANOVA* menunjukkan perbedaan yang signifikan perubahan variasi HRT terhadap penyisihan total nitrogen ($p < 0,05$), dan uji korelasi didapatkan nilai $R > 0,9$, yang menunjukkan hubungan sangat kuat antara waktu tinggal dan efisiensi penyisihan. Hasil ini membuktikan bahwa sistem pertumbuhan terlekat anaerob-aerob menggunakan media lekat PVC dan PET terbukti efektif dalam menyisihkan total nitrogen di air limbah domestik.

Kata kunci: air limbah domestik, *Hydraulic Retention Time* (HRT), media lekat, reaktor anaerob-aerob, total nitrogen



ABSTRACT

This study aims to analyze the effectiveness of total nitrogen removal from domestic wastewater using a combined biological treatment system of anaerobic–aerobic processes with attached growth media made of Polyvinyl Chloride (PVC) and Polyethylene Terephthalate (PET). The treatment was conducted at a laboratory scale using a continuous flow reactor system with variations in Hydraulic Retention Time (HRT) of 36, 24, and 12 hours. The wastewater used was artificial wastewater, formulated to mimic the characteristics of real domestic wastewater from the Kampung Duri Wastewater Treatment Plant, Pauh District, Padang City, West Sumatra. The anaerobic reactor utilized honeycomb PVC as the attached media, while the aerobic reactor used cut pieces of recycled plastic bottles (PET) as microbial growth media. During the treatment process, parameters such as pH, temperature, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Volatile Suspended Solids (VSS), and total nitrogen were analyzed. The seeding process was carried out until the VSS concentration reached 2500–4000 mg/L. Total nitrogen was analyzed using the UV spectrophotometry method based on the Standard Methods for the Examination of Water and Wastewater (2017). The results showed the highest total nitrogen removal efficiency at HRT 36 hours (62.50%), followed by HRT 24 hours (58.29%) and HRT 12 hours (54.63%). Microbial identification indicated the presence of Gram-positive, rod-shaped (bacilli), purple-stained bacteria. One-way ANOVA showed a significant effect of HRT variation on total nitrogen removal ($p < 0.05$), and correlation analysis resulted in $R > 0.9$, indicating a very strong relationship between retention time and removal efficiency. These results demonstrate that the attached growth anaerobic–aerobic system using PVC and PET media is effective in removing total nitrogen from domestic wastewater.

Keywords: anaerobic-aerobic reactor, attached growth media, domestic wastewater, Hydraulic Retention Time (HRT), total nitrogen

