Analisis Performa Nanofiltrasi Ceramic Membrane sebagai Post-Treatment Oksidasi Fenton Heterogen dengan Modifikasi Katalis Fly Ash pada Air Limbah Industri Wine = Performance Analysis of Ceramic Membrane Nanofiltration as Post-Treatment of Heterogeneous Fenton Oxidation with Fly Ash Catalyst Modification in Wine Industry Wastewater

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Abstrak

Industri air limbah wine menghasilkan air limbah yang memiliki karakteristik tinggi kandungan organik serta pH bersifat asam. Pengolahan konvensional dalam mengolah air limbah industri wine sangat kompleks, sehingga membutuhkan penanganan secara khusus. Saat ini, terdapat teknologi pengolahan yang sesuai dengan karakteristik air limbah wine yaitu proses oksidasi Fenton dan teknologi membran. Teknologi membran memiliki ukuran pori yang berbeda-beda, saat ini banyak pemanfaatan membran jenis nanofiltrasi dalam pengaplikasian pengolahan limbah industri. Membran nanofiltrasi memiliki kemampuan yang mirip dengan reverse osmosis yang dapat menyisihkan kandungan bahan organik serta anorganik. Proses filtrasi pada penelitian ini dilakukan secara konstan fluks dengan variasi fluks 40 LMH, 50 LMH, dan 60 LMH. Hasil penyisihan COD, besi, dan warna pada fluks 40 LMH, 50 LMH, dan 60 LMH secara berturut-turut adalah 64% ; 93%; 100%, 75%; 93% ; 100%, dan 76%; 94%; 100%. Hasil penelitian menunjukkan bahwa efisiensi penyisihan paling efektif pada fluks 60 LMH. Namun fluks 60 LMH rentan mengalami fouling yang menyebabkan permeabilitas menurun seiring berjalannya waktu. Selain itu, reversibility pada kondisi pengoperasian fluks 60 LMH didominasi oleh jenis irreversible fouling, sehingga proses mechanical backwash tidak cukup untuk mengembalikan performa membran dan membutuhkan chemical cleaning.
.....The wine wastewater industry produces wastewater that is characterized by high organic content and an acidic pH. Conventional processing of wine industry wastewater is very complex, so it requires special handling. Currently, there are processing technologies that suit the characteristics of wine wastewater, namely the Fenton oxidation process and membrane technology. Membrane technology has different pore sizes, currently many nanofiltration type membranes are used in industrial waste processing applications. Nanofiltration membranes have capabilities similar to reverse osmosis which can remove organic and inorganic materials. The filtration process in this study was carried out at constant flux with flux variations of 40 LMH, 50 LMH, and 60 LMH. The COD, iron and color removal results at fluxes of 40 LMH, 50 LMH and 60 LMH respectively were 64%; 93%; 100%, 75%; 93% ; 100%, and 76%; 94%; 100%. The results showed that the removal efficiency was most effective at a flux of 60 LMH. However, 60 LMH flux is susceptible to fouling which causes permeability to decrease over time. Apart from that, reversibility at 60 LMH flux operating conditions is dominated by irreversible fouling, so the mechanical backwash process is not enough to restore membrane performance and requires chemical cleaning.