Work-Package 2.1.1 "Study of manure management in surrounding countries: study visits to Northern Germany, Denmark and Flanders – February / March 2023"

Study of manure management in surrounding countries

Paul Galama, Peter Groot Koerkamp, Sierk Spoelstra and Abele Kuipers

Biogas.

Northern-Germany has a network of biogas plants installed on farm level. We visited a dairy farm applying co-fermentation to produce biogas (methane + carbon dioxide). Land is bought or leased to grow fodder beet, maize or grass for on-farm co-fermentation. Fermentation of manure is a minor part of the total organic material being processed. The biogas is converted into electricity. The farmer receives a state-guaranteed minimum price for the electricity which is delivered to the electricity net.

Denmark is ambitiously committed to biogas production. Already, more than 30% of all gas in the country is biogas. A long term policy exists to support biogas production from farms. Ambition by 2030 is that all gas will be biogas. A large biogas plant near Holsterbo was visited. About 150 livestock farmers supply manure to this plant and use the digestate as fertilizer. Interestingly, this initiative was started mainly because there was a phosphate surplus in the region. This was partly due to mink farming. Mink produce manure with relatively high phosphate contents. The fibre fraction with phosphate is separated and is as an OS rich manure product sold in P-deficient regions. The Biogas plant we visited was industrially designed, with a lot of attention to surroundings, local acceptance, aesthetics, connection with other industries and villages with a heat grid etc. Everything was very clean, even the manure tanker was clean. The underlying objective is to gain and maintain local acceptance.

Biogas contains 5 to 20 % carbon dioxide, when burned this is not a problem, but it cannot be delivered to the gas grid without treatment. As an alternative to removing the carbon dioxide, the conversion of carbon dioxide into methane using hydrogen obtained by hydrolysis was mentioned. In case of excess electricity this hydrolyses process could be an option to upgrade the biogas to a more pure gas.

One private firm with 15 biogas plants in Denmark has recently decided to extend its operation to the Netherlands. They envision that the market for biogas production has improved in last years in the Netherlands.

In Flanders these days 35 biogas plants are active on farms. They focus on mono-fermentation, thus only on manure. One newly built very well equipped biogas plant was visited in West Flanders.

Digestion of manure without co-fermentation results in an amount of gas produced per unit input that is smaller than from crops such as corn silage, because a large part of the degradable energy in corn silage has already been utilized by the animal.

Low-emission housing systems.

Low-emission housing in Denmark focuses on 2 tracks. On the one hand, acidification of slurry collected in shallow cellars under the slats and acidified in installations outside the barn. Emissions from the floor are not addressed. Acidification (6 kg gec. H2SO4/m3 manure) is said to reduce the ammonia emission by about 30% and methane emission by 16%. Acidification has been installed on about 70 dairy farms, but is at present applied on about 25 dairy farms and additionally by a few dozen pig farms. It mainly seems to suit large farms.

The dairy farm visited near Holsterbo had a circular manure chute 1.2 m deep, in which the acidified manure was pumped around. However, 60-70 cm of the depth could not be utilized because it was full of sediment. Understanding the nature of sediment and processes in the sediment seems to be further useful to be further explored.

Farms often forgo acidification because transporting manure to large biogas plants is increasingly an alternative. One reason is that manure acidified with sulphuric acid cannot be delivered to biogas plants because the development of some H2S inhibits the biogas production due to sulfate reduction.

In the Netherlands, acidification of urine fraction is more commonly considered than acidification of the manure storage. This would reduce the acid consumption and avoid additional sulfur fertilization. Moreover, we have deep cellars and the Danish acidifier system will be more difficult to fit in and, therefore, requires additional investment.

The other system is based on quick removal of the manure. The so-called solid drain floor is applied as a low-emission system. It is a concrete sloping floor with discharge of manure through a central gutter into an underlying narrow shallow gutter. In the gutter the slurry is drained and transported to an outside storage. In general, farmers prefer this system of the drain floor because the double-slide floor gives the same reduction in ammonia emissions as acidification (about 33%), and does not the input of acids and the corrosion problem as can be the case with acidification. Emission values in DK are expressed per m2 of production area (this includes bedding).

The solid drain floor can become slippery unless the system is combined with sand in the cubicles which is common in Denmark. A sand trap is then needed. This system suits solid floors and shallow cellars.

A pilot plant of N2 Applied was visited in Foulum. Manure is separated in urine and faces and only the liquid fraction is treated. Questions about how contact is established between

plasma and manure, temperature of plasma, possible by-products and possible effects of reactions with nitrogen oxide were yet not fully answered.

Capturing methane in the barn.

Dairy farming in Denmark mainly takes place without grazing. The barns have most times windows that can be opened and closed and an opening in the ridge. This way ventilation can be somewhat controlled and ventilation rates are relatively low compared to the most modern open housing facilities in our country.

Research is under way to capture methane from the housing facilities. Most methane production is from the cow. The methane box at the head end of the cubicle inspires to specifically capture air at the head end of the lying area or feed alley or combi as in a feed cubicle. Capturing air at a covered feeding conveyor is also an option.

Also at Wageningen University & Research, experiments are going on to capture methane close to the head of the cow. Adapted new ventilation techniques are necessary to support this.

We concluded that in neighboring countries lessons can be learned about manure management


LILMANN