

**PERENCANAAN PENURUNAN AMONIA (NH₃)
MENGUNAKAN UNIT *FIXED BED ADSORPTION COLUMN*
DENGAN VARIASI WAKTU OPERASIONAL
DI PT. X, KABUPATEN CILACAP, PROVINSI JAWA TENGAH**

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INTISARI

Industri pengolahan minyak bumi dan gas alam di PT. X, Kabupaten Cilacap, menghasilkan limbah cair dengan kandungan amonia (NH₃) tinggi yang berpotensi mencemari perairan sekitar. Penelitian ini bertujuan menganalisis kualitas awal amonia pada limbah terproduksi di IPAL PT. X dan sungai sekitarnya, mengevaluasi efektivitas unit *fixed bed adsorption column*, mengkaji pengaruh waktu operasional, menilai parameter pendukung seperti COD dan minyak & lemak, serta memberikan rekomendasi pengelolaan amonia.

Metode penelitian meliputi pengumpulan data primer dan sekunder, pengujian laboratorium kualitas air, dan perancangan unit *fixed bed adsorption column* berisi pasir silika, zeolit, dan karbon aktif. Pengujian dilakukan dengan mode operasi *falling head* pada variasi waktu 1, 2, 3, dan 4 jam. Analisis meliputi evaluasi kualitas awal, efektivitas penurunan amonia, COD, dan minyak & lemak, serta analisis regresi polinomial untuk melihat hubungan waktu operasional dengan efisiensi adsorpsi.

Hasil penelitian menunjukkan kadar amonia awal di IPAL PT. X melebihi baku mutu PERMEN LH No. 19 Tahun 2010 (19,32 mg/L), menyebabkan sungai sekitar masuk kategori tercemar sedang. Unit *fixed bed adsorption column* menurunkan amonia hingga 90,21% pada waktu tinggal optimal 3 jam, menghasilkan konsentrasi akhir 1,89 mg/L. Waktu operasional berpengaruh signifikan terhadap proses adsorpsi, dan terdapat korelasi positif antara penurunan COD serta minyak & lemak dengan efisiensi penurunan amonia. Unit ini direkomendasikan sebagai pengolahan tambahan di IPAL PT. X karena efektivitas tinggi dan biaya operasional rendah.

Kata kunci: adsorpsi, air limbah industri minyak bumi dan gas alam, amonia, waktu operasional

**PLANNING OF AMMONIA (NH₃) REDUCTION USING
A FIXED BED ADSORPTION COLUMN UNIT
WITH VARIATIONS IN OPERATIONAL TIME
AT PT. X, CILACAP REGENCY, CENTRAL JAVA PROVINCE**

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ABSTRACT

The petroleum and natural gas processing industry at PT. X, Cilacap Regency, produces wastewater with high ammonia (NH₃) content, posing a potential threat to surrounding water bodies. This study aims to analyze the initial ammonia concentration in wastewater produced at PT. X's WWTP and nearby rivers, evaluate the effectiveness of a fixed bed adsorption column unit, examine the influence of operational time, assess supporting parameters such as COD and oil & grease, and provide recommendations for ammonia management.

The research methods included collecting primary and secondary data, conducting laboratory tests on water quality, and designing a fixed bed adsorption column unit filled with silica sand, zeolite, and activated carbon. Experiments were carried out in falling head operation mode with operational time variations of 1, 2, 3, and 4 hours. The analysis covered initial quality assessment, ammonia, COD, and oil & grease removal efficiency, and simple polynomial regression to examine the relationship between operational time and adsorption efficiency.

The results showed that the initial ammonia level at PT. X's WWTP exceeded the quality standard of Minister of Environment Regulation No. 19 of 2010 (19.32 mg/L), causing surrounding rivers to be classified as moderately polluted. The fixed bed adsorption column reduced ammonia by up to 90.21% at an optimal contact time of 3 hours, yielding a final concentration of 1.89 mg/L. Operational time had a significant influence on the adsorption process, and there was a positive correlation between COD and oil & grease reduction and ammonia removal efficiency. This unit is recommended as an additional treatment in PT. X's WWTP due to its high effectiveness and low operational cost.

Keywords : *adsorption, industrial wastewater, ammonia, activated carbon, zeolite*