COUPLING ANAEROBIC DIGESTION OF SWINE MANURE AND MEMBRANE-BASED NITROGEN RECOVERY FROM DIGESTATE: A NOVEL APPROACH FOR SWINE MANURE VALORIZATION

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Reducing NH_3 emissions and nutrient recycling are two major concerns in European agriculture nowadays. The high amount of NH_4^+ that remains in the digestate makes its land-application difficult. The objective of the present study is to investigate a combined technology for swine manure (SM) treatment coupling AD and gas-permeable membrane technology (Fig. 1).

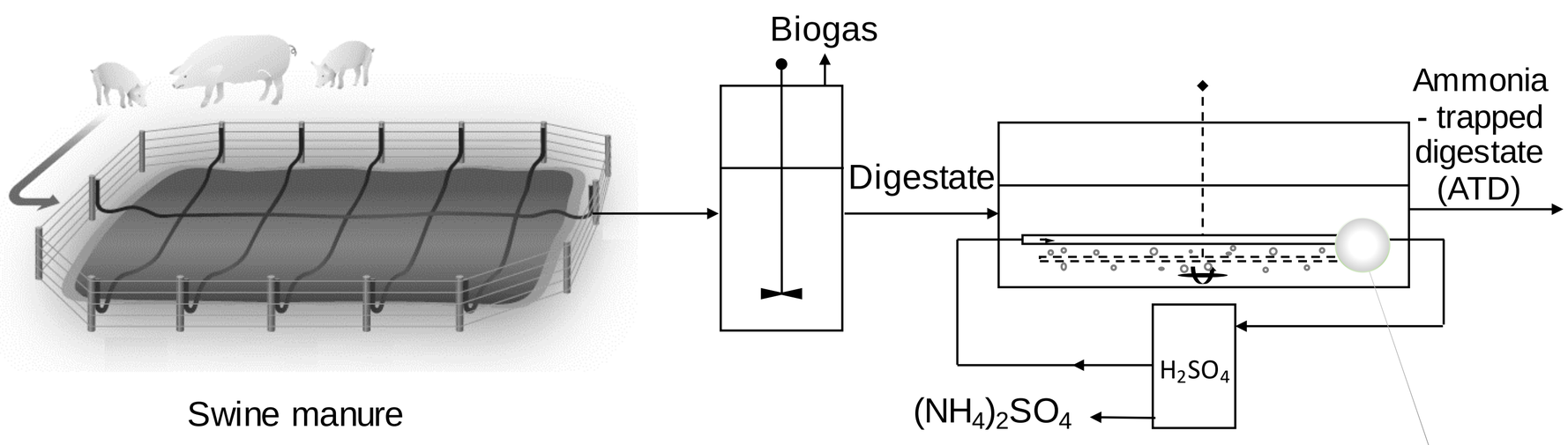

Fig. 1. Scheme of the combined technology for swine manure treatment

- Total COD and soluble COD reductions of 45 and 70 %, respectively (Table 1).
- Removals of 59 and 82 % of the initial total nitrogen (TKN) and total ammonia nitrogen (TAN), respectively.

Table 1. Chemical characterization of the raw SM, digestate and ATD.

Parameter	Unit	SM		Digestate		ATD		Removal
		Average	STD	Average	STD	Average	STD	%
CODt	g L^{-1}	37.39	1.5	20.09	0.9	20.56	1.6	45
CODs	g L^{-1}	12.27	0.7	3.52	0.1	3.66	0.1	70
TKN	g L^{-1}	2.91	0.2	2.82	0.0	1.18	0.0	59
TAN	g L^{-1}	1.76	0.1	2.01	0.0	0.31	0.0	82

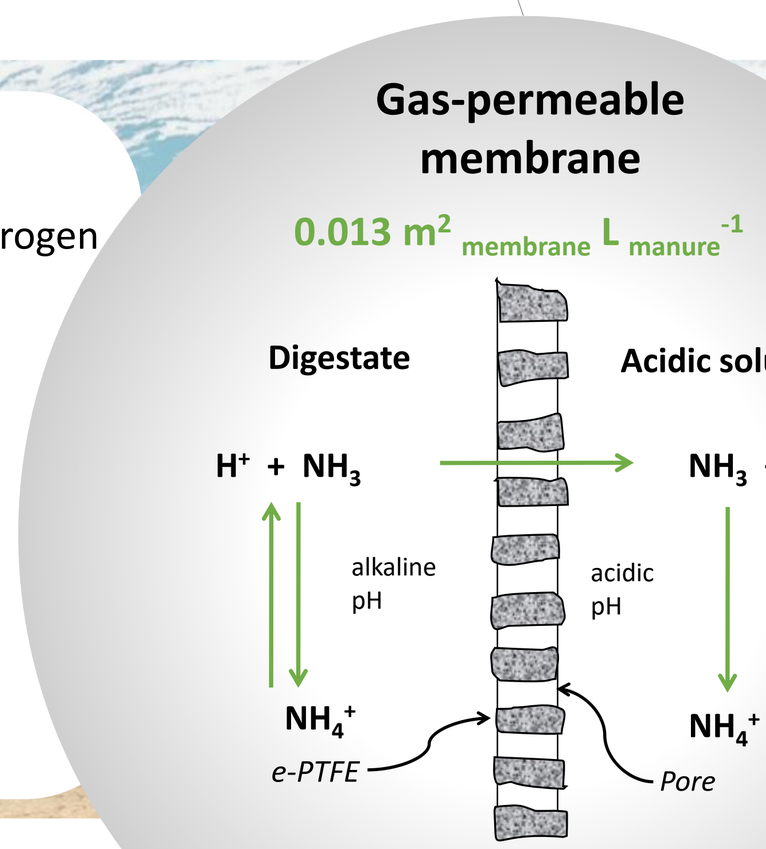

Fig. 2. Cross section of a hydrophobic gas-permeable membrane (García-González et al., 2015)

- Methane yield of 179 ± 3 mL CH_4 g volatile solids (VS) $^{-1}$ (Fig. 3A).
- 63 % of the removed TAN recovered as a $(NH_4)_2SO_4$ solution.
- This solution presented a final concentration of 8.7± 0.2 g TAN L^{-1} (Fig. 3B).
- N-recovery rate accounted for up to 34 g NH_4^+ m $_{membrane}^{-2}$ day $^{-1}$.

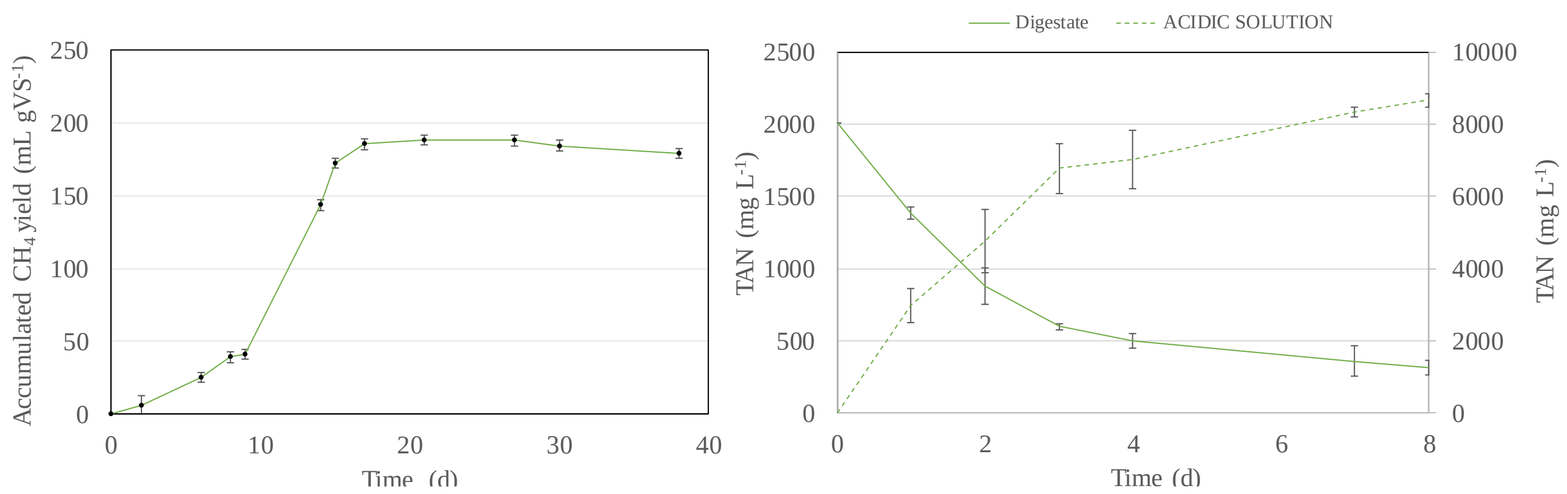

Fig. 3. Accumulated CH_4 yield (A), TAN lost in the digestate and recovery in the acidic solution (B).

The application of gas-permeable membrane technology coupled to AD contributes to a sustainable livestock waste treatment, reducing nitrogen content of the digestate and, therefore, helping to its management in vulnerable zones. The overall CODs and TAN removals were 70 and 82%, respectively. Moreover, these pollutants were recycled as sustainable energy in the form of methane and fertilizers.

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