

INTISARI

Limbah cair murni (*raw wastewater*) dari Sentra Batik Giriloyo yang diambil pada tanggal 3 Desember 2025 pukul 18.00 WIB memiliki konsentrasi parameter BOD, COD, TDS, dan zat warna pekat yang melampaui baku mutu lingkungan, sedangkan parameter TSS, fenol, dan amonia berada di bawah baku mutu, serta parameter kromium dan sulfida tidak terdeteksi sejak awal pengujian. Penelitian ini bertujuan mengevaluasi keandalan sistem *Constructed Wetland* (CW) dalam menyisihkan polutan, menilai respons morfologi, serta mengukur kepatuhan efluen terhadap regulasi. Eksperimen menggunakan kerapatan vegetasi sejumlah 4 tanaman per reaktor, waktu retensi hidrolis (HRT) 8 hari, dan susunan vertikal media (3 L arang aktif di bawah dan 3 L pasir kasar di atas) pada perlakuan limbah konsentrasi 50% dan 75%.

Hasil penelitian menunjukkan adanya spesialisasi fungsional antar-reaktor, di mana media filtrasi vertikal bertindak sebagai penyaring fisik-kimia utama yang dioptimalkan oleh karakteristik perakaran tanaman. Sistem polikultur paling efektif menyisihkan parameter Warna (79%), BOD (77%), dan TSS (69%) akibat kombinasi perakaran yang heterogen. Sementara itu, monokultur *Chrysopogon zizanioides* unggul menyisihkan parameter Amonia (51%), TDS (32%), dan Fenol (29%), serta monokultur *Phragmites karka* mengoptimalkan penyisihan parameter COD hingga 76%. Pengujian respons morfologi membuktikan vegetasi pada konsentrasi 50% tumbuh lebih optimal dibandingkan konsentrasi 75% akibat beban fitotoksisitas yang rendah. Konfigurasi polikultur dan monokultur tidak berdampak signifikan pada tinggi *C. zizanioides*, namun sistem polikultur menyebabkan *P. karka* tumbuh lebih rendah karena dugaan kompetisi nutrisi. Selain itu, ditemukan anomali tinggi tajuk akibat kompetisi intraspesifik pada monokultur *P. karka* 75% (satu individu mencapai 33 cm diduga karena keunggulan rimpang awal, sedangkan tiga lainnya terhambat di angka 19,3 cm akibat efek naungan). Secara regulasi, sistem ini belum mencapai kepatuhan penuh terhadap Perda DIY No. 7 Tahun 2016, namun berhasil memenuhi Permen LHK No. P.16/2019 untuk parameter warna. Sistem CW ini direkomendasikan sebagai pengolahan sekunder (*secondary treatment*).

Kata Kunci: *Constructed Wetland*, Limbah Batik, *Chrysopogon zizanioides*, *Phragmites karka*, Pengolahan Sekunder.

ABSTRACT

Raw wastewater from Sentra Batik Giriloyo collected on December 3, 2025, at 18:00 WIB contained high concentrations of BOD, COD, TDS, and color exceeding environmental standards, while TSS, phenol, and ammonia were below thresholds, and chromium and sulfide remained undetected. This study evaluated a Constructed Wetland (CW) system to determine pollutant removal efficiency, assess morphological responses, and measure effluent regulatory compliance. The experiment utilized 4 plants per reactor, an 8-day hydraulic retention time (HRT), and vertically stratified media (3 L activated charcoal at the bottom and 3 L coarse sand at the top) under varied concentrations of 50% and 75%.

*Results demonstrated a clear functional specialization among the reactors, where the vertical filter media acted as the primary physical-chemical barrier, enhanced by plant root characteristics. The polyculture system was highly effective in removing Color (79%), BOD (77%), and TSS (69%) due to heterogeneous root combinations that expanded varied aerobic-anaerobic biofilm zones within the media. Meanwhile, *Chrysopogon zizanioides* monoculture excelled in removing Ammonia (51%), TDS (32%), and Phenol (29%) as root oxygen transfer prevented media saturation, and *Phragmites karka* monoculture optimized plant-mediated COD removal (76%). Morphological evaluation indicated that vegetation under the 50% concentration grew more optimally than under 75% due to lower phytotoxicity. Planting configurations showed no significant effect on *C. zizanioides* height, but the polyculture system led to lower *P. karka* growth, presumably due to nutrient competition. Furthermore, a distinct canopy height anomaly occurred due to intraspecific competition in the 75% *P. karka* monoculture (one individual reached 33 cm likely due to initial rhizome dominance, while three others were stunted at 19.3 cm due to the shading effect). Regarding compliance, the system did not achieve full compliance with Perda DIY No. 7/2016 but successfully met Permen LHK No. P.16/2019 for color standards. This CW system is recommended as a secondary treatment.*

Keywords: *Constructed Wetland, Batik Wastewater, *Chrysopogon zizanioides*, *Phragmites karka*, Secondary Treatment.*