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Evaluasi Kinerja Sistem Instalasi Pengolahan Lindi (IPL) Zona Transisi 1 dan 2 pada TPA Piyungan, Kecamatan Piyungan, Kabupaten Bantul
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INTISARI

Instalasi Pengolahan Lindi (IPL) Zona Transisi TPA Piyungan mengolah lindi dari Zona Transisi 1 dan 2 melalui bak ekualisasi, koagulasi-flokulasi, sedimentasi, oksidasi kimiawi, bak anaerobik, filtrasi karbon aktif, dan bak maturasi, mengombinasikan mekanisme fisik, kimia, dan biologis. Pemantauan oleh DLHK DIY pada 2025 menunjukkan efluen beberapa parameter melebihi baku mutu. Penelitian ini bertujuan menganalisis karakteristik lindi, beban pencemar, dan penyebab ketidakoptimalan, mengevaluasi efisiensi dan kesesuaian parameter unit terhadap kriteria desain, serta menyusun rekomendasi perbaikan.

Penelitian dilakukan di IPL Zona Transisi TPA Piyungan, DIY, dengan pengambilan sampel lindi di tiga inlet, setiap unit pengolahan, dan outlet, serta pengukuran debit volumetrik pada inlet, outlet, dan *gate valve* bak ekualisasi, dilaksanakan pada April–Mei 2026 selama tiga periode pengamatan. Parameter pH, COD, dan TSS diukur pada seluruh unit sesuai relevansi pengolahannya, warna hanya pada inlet, dan *Escherichia coli* hanya pada bak maturasi. Evaluasi meliputi analisis karakteristik lindi dan beban pencemar, perhitungan efisiensi kinerja tiap unit dan IPL secara keseluruhan, kesesuaian parameter operasional unit terhadap kriteria desain, observasi operasional-pemeliharaan, serta *jar test* menggunakan *polyaluminium chloride* dan NaOCl.

Hasil menunjukkan karakteristik lindi Inlet 1 berupa muda menuju transisi, Inlet 2 berupa lindi stabil, dan Inlet 3 berupa rembesan tanggul Zona Transisi 1, dengan debit total 32,33–65,90 m^3/hari. Seluruh unit tidak memenuhi kriteria desain, seperti waktu detensi bak ekualisasi jauh melebihi kriteria, gradien kecepatan dan konfigurasi *mixer* 1 tidak sesuai kriteria, *overflow rate* rendah dan short-circuiting pada bak sedimentasi, hingga SDB gagal berfungsi akibat media dan drainase tidak sesuai standar. Beban masuk berkisar 318,73–361,58 kg COD/hari dan 19,93–52,50 kg TSS/hari. Efisiensi keseluruhan IPL untuk COD sebesar 7%, −3%, dan −4%, serta TSS sebesar 22%, −21%, dan 10%, sehingga efluen belum memenuhi baku mutu Permen LHK No. 59/2016. Dari aspek operasional ditemukan masalah pada dosis koagulan, saluran bypass terbuka, media filtrasi, pH operasi, dan SOP belum tersedia. Rekomendasi meliputi optimalisasi operasi, rehabilitasi-modifikasi unit, dan penyusunan SOP. Sebagai bagian dari rekomendasi, dilakukan *jar test* dengan dosis optimum PAC 1.800 mg/L dan NaOCl 50 mg/L menghasilkan efisiensi COD 76%.

Kata Kunci: Air Lindi, Kriteria Desain, Efisiensi Pengolahan, Instalasi Pengolahan Lindi, TPA Piyungan

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ABSTRACT

The Leachate Treatment Plant (LTP) in the Transition Zone of TPA Piyungan (Piyungan Landfill) treats leachate from Transition Zones 1 and 2 through an equalization basin, coagulation–flocculation, sedimentation, chemical oxidation, an anaerobic basin, activated carbon filtration, and a maturation basin, combining physical, chemical, and biological mechanisms. Monitoring by the DIY Environmental and Forestry Agency (DLHK DIY) in 2025 showed that several effluent parameters exceeded the applicable quality standards. This study aims to analyze the leachate characteristics, pollutant loads, and causes of suboptimal performance, evaluate treatment efficiency and the conformity of unit parameters with design criteria, and formulate improvement recommendations.

The research was conducted at the LTP in the Transition Zone of TPA Piyungan, DIY, with leachate sampling at three inlets, each treatment unit, and the outlet, and volumetric flow measurement at the inlets, outlet, and the equalization basin gate valve, conducted in April–May 2026 over three observation periods. pH, COD, and TSS were measured at all units according to their treatment relevance, color only at the inlets, and *Escherichia coli* only at the maturation basin. The evaluation included analysis of leachate characteristics and pollutant loads, calculation of efficiency for each unit and for the LTP as a whole, conformity of unit operational parameters with design criteria, observation of operational-maintenance conditions, and jar testing using polyaluminium chloride and NaOCl.

Results show that Inlet 1 leachate is young transitioning toward intermediate, Inlet 2 is stabilized leachate, and Inlet 3 is seepage from the Transition Zone 1 embankment, with a total flow rate of 32.33–65.90 m^3/day. None of the units met the design criteria: the equalization basin's detention time far exceeded the criteria, the velocity gradient and configuration of Mixer 1 did not meet the criteria, the sedimentation basin showed a low overflow rate and short-circuiting, and the sludge drying beds failed to function due to non-standard media and drainage. The incoming load ranged from 318.73–361.58 kg COD/day and 19.93–52.50 kg TSS/day. Overall LTP efficiency for COD was 7%, −3%, and −4%, and for TSS was 22%, −21%, and 10%, so the effluent still failed to meet the standards under Regulation of the Minister of Environment and Forestry No. 59 of 2016. Operationally, problems were found in coagulant dosing, open bypass channels, filtration media, operating pH, and the absence of an SOP. Recommendations include operational optimization, unit rehabilitation and modification, and SOP development. As part of these recommendations, jar testing with optimum doses of 1,800 mg/L PAC and 50 mg/L NaOCl achieved 76% COD removal efficiency.

Keywords: Leachate, Design Criteria, Treatment Efficiency, Leachate Treatment Plant, TPA Piyungan