

## Pilot-scale membrane ultrafiltration of pre-treated digestate

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December  
2015  
No. 25

At the Department of Chemical Engineering, Biotechnology and Environmental Technology, University of Southern Denmark, recovery of nutrients in wastewater such as farm effluent in the form of phosphorous, ammonium and potassium has for a long time been an object of investigation. Solid-liquid separation is a common practice for obtaining a nutrient-rich concentrate that can be used on crops as fertilizers. In the separation process, membranes have played a major role. Ultrafiltration (UF) membranes for separating different components in the feed-stock demands pre-treatment, where larger particles (often non-digested and of ligno-cellulosic origin) are removed from the feed-stock before the separation process takes place.

It is known that storing manure or digested manure in large tanks often separate in three fractions during storage if the manure is not agitated. The three fractions constitute a floating layer of insufficiently digested ligno-cellulosic biomass, a middle fraction with mainly suspended matter and a low content of dry matter and a lower layer which is a precipitated heavy fraction consisting of a mixture of sand, inorganic insoluble salts and biomass co-precipitated with the inorganic parts. The middle fraction obtained purely by sedimentation contains, however dissolved phosphorous, ammonia, and potassium, which can be separat-

ed by means of different membrane types.

In this study, a pilot-scale ultrafiltration was tested in order to investigate the ultrafiltration performance with regards to separation efficiency of fine and suspended matter, nutrient and heavy metal content in the permeate and concentrate. Digestate from a biogas plant at Northern Italy was collected and pre-treated as a feed for the membrane pilot. The pre-treatment included a solid-liquid separation via a decanter centrifuge following flocculation with a cationic polymer. The membrane module was an industrial stainlesssteel pressure vessel with a tubular polysulfone ultrafiltration membrane (PU 120, PCI Membranes, UK). The operating conditions used during the experiment are indicated in the Table 1.

The experiment is currently underway, and we expect that results will provide important information on the effect of operating conditions on the characteristics of the permeate and concentrate. Furthermore, results from this study will be also used to compare with previous studies in order to evaluate the effects of different pre-treatment methods of digestate on the UF performance, which will give an idea of whether pre-treatment plays an important role to the filtration process or not and if yes which pretreatment is preferred.

**Table 1 Operating conditions used during the experiments**

Treatment	Operating conditions			Number of repetitions
	Pump cross-flow velocity (m/s-1)	Applied pressure (bar)	Processing time (mins)	
1	1.4	3.9	180	2
2	1.9	3.9	180	2
3	2.7	3.9	180	2
4	1.4	4.9	180	2

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