GAS EMISSION FROM STORAGE FACILITIES BEFORE AND AFTER BIOGAS

AARHUS UNIVERSITY
TECHNICAL SCIENCES

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BACKGROUND

Emission of:

- methane, CH_4
- ammonia, NH_3 (a small part can be oxidized to N_2O)
- nitrous oxide, N_2O (direct and indirect emission from NH_3)

Global Warmning Potentials non-fossil CH_4 (IPCC Assessment report 6)

- GWP_{100}: 27 years
- GWP_{20}: 81 years

Significance: Methane might be more important as a GHG in the near future. Luckily, its lifetime is relatively short in the atmosphere (12 years)

WHOLE CHAIN IS IMPORTANT

Important to measure emission from the whole chain:

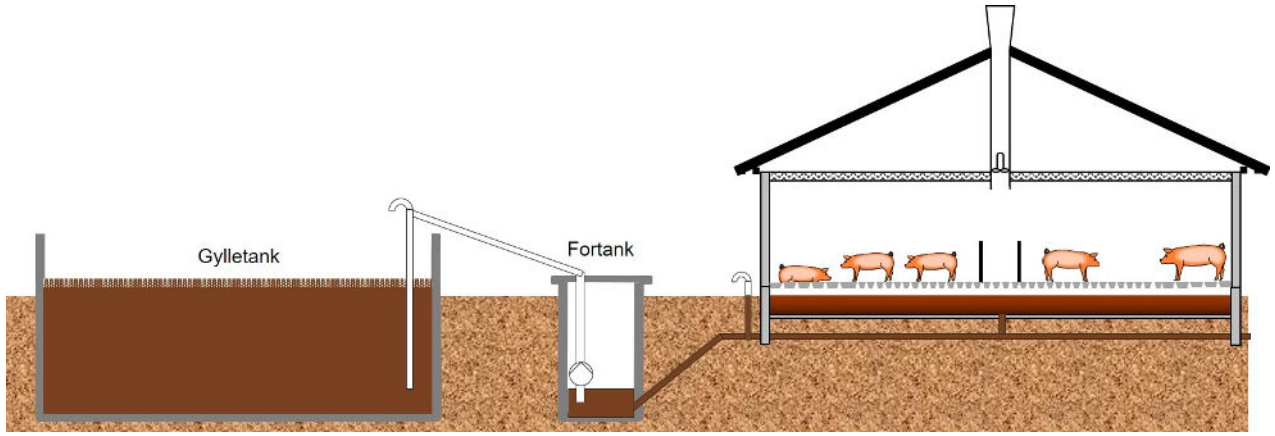
- Animals – enteric CH_4
- Manure
  - barns
  - storages
  - biogas plants
  - storage of digestates
  - application on the fields

Reduction in one place -> can increase downstream emission

FREQUENT FLUSHING OF SLURRY - METHANE

Example with finishing pigs – simulation with Arrhenius type model

- Fully slatted floors
- Slurry production, (0.9 cm/day)
- Temperature
  - barn: 19 °C
  - storage: ambient (almost)
  - from May to April (average 6 – 7 months



Flushing intervals (days)	HRT (days)	Without biogas (kg CH_4 / ton slurry)			With biogas (kg CH_4 / ton slurry)		
		Barn	Slurry tanks	Barn & Storages	Barn & pre-tanks	Slurry tanks	Barn and storages
35	21	2.3	2.5	4.8	2.5	0.1	2.6
7	7	0.9	3.0	3.9	1.1	0.2	1.3

LOSSES BIOGAS PRODUCTION

Leakages on a biogas plant can affect the “greenness” of process.

- In Denmark we aimed for a loss of < 1% of the produced biogas
- In reality it is higher, ~ 2.5%
- Especially important when using energy crops

GAS EMISSIONS FROM DIGESTATE

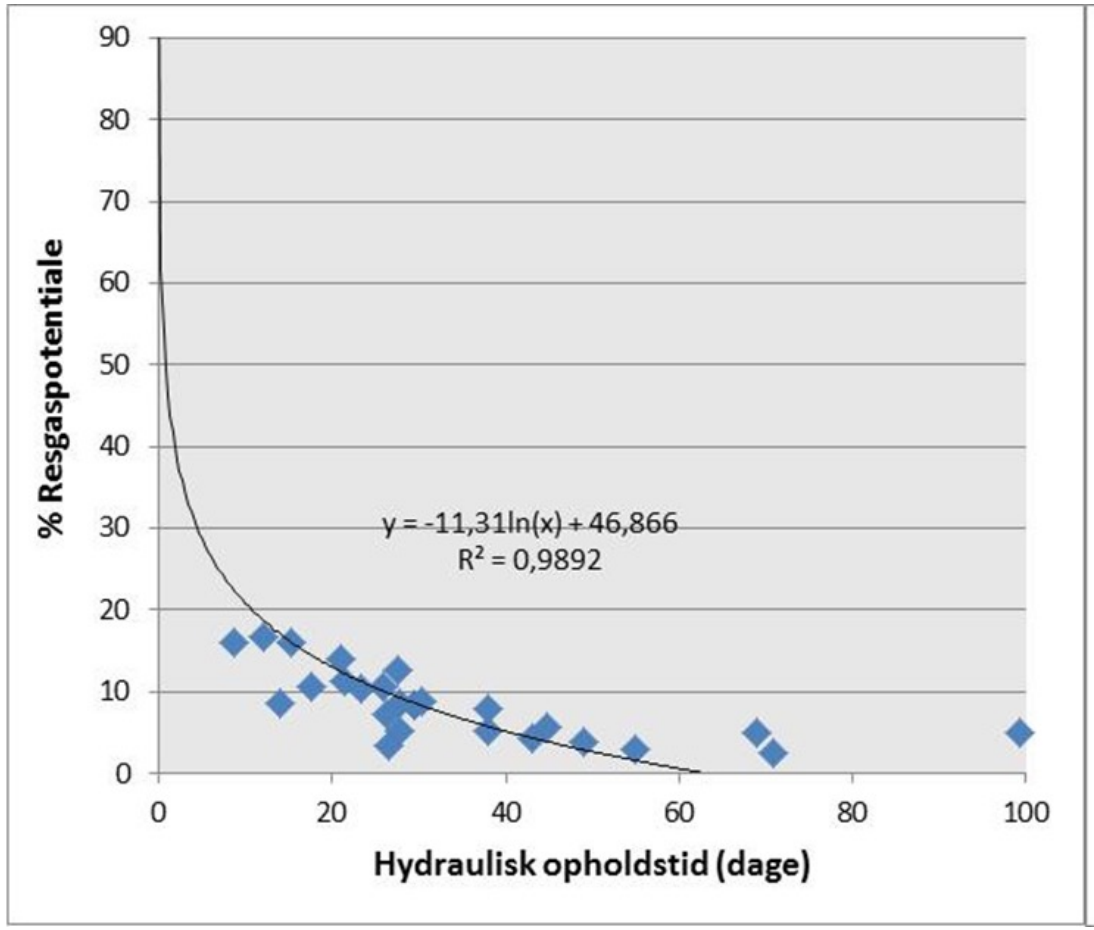
Digestates applied on the fields emit more NH_3 than un-digested slurry due to:

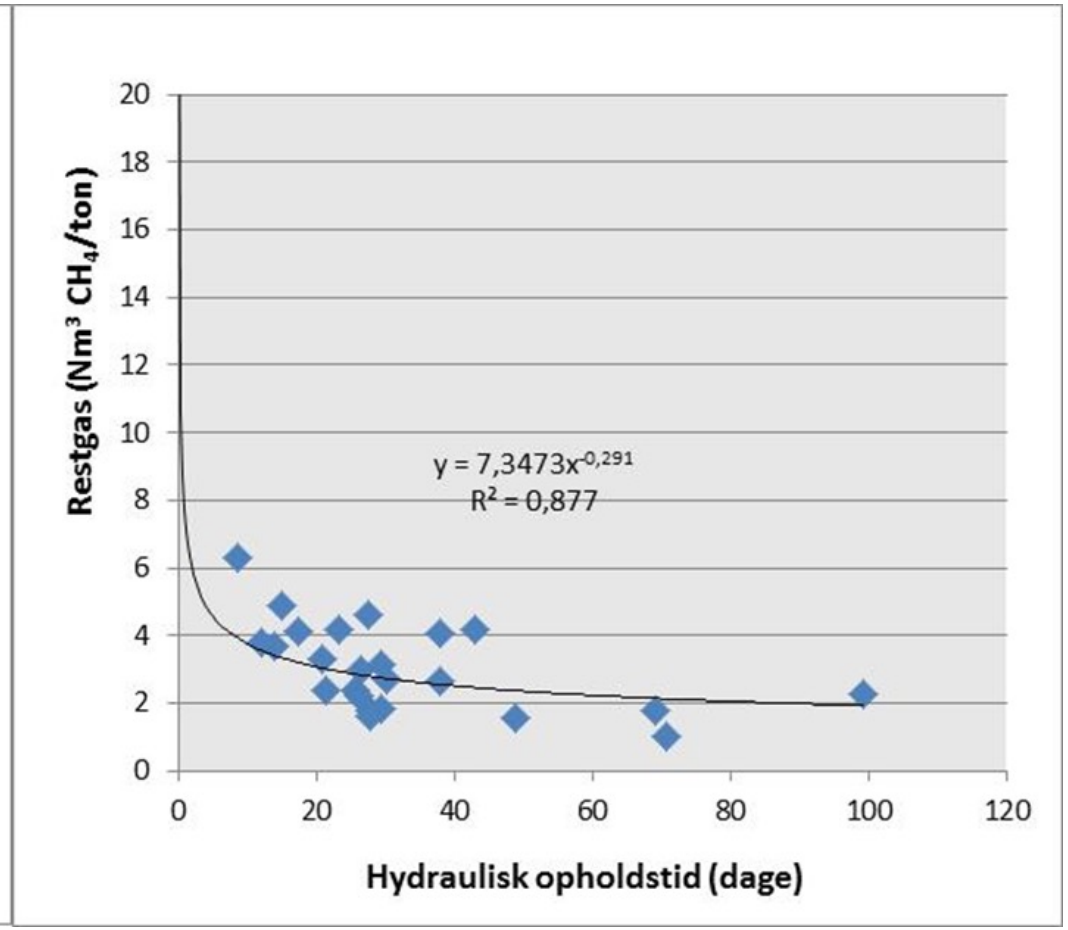
- conversion of org-N into NH_4^+
- addition of N in feedstock to the biogas plant
- higher pH in the digestate

In Denmark, digestate should be applied on the fields using one of the following technologies:

- acidified,
- injected in open slot (grass) or closed slot (soil without crops)
- trailing hoses and incorporated into the soil within 4 hours

RESIDUAL METHANE PRODUCTION





METHANE EMISSION FROM DIGESTATE

Not all of the residual methane is produced:

- Lower temperature -> higher CO_2/CH_4 ratio
- low-dose acidification can reduce CH_4 production

Headspace gas from covered slurry tanks or lagoons can be reduced by:

- flaring (thermal combustion of gas)
- oxidized in soil or biofilter (long retention times)

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