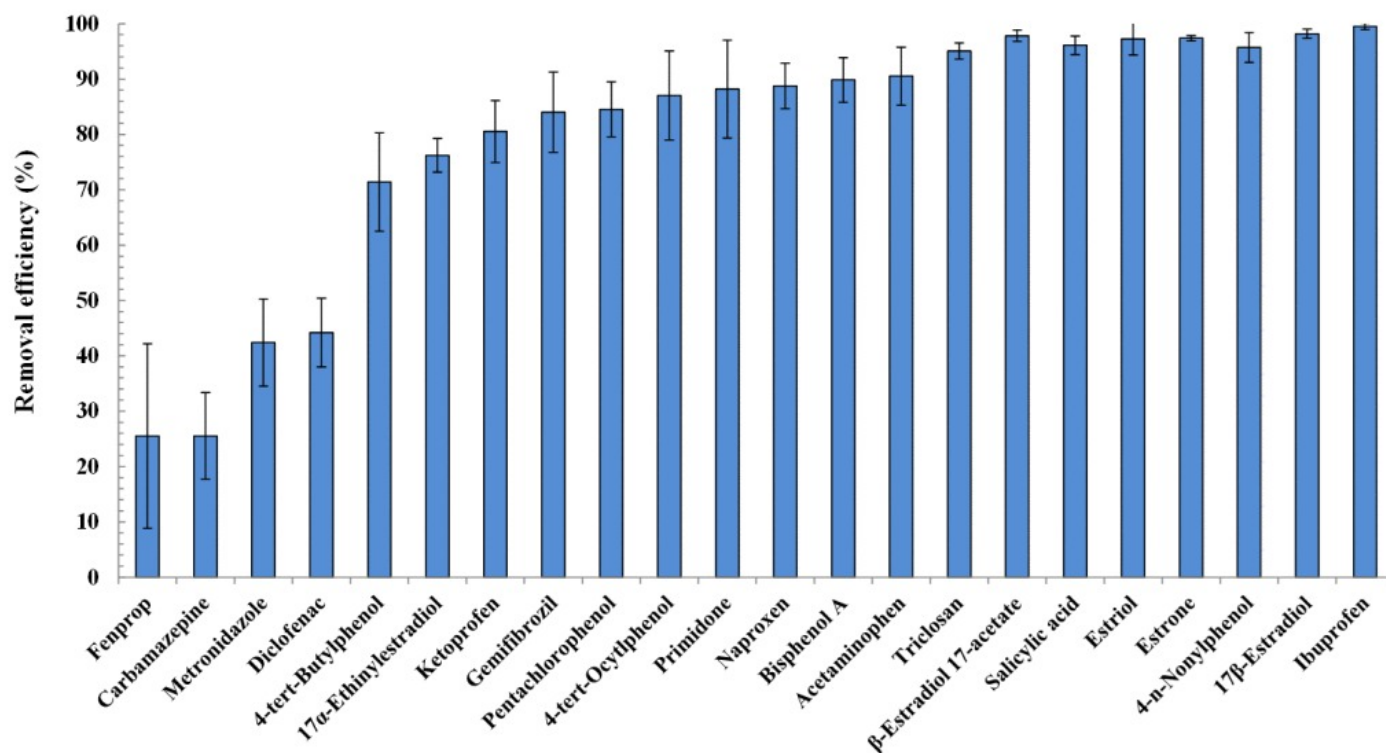


Hybrid moving bed biofilm reactor-membrane bioreactor system for micropollutant removal

In recent years, the frequent detection of micropollutants in the aquatic environment has raised growing concerns due to their detrimental effects on aquatic organisms and human health. Micropollutants, also termed emerging contaminants, consist of a wide variety of substances that are present at trace concentrations (a few ng/L to several µg/L) in waters. These chemicals usually end up in sewage treatment plants as a consequence of the use of pharmaceuticals, personal care products, pesticides and industrial material. Due to their recalcitrance, micropollutants often experience insufficient removal during sewage treatment plants. As a result, majority of micropollutants are continuously released into the receiving waters.

To address this problem, research needs to be undertaken to develop new wastewater treatment methods. One of the current innovations in this regard is the combination of a moving bed biofilm reactor (MBBR) and a membrane bioreactor (MBR). To date, the effectiveness of MBBR-MBR hybrid systems for micropollutant removal is still largely unknown. The main goal of this study was to investigate how well a MBBR-MBR hybrid system can treat micropollutant-bearing wastewater. In addition, since membrane fouling is a significant issue that can lead to increased operating costs and treatment failure, the other focus of our study was to examine membrane fouling in the MBBR-MBR hybrid system.



The hybrid system used consists of an MBBR using sponge cubes as biofilm carriers and an MBR. During our study, we compared the MBBR-MBR system with a conventional MBR in terms of treatment effectiveness and membrane fouling. The results showed that the MBBR-MBR hybrid system were more effective and stable in removing organic matter, nitrogen and phosphorus from wastewater. We also observed higher and consistent elimination of micropollutants in the hybrid system. The compounds with higher hydrophobicity were all effectively eliminated (>80% removal) by the MBBR-MBR system. However, some compounds, such as carbamazepine and fenprop, were insusceptible to MBBR-MBR treatment. We found that the removal of micropollutants in the hybrid system was mainly a result of biological degradation. There were other mechanisms for micropollutant removal, such as adsorption, but they were much less significant.

Compared with the conventional MBR, the MBBR-MBR hybrid system showed considerably superior membrane performance. The operation of the hybrid system lasted for around 90 days before severe membrane fouling took place. By contrast, the conventional MBR exhibited a much faster fouling rate, and the operation continued for only 15 days. We ascribed the difference to the considerably higher level of soluble microbial products observed in the conventional MBR.

The findings from this study may be useful in providing a better understanding for the application of MBBR-MBR systems. While we have demonstrated the benefits of the hybrid system, further investigations are still needed to optimize this promising technology.

Publication

[Evaluation of micropollutant removal and fouling reduction in a hybrid moving bed biofilm reactor-membrane bioreactor system.](#)

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