Integrated greywater treatment using nanofiltration for the production of reusable water

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Motivation

The global demand for sustainable water treatment is driven by water scarcity, increasing urbanization, and the need to reduce environmental pollution[1]. Greywater, which accounts for the majority of domestic wastewater, is a promising source for subsequent reuse[2]. However, full-scale adaptation has been limited due to the presence of organic micropollutants (OMPs) and other emerging contaminants present in secondary effluents.
Biological treatment followed by hollow fiber nanofiltration (NF) has shown to be an effective configuration to remove conventional wastewater contaminants and micropollutants[3][4]. However, while NF successfully removed OMPs from the effluent, these substances were not degraded and end up in the concentrate. Therefore, further investigations into combined configurations of biological treatment, nanofiltration and post-treatment for OMPs removal are required to develop sustainable alternative treatment strategies.

Technological challenge

Currently, NF systems for greywater treatment are predominantly used at the pilot scale, where the concentrate streams are not considered as a limiting factor. During large-scale application, implementing concentrate recirculation to the biology could be of interest. However, the impacts of recirculation on the process remain, as of yet, not well understood and require further investigations.
The impact of this closed-loop system on the NF unit's operation and its efficiency in OMPs removal on the long term, remains an important area of interest.
Implementing additional treatment steps upstream of the NF could provide additional advantages, such as increased membrane lifetime, but its impacts on the entire process have not been studied in depth yet.[5].
Lastly, the impact of greywater quality on membrane ageing and irreversible changes to the membrane requires more attention.

Fig 1. Nanofiltration unit used during the project

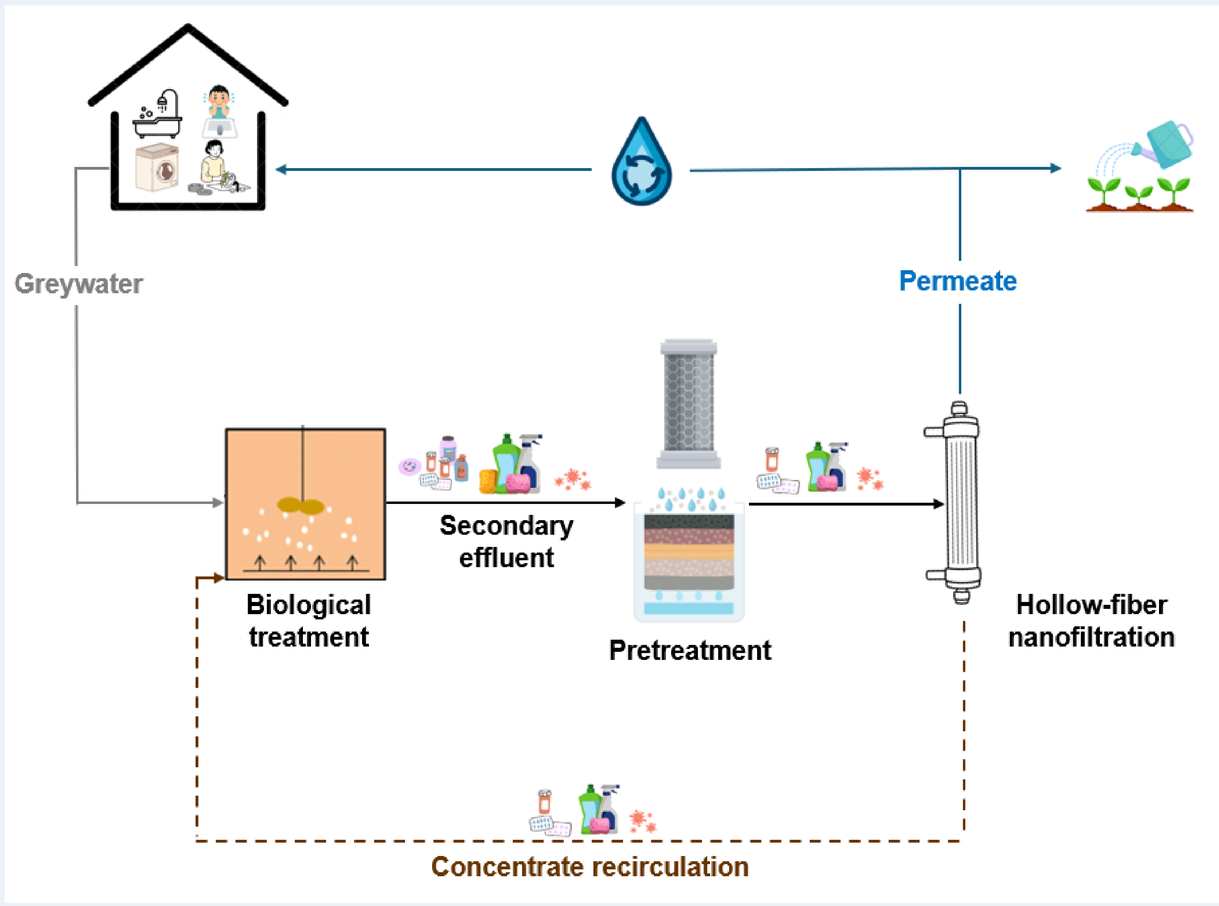

Fig 2. Graphical abstract of the research project

Research goals

• Examine the suitability of the integrated greywater treatment, combined with concentrate recirculation (Fig 2), as an effective approach to remove organic micropollutants and to ensure the production of high-quality water suitable for reuse

• Investigate the effect of secondary effluent treatments to the membrane's key performance indicators

• Explore post-treatment methods, such as advanced oxidation processes, for both the concentrate and permeate to address residual micropollutants

• Assess the environmental and operational impacts of combining biological treatment with NF and other advanced post-treatment technologies to create a sustainable, closed-loop greywater treatment system

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