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TECHNOLOGY FACT SHEET

Membrane filtration and reverse osmosis

Membrane technology is mostly used on a pre-treated (liquid fraction of) digestate stream, meaning that most of the solids have been removed.

The input stream is forced through the membrane's pores by means of pressure. The pore size of the membrane determines which molecules go through and the pressure to be used

Characteristics of different membrane filtration types. Source: Lenntech.com. TM= transmembrane

Type of membrane	Pore size[1]	pressure	Membrane material	retaines
Microfiltration	0.1-1µm	1-3 bar	Organic materials, e.g. polymer based membranes Inorganic materials,e.g. ceramic or stainless steel	Suspended particles, bacteria
Ultra-filtration	200nm-10nm	2-10 bar	Polymer materials, e.g. polysulfone, polyethersulfone, polyvinylideenfluoride, polypropylene, cellulose acetate, polylactic acid Ceramic membranes for high temperature applications.	+ viruses
Nano filtration	10nm-1nm	8-40 bar	Organic, thin-film composite membranes	+some multi-valent ions
Reverse osmosis	<1nm	10-100 bar	Semi-permeable, thin film composite membranes: -Polyester support web -Microporous polysulfone interlayer - Ultra think polyamide barrier layer	+multivalent ions +monovalent Ions

Micro filtration (MF) and/or ultra-filtration (UF) separate all remaining suspended solids and colloidal dispersed fraction (MF), macromolecules (UF) into a "concentrate".

Waeger et al. (2010) recommended ceramic ultrafiltration membranes with pore sizes of 20–50 nm for biogas digestate filtration applications.

The water with dissolved compounds like ammonium is not retained by these membranes and this stream is called the "permeate".

In order to further purify the permeate, nanofiltration and reverse osmosis (RO) can be applied.

Unlike RO membranes, which reject almost all solutes (low molecular, neutral molecules like CO_2 and NH_3 will pass), NF membranes will reject most multi-valent ions but a significant amount of mono-valent ions will pass.

[1] NF and RO membranes technically don't have pores, their separation ability is not based on particle size but on differences in diffusion velocity of ions and particles. The pore size indicated here give an indication on the size of the particles that can be retained by these membranes.

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RO can also be used on a pre-processed digestate stream, such as the condensate of the evaporator, liquid fraction from DAF, pre-treated with a paper filter. When using RO as a final separation step, also nutrients (i.e. ions) can be separated in the concentrate stream, however the concentrations are not as high as in synthetic mineral fertilisers.

The permeate stream generated from RO contains low concentrations of nutrients and can be discharged to sewer or surface water, if necessary after a 'polishing' step, or re-used as process water (Hoeksma and De Buisonjé 2011; Hoeksma, de Buisonjé, and Aarnink 2012).Therefore, membrane techniques are often used to reduce the volume of the digestate stream (Lebuf et al. 2013).

Read more about the recovery efficiencies, fouling and scaling, use of additives, energy requirements and costs in Chapter 2.2.3 of D 3.2 Final report on schemes and scenario's for nutrient recovery and Reuse.
www.systemicproject.eu/downloads →"project deliverables"

References

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