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Microfiltration and ultrafiltration as a posttreatment to biogas plant digestates for producing concentrated fertilizers

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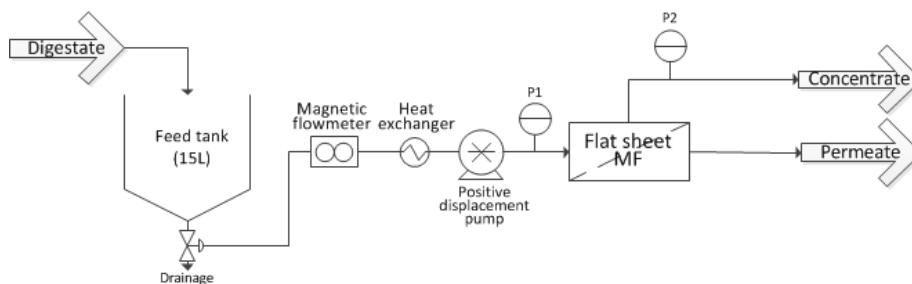
Key Words: microfiltration, ultrafiltration, digested manure, nutrient recovery

Introduction

Prior investigations show that microfiltration (MF) and ultrafiltration (UF) can be used for post treatment of biogas plant digestate [1] [2]. The objective of this research is to evaluate the nutrient (i.e. nitrogen, phosphorus, potassium) recovery potential of MF and UF. MF and UF membranes were tested on biogas plant digestates. The obtained concentrates can be used as concentrated liquid fertilizers in agriculture, the resulting permeate for irrigation.

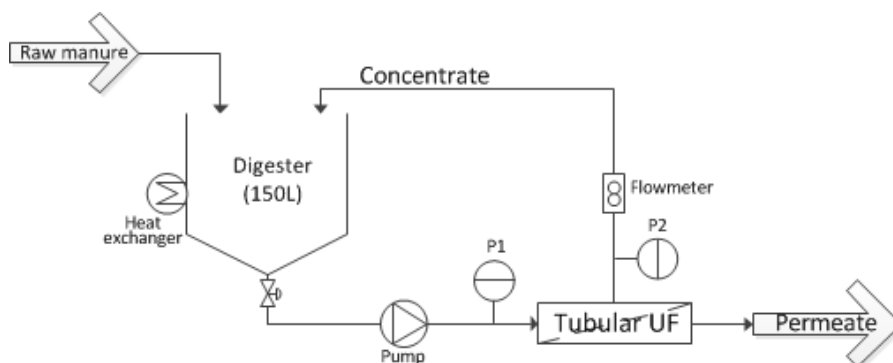
Material and Methods

Two MF flat sheet membrane materials (polyvinylidene fluoride-PVDF and polysulfone-PS) and three pore sizes (0,2-0,5-0,8 μ m) were tested using cross-flow filtration on a LabStak®



M10 laboratory plant (Figure 1). The feed stream was the centrifuged digestate liquid fraction from Fangel Biogas (Denmark).

Figure 1. LabStak® M10 setup



The UF experiments were performed by BioScan A/S using polyethersulphone (PES) tubular membranes (40kDa). The digestate feed was produced in a pilot scale plant (Figure 2).

Figure 2. UF pilot plant setup

Results and conclusions

The composition and characteristics of the digestates used in the MF and UF experiments are shown in Table 1 and Table 2, respectively. The composition differs as different manure and organic waste sources were used to feed the Fangel Biogas and BioScan A/S digesters.

Table 1. Feed composition for MF plant– Fangel Biogas digestate (Denmark)

Composition	pH	DM (%)	TKN (g/L)	P (g/100g)	K (g/100g)	Ca (g/100g)	Mg (g/100g)	Na (g/100g)
Value	8.17 ± 0.21	2.7 ± 1.2	0.23 ± 0.02	1.7 ± 0.1	7.5 ± 0.7	2.2 ± 0.2	0.3 ± 0.03	4.8 ± 0.4

Table 2. Feed composition for UF plant– BioScan A/S (Denmark)

Composition	pH	DM (%)	NH ₄ ⁺ (g/L)	H ₂ PO ₄ ⁻ (g/L)	K (g/L)	Ca (g/L)	Mg (g/L)	Na (g/L)
Value	8	3.2	2.7	1.7	0.46	0.39	0.24	0.11

A volume reduction (VR) of 50% was achieved by MF operated at 30°C, 1 bar transmembrane pressure (TMP) and a cross-flow velocity of 1.4 m/s. The UF concentration tests run at 25°C, TMPs between 1.6 and 3.1 bar and cross flow velocities between 2 and 3.4 m/s, achieved a maximum VR of 70%.

The obtained permeate and concentrate samples are to be analysed. The results will show how nutrients are distributed between concentrate and permeate depending on the applied TMP, cross flow velocity, VR, membrane material and pore size.

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