Title:

An electrochemical dual-membrane reactor with multi-function carbon membrane electrode for efficient treatment of refractory organic wastewater

Authors & affiliations:

Zishang Chen[1], Jianxin Li[*1]*
[1] Tiangong University, Tianjin

Abstract:

An electrochemical dual-membrane reactor with multi-function carbon membrane electrode for efficient treatment of refractory organic wastewater

*Zishang Chen[1], Jianxin Li**

[1] State Key Laboratory of Separation Membranes and Membrane Processes, Tiangong University, Tianjin 300387, PR China, E-mail address: jxli@tiangong.edu.cn

Recently, the electrochemical membrane (ECM) based on advanced oxidation process has been increasingly recognized as one of the most promising candidates for next-generation water purification technologies. While the energy consumption (EC) of ECM reactor (ECMR) is a key issue to be solved in its practical application. Carbon material with good conductivity have great potential as ECM electrode for high-efficient treatment of refractory organic wastewater. Herein, a self-supported carbon membranes (CM) from activated carbon and phenolic resin were used as both anode and cathode to consist of the electrochemical dual-membrane reactor (EDMR) for synthetic phenolic wastewater treatment. Specifically, CM with microstructure defects as cathode to work for electro-Fenton reaction process. On the other hand, CM with nano-TiO_2 loaded as anode to work for electrocatalytic reaction process. Moreover, the CMI-7000 cation exchange membrane acts as the separator between the anode cell and cathode cell of the EDMR. Results showed that EDMR under the voltage of 2.1 V, electrode distance of 2.2 cm and residence time of 2.4 min displayed the better electrochemical degradation performance. When the concentration of phenolic wastewater was 470 mg/L, the removal rate of phenol and COD obtained from EDMR anode and cathode mixed permeate were up to 86.8 % and 78.1%, respectively, and the EC of EDMR were 0.43 kWh/kg COD. Compared with the traditional ECMR with only one anode membrane working, the EC of EDMR was reduced by 28.3% under the same operation conditions. EDMR with a high electrochemical reaction efficiency were ascribed to the synergy effect of electrocatalytic oxidation and electro-Fenton oxidation. Specially, the synergy of anode and cathode to promote the formation of singlet oxygen. In summary, our current study provides an effective solution for industrial refractory organic wastewater treatment.