

## **ABSTRAK**

### **OPTIMALISASI UNIT PENGOLAHAN AIR LIMBAH DI PABRIK GULA (PG) MADUKISMO KALURAHAN TIRTONIRMOLO, KASIHAN, BANTUL, DAERAH ISTIMEWA YOGYAKARTA**

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Optimalisasi unit pengolahan air limbah merupakan upaya penting dalam menjaga kualitas lingkungan, terutama pada industri gula yang berpotensi menghasilkan limbah cair dengan kandungan pencemar yang tinggi. PG Madukismo berlokasi di Kalurahan Tirtonirmolo, Kapanewon Kasihan, Kabupaten Bantul, Daerah Istimewa Yogyakarta, menghasilkan limbah cair yang berasal dari berbagai tahapan yaitu proses produksi, air jatuhan kondensor, serta air abu ketel. Berdasarkan kondisi eksisting di lapangan, kualitas efluen yang dihasilkan masih belum optimal, ditunjukkan oleh karakteristik air limbah yang keruh, berbau, serta suhu yang melebihi baku mutu akibat kerusakan unit *spray pond*, serta kurang optimalnya proses pengendapan abu ketel akibat waktu tinggal yang tidak memadai. Oleh karena itu, penelitian ini dilakukan untuk menganalisis kualitas influen dan efluen air limbah, menentukan status mutu badan air penerima, mengevaluasi kinerja IPAL, serta memberikan arahan pengelolaan air limbah.

Penelitian ini dilakukan dengan menggunakan metode analisis indeks pencemaran (IP), neraca massa untuk mengetahui status mutu air sungai, serta evaluasi kinerja IPAL untuk menilai apakah kinerja unit sudah optimal. Berdasarkan hasil penelitian, diperoleh bahwa karakteristik efluen pada proses produksi memiliki nilai suhu sebesar 42°C, BOD 58,3 mg/L, COD 232,5 mg/L, dan TSS 33 mg/L. Pada proses air jatuhan, nilai efluen menunjukkan suhu sebesar 42°C, BOD 58,3 mg/L, COD 232,5 mg/L, dan TSS 33 mg/L. Sementara itu, pada proses air abu ketel diperoleh nilai suhu sebesar 30°C, BOD 8,5 mg/L, COD 5 mg/L, dan TSS 276 mg/L. Berdasarkan hasil tersebut, kualitas efluen diketahui masih belum memenuhi baku mutu air limbah yang berlaku. Hal ini diperkuat oleh hasil perhitungan Indeks Pencemaran (IP) yang menunjukkan nilai sebesar 5,652. Perhitungan neraca massa menunjukkan bahwa diperlukan pengolahan yang lebih baik untuk mengurangi beban pencemar pada badan air. Berdasarkan evaluasi, desain unit belum memenuhi standar desain Metclaf dan Eddy tahun 2003, sehingga arahan pengelolaan secara teknis yang dilakukan berupa perancangan ulang unit IPAL pada tiap proses dengan penyesuaian dimensi unit serta penentuan waktu tinggal.

Kata kunci: Air limbah; IPAL; Kualitas air; Perancangan Ulang; Pencemaran

## **ABSTRACT**

### **OPTIMIZATION OF THE WASTEWATER TREATMENT UNIT AT THE MADUKISMO SUGAR FACTORY (PG), TIRTONIRMOLO VILLAGE, KASIHAN, BANTUL, SPECIAL REGION OF YOGYAKARTA**

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Optimizing the wastewater treatment process is an important effort to maintain environmental quality, especially in the sugar industry which has the potential to produce liquid waste with high pollutant content. PG Madukismo is located in Tirtonirmolo Village, Kasihan District, Bantul Regency, Special Region of Yogyakarta, producing liquid waste from various stages of the production process including sugarcane washing, milling, purification, evaporation, condenser water, and boiler ash water. Based on the existing conditions in the field, the quality of the effluent produced is still not optimal, shown by the characteristics of turbidity, smelly, and temperature that exceeds the quality standard due to damage to the spray pond unit, as well as the suboptimal boiler ash deposition process due to inadequate residence time. Therefore, this study was conducted to analyze the quality of wastewater influent and effluent, determine the quality status of the receiving water bodies, evaluate the performance of WWTP, and provide direction for wastewater management. This research was conducted using quantitative and qualitative approaches. Based on the results of the study, it was obtained that the effluent characteristics in the production process had a temperature value of 42°C, BOD of 58.3 mg/L, COD of 232.5 mg/L, and TSS of 33 mg/L. Meanwhile, in the boiler ash water process, a temperature value of 30°C was obtained, BOD 8.5 mg/L, COD 5 mg/L, and TSS 276 mg/L. Based on these results, the effluent quality is known to still not meet the applicable wastewater quality standards. This is strengthened by the results of the calculation of the Pollution Index (IP) which shows a value of 5.652. The calculation of the mass balance shows that better treatment is needed to reduce the pollutant load on water bodies. Based on the evaluation, the unit design did not meet the design standards of Metclaf and Eddy in 2003, so the technical management direction was carried out in the form of redesigning the WWTP unit in each process by adjusting the unit dimensions and determining the dwell time.

**Keywords:** Wastewater; WWTP; Water quality; Replanning; Pollution