Comprehensive Evaluation of a Full-Scale Combined Biological Process for the Treatment of Petroleum Refinery Wastewater using GC-MS and PCR-DGGE Techniques

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A full-scale biological process, combining recirculated biofiltration, hydrolysis acidification, anoxic/oxic, anoxic/oxic and membrane bioreactor treatment (RBF-HA-A/O/A/O-MBR), was used for treating petroleum refinery wastewater (PRW). A 25-day field monitoring experiment was conducted to evaluate its running performance. The results showed that the removal efficiencies of COD_{Cr}, BOD₅, TOC, TN, NH₄⁺-N were 96%, 100%, 98%, 56.24% and 100%, respectively. However, TN was reduced to 61.09 mg/L from 139.60 mg/L, which was failure to meet the industrial wastewater discharge requirements (20 mg/L). Gas chromatography-mass spectrometry (GC-MS) analysis showed that the main organic compounds in the influent of the A/O-MBR process were low-concentration and bio-refractory heterocyclic compounds, esters, organic acids, aldehydes and ketones, alkanes, alcohols. It was believed that insufficient effective carbon source limited the nitrogen removal efficiency. The microbial community structural analysis based on the polymerase chain reaction–denaturing gradient gel electrophoresis (PCR-DGGE) technology revealed that the predominant bacteria in different reactors were different. The results showed that the microorganisms of organics degradation were diverse, however, the amount of nitrifying bacteria and denitrifying bacteria were rarely detected or even undetected. Our results suggested that this biological treatment process was effective for organic removal but needs to be improved to increase the TN removal efficiency.

Keywords: Petroleum refinery wastewater; Full-scale biological system; RBF-HA-A/O/A/O-MBR; Running performance

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