Molecular-level transformation of dissolved organic matter during forward osmosis treatment of mature landfill leachate wastewater: Impact of ozonation pretreatment strategy

Feng Zhou[1], Bing Xie[1] and Min Zhan[1]

[1]*Shanghai Engineering Research Center of Biotransformation on Organic Solid Waste, School of Ecological and Environmental Sciences, East China Normal University, Shanghai 200241, China*

Email: mzhan@des.ecnu.edu.cn

Keywords: Forward osmosis process; Ozonation pretreatment; Mature landfill leachate; Fouling mechanism; Transformation characteristics

Abstracts: Forward osmosis (FO) has been adopted to treat complex wastewater such as mature landfill leachate due to its high rejection of organics[1]. In this study, impacts of ozonation pretreatment enhanced FO membrane system treating mature landfill leachate wastewater were assessed to elucidate its concentration performance, membrane fouling, and transformation characteristics of dissolved organic matter (DOM). For the FO process, it was observed that when ozone pretreatment was applied under a controlled recovery rate, the processing time was significantly reduced and a final membrane flux was greater than that of the without ozonation. Ozonation pretreatment of landfill leachate, conducted at varying durations, revealed that the processing time for FO treatment of old landfill leachate progressively decreased with extended ozone exposure. Interestingly, for medium landfill leachate, prolonged ozone exposure led to an increase in FO processing time. The reversibility of fouling resistance, contact angle, scanning electron microscopy (SEM), and atomic force microscop (AFM) analysis proved that optimal ozone exposure times for medium and old landfill leachate were determined to be 10 h and 40 h, respectively, and optimal ozone pretreatment mitigated membrane fouling, manifested by reduced hydrophobicity, decreased surface fouling, and lowered surface roughness. Fourier transform infrared spectrometer (FTIR) analysis suggests the presence of contaminants such as polysaccharides and proteins on membranes. The exacerbation of membrane fouling observed with the excessive introduction of ozone during the treatment of medium landfill leachate may be attributed to an increase in soluble extracellular polymeric substances and low molecular weight substances[2]. Besides, the changes in the leachate composition along the treatments were tracked by excitation-emission matrix-parallel factor analysis (EEM-PARAFAC) to identify fulvic-like (C1), protein-like (C2), and soluble microbial by-product-like (C3) components[3]. The Fmax of C1 and C2 exhibit a decreasing trend for medium landfill leachate, and the Fmax of C1 on the membrane was found to be significantly lower than that of C2. For old landfill leachate, the C3 shows resistance to degradation with the increase in ozone, while the variations in C1 and C2 on the membrane are similar between medium and old landfill leachate. Meanwhile, the concentrations of humic substances and amino acids were further quantified, revealing that the concentration of fulvic acid significantly exceeded that of humic acid and the amino acids were primarily composed of components L-Histidine, L-AsparticAcid, and L-(+)-Lysine. In the catalytic process of landfill leachate by ozone, the main free radicals involved were $^{\bullet}OH$ and $^{\bullet}O_2^-$, which play a role in the degradation of organic compounds.

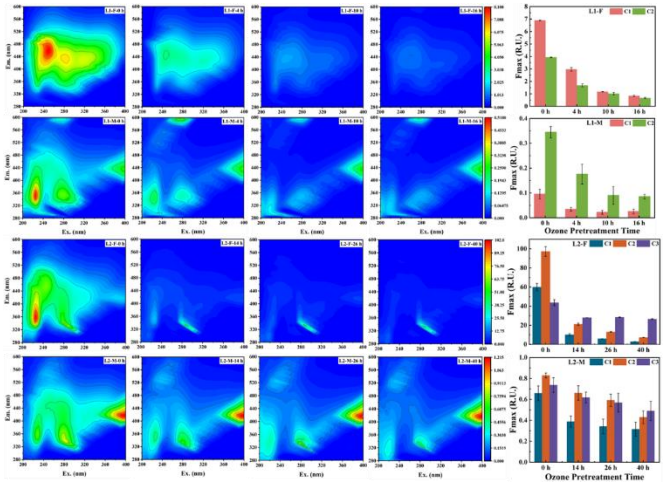

Figure 1 Variation trend of maximum fluorescence intensity of different components.

References

[1] Bilal Aftab, Yong Sik Ok, Jinwoo Cho, Jin Hur a, *Water Res.* **2019**, *160*, 217-227.

[2] Huifang Sun, Hang Liu, Siyu Wang, Fangqin Cheng, Yu Liu, *Water Res.* **2018**, *146*, 328–336.

[3] Bilal Aftab, Jinwoo Cho, Hyun Sang Shin, Jin Hur, *Waste Management.* **2020**, *102*, 260-269.