

Figure 2. Two container-style manure reception tanks. Background: secondary digester tank. Left: manure truck



Torsten Fischer of Krieg + Fischer Ingenieure discusses an accident investigation where the addition of chemicals nearly destroyed the biology in the digester tank of a biogas plant in northern Germany

# Investigating the chemically-damaged biological system of a biogas plant

**T**orsten Fischer, founder and managing director at Krieg + Fischer Ingenieure, has been an expert legal witness for more than 10 years, covering 120 cases, and wrote his first report about a biogas plant accident more than 15 years ago. In this personal account, Fischer discusses a legal dispute between an investor and a farmer, exclusively for *Bioenergy Insight*.

## Setting

A typical German biogas plant: corn silage and manure as input substrates, digester tank, secondary digester tank, combined heat and power. The manure was provided by an external supplier. The plant was built in 2010. I was asked by an insurance

company to write a report about the cause of the damage following an incident in 2018.

## My reaction

Chemicals harmed a biological system? I only know about this from literature.

## The job

First, I visited the farm that supplied the manure to the biogas plant. It was a fairly small, family-operated business that bred and fattened pigs. The stables were operated in 'all-in all-out' mode, meaning the operation starts with small piglets all fed and slaughtered at the same time. After taking all the pigs out, the stable must be disinfected. This disinfection is usually done with chemicals and water –

this stream is usually kept in a separate storage tank.

Only 'clean' manure is trucked to the biogas plant, which was my second place to visit. For years, everything worked well, until once, the separation did not work and manure together with the chemicals and the wash water were driven to the biogas plant before being pumped into the digester tank. As a result, the biogas operation saw a severe drop in production.

## My report

On 29 August and 6 September 2018, the farm trucked approximately 120 cubic metres (m<sup>3</sup>) of contaminated manure to the biogas plant and pumped it into two reception tanks (see Figure 2). The biogas plant feeds approximately 8 m<sup>3</sup> daily

from there into the digester tank. On 7 and 8 September, biogas production collapsed. On 13 September, a sample from the manure was taken and sent to a laboratory for investigation. The result of the investigation was significantly reduced biogas potential. The only question left was: how severe is the damage?

## Investigation

Because the operator of the biogas plant reacted quickly, the supply of manure was stopped immediately, limiting the losses. A typical reaction is also to 'stabilise' a biological system with more manure. The manure came from a third party, supplied on 11 September. All-in-all, the operator needed around 700 m<sup>3</sup> of manure to properly 'heal' the biological system.

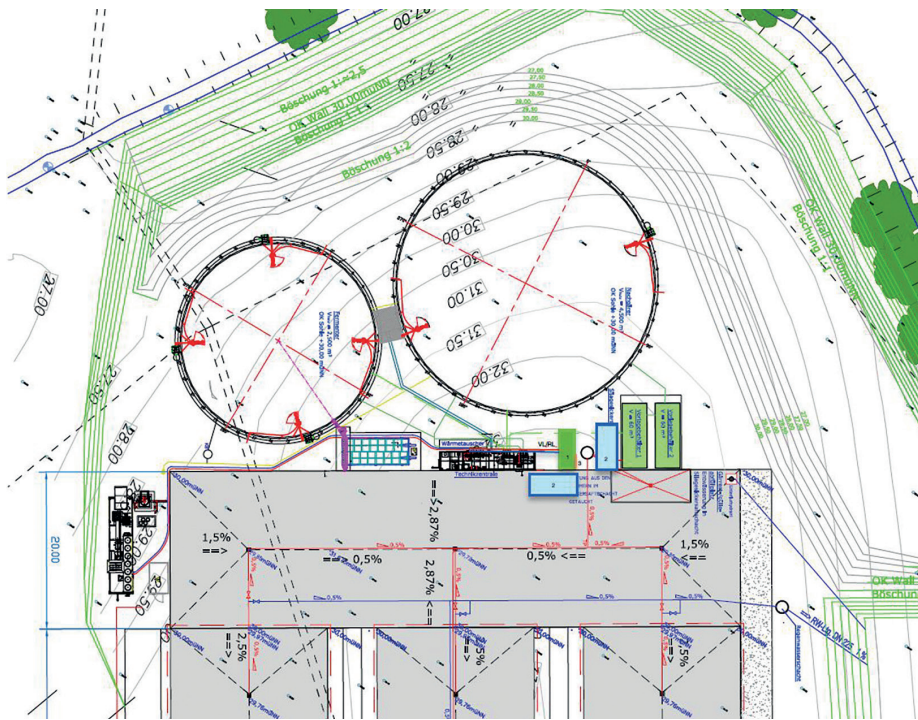


Figure 1. Extract from the site-layout drawing. Left side tank: digester tank; right side tank: secondary digester tank. Right-hand side below the secondary digester tank: manure reception tanks (green rectangles). Outside left: combined heat and power plant

During this period, less corn was fed. The costs for extra manure, in addition to the laboratory investigation and the reduction of electrical kWh supplied to the grid, minus the saved corn silage, resulted in a total damage value of roughly €23,000 net. While the costs for the laboratory and the foreign manure came from the related invoices and the reduction of the electrical kWh could easily be derived from the monthly settlements from the utility, it was more challenging to accurately calculate the saved solids. The result is shown in Figure 3.

The basis for the damage value was a simplification of the situation: on average, the total feeding of all solid input substrates before and after the accident was 24,600 kg per day. This is the baseline in Figure 3, which clearly shows the ups and downs in the period from end of August to mid-November 2018. In the early period when biogas production started to reduce the operator counteracted it by slightly increasing the amount of solid input substrates, approximately +24 tons of corn silage.

Between 8 September and

“...the biogas operation saw a severe drop in production”

18 October, the feeding was reduced. The savings during this period were equivalent to approximately 236 tons of corn silage. After 18 October, the operator fed an additional +67 tons of corn silage until the pre-accident biogas production level was reached again. In total, this amounts to approximately

145 tons of saved corn silage. The main damage came from the reduction of biogas, which accounted for nearly 80% of the €27,000 damage. The saved corn silage reduced the damage by about €4,000, resulting in a total sum €23,000 of damage.

It is clear biogas production from 1 ton of corn silage

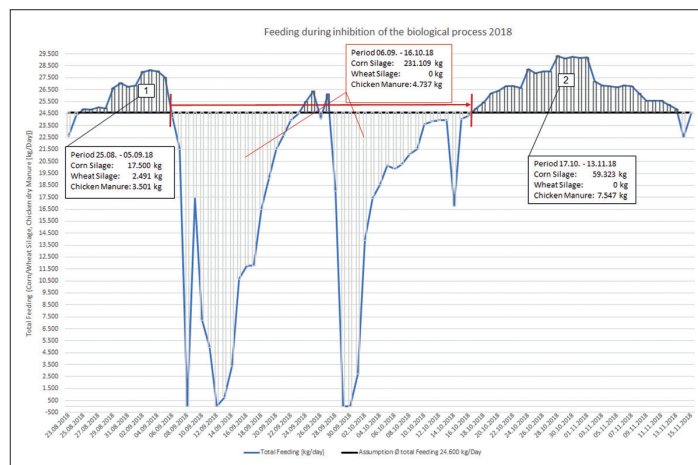


Figure 3. Interruption of feeding of solids (corn & wheat silage, chicken dry manure) in the period of biological problems until the recovery of the biological system in the digester tank

compared to 1 ton of wheat silage compared to 1 ton of chicken dry manure varies. In each case, it depends on TS and VS numbers and the age of the substrate and what it had cost the biogas plant operator to produce or receive the substrates. In such cases, it is my job to make a proposal that is acceptable for everyone. None of the participants opposed my calculation. The insurance was paid – job done.

### Conclusion

Stuff happens. This is why you had better have insurance cover.

### The fine print

If the operator of the biogas plant had waited for another two, three, or four days and kept on feeding contaminated manure, there might have been significantly higher damage than ‘just’ an inhibited biological system. I was impressed by his quick reaction.

### Lessons learned

Because the operator had a great overview and control of his operation, he stopped feeding of manure within one day. The logic is clear: you have two input substrates and if your corn silage is not the source of the problem, then it is the manure. But, being so consequent needs courage and a will to make decisions. ●

*Note: not all details have been presented in full and some elements have been simplified.*

### For more information:

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