Name	Job Title	Area of Expertise
CHANG Ying Shi	Assistant Professor	Chemical Engineering

1. Main Research Topics

① Nutrient recovery and water purification from aquaculture wastewater

Recovering ammonia (NH_3) and phosphate (PO_4^{3-}) nutrients from aquaculture wastewater is a sustainable method for waste valorization. Conventional biological treatments are inefficient, often removing rather than recovering NH_3 while generating substantial PO_4^{3-}-rich sludge, consuming significant time, energy, and space. This research aims to intensify a sustainable vacuum membrane distillation (VMD) system to transform aquaculture wastewater into valuable resources and purified water (**Fig. 1**). Our goal is to achieve high-value nutrient recovery by concentrating PO_4^{3-} up to 10-folds and simultaneously recovering >90% of NH_3 in highly concentrated forms, suitable for agricultural N-P fertilizer production, and purified water production for reuse within the aquaculture system or for drinking or irrigation purposes. The effect of operating parameters such as feed temperature, pH, and phosphoric acid concentration as an NH_3-absorbing medium will be evaluated and optimized for NH_3 recovery. Further, feed temperature and crossflow velocity will be optimized to maximize PO_4^{3-} concentration and purified water yield. In addition, the fouling mechanism of VMD membrane towards complex aquaculture wastewater matrix, and the necessity of wastewater pretreatment will be elucidated. Overall, the research outcomes are expected to enhance circular aquaculture economy by transforming waste into valuable products, directly contributing to both environmental sustainability and improved water security.

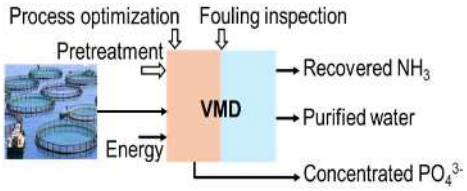

Fig 1. Overview of the research and targeted products

② Perfluoroalkyl substance remediation

Pre-concentrating perfluoroalkyl substances (PFAS) from contaminated water is a crucial step for their effective downstream destruction. Previous research by the applicant demonstrated that direct-contact membrane distillation (DCMD) using a commercial polyvinylidene fluoride (PVDF) membrane can pre-concentrate PFAS, however, surfactant-like PFAS fouled and diffused through the membrane, contaminated the permeate. This proposal aims to develop a novel amphiphobic PVDF surface-modified with silanized nanoparticles, designed to repel both surfactant and water (**Fig. 2**). Enhanced PFAS pre-concentration and water recovery will be achieved using optimal nanoparticle concentration and process conditions. The viability of the modified membrane performance will be assessed using real PFAS-contaminated groundwater. The research outcomes are expected to advance PFAS remediation, promote zero waste discharge, and enhance water security.

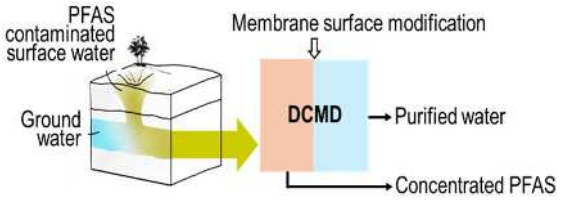

Fig. 2 PFAS-contaminated groundwater remediation through DCMD

2. Keywords

Membrane separation, water and wastewater treatment, resource recovery, desalination, process engineering, membrane development

3. Remarks and Websites

Future prospects and social implementation

My research aims to revolutionize wastewater management by transforming pollutant streams into valuable resources. We develop scalable membrane technologies for broad commercial deployment, directly applicable to diverse wastewater matrices. These solutions empower operations of all scales, from small to large industrial facilities, to minimize effluent discharge, optimize resource recovery, achieve regulatory compliance, and fully embrace circular economy principles.

On-going research funding:

(1) KAKENHI Research Start up Support Project (FY2024–2025)
(2) KAKENHI Young Scientist Research Project (FY2025–2027)

researchmap: https://researchmap.jp/ChangYingShi

Laboratory: Water Treatment Laboratory https://www.waterenviron.com/home