

# Monitoring of a digester using the FOS/TAC ratio helped to solve a critical situation

## Problem

Ceres controls the operation of its digester by monitoring the FOS/TAC ratio (AGV/TAC). Following a spreading operation, the digester found itself in a critical biological situation, impacting the site's profitability.

## Solution

Thanks to the AT1000 Biogas Titrator and a reinforced monitoring of the FOS/TAC ratio, the recovery of the digester was controlled, in a short time, while guaranteeing the safety of the installation.

## Benefits

The use of the AT1000 Biogas Titrator allows an easy and instantaneous monitoring of the FOS/TAC ratio but also of other parameters such as pH or Redox. This allows the operator to effectively control a digester in all circumstances.



View of the digester

## Location

CERES, based in Germigny (France), has been operating a digester on a 5-hectare site since February 2020, at an investment of €6 million.

This installation processes agricultural materials from organic farming (grass, immature cereals, hay, etc.) produced by 25 local farmers within a 10 km radius.

The biogas produced is filtered and the biomethane obtained is injected into the Gaz de France network. The digestate is then used as a liquid fertiliser for organic farming. The future plan is to compress the biomethane and use it as a biofuel for all types of vehicles.

CERES is partnering with the local farming community for sustainable energy solutions.

## Operation of the digester

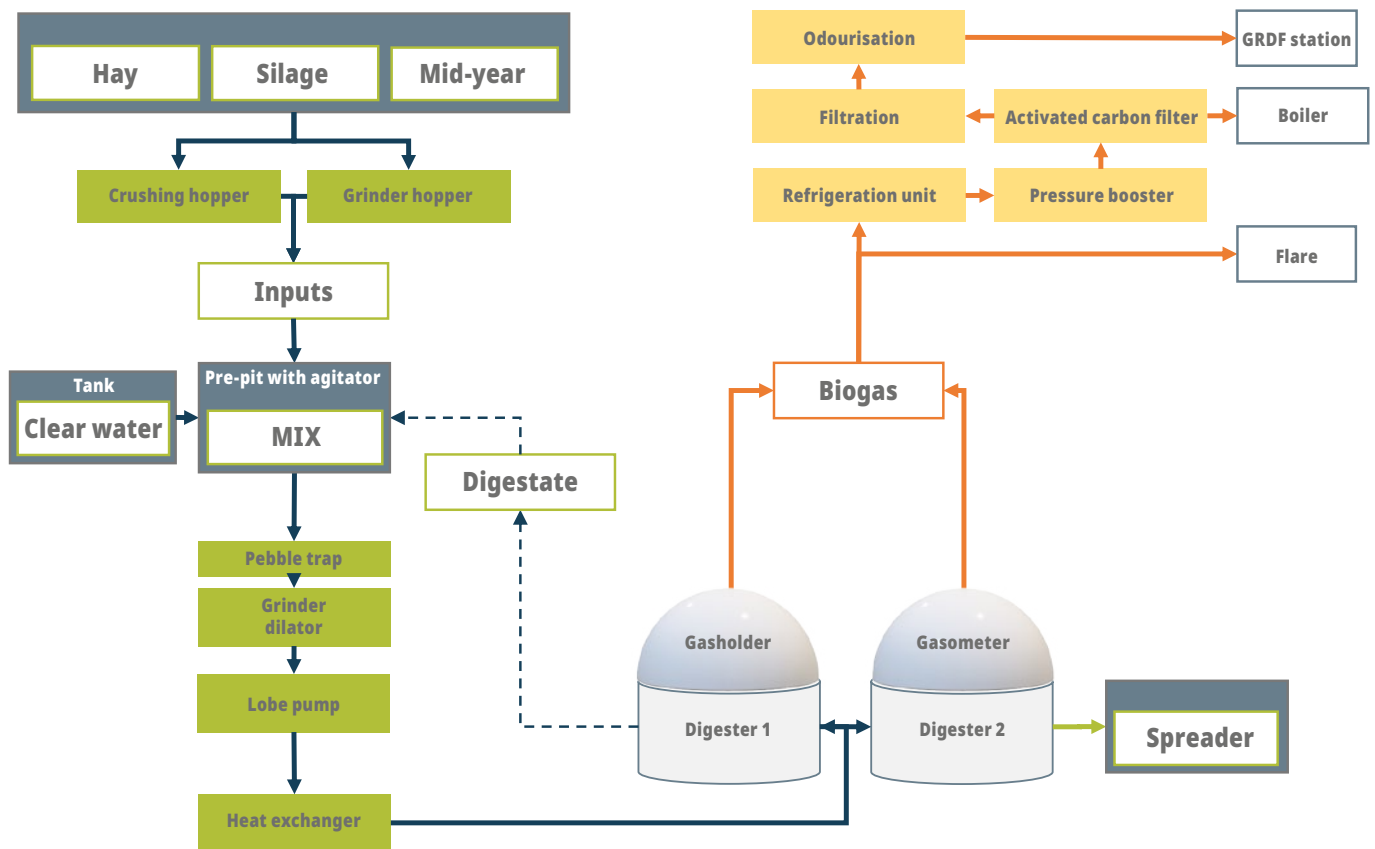
The installation digests up to 30 tonnes of material per day and produces 190 Nm<sup>3</sup>/h, i.e. the equivalent of the gas consumption of 3,000 inhabitants (1,000 kW electric).

As the inputs are variable, so is the organic load that enters the digester. Three times a week, the users take several samples to measure various parameters including the organic load, pH, ORP, FOS/TAC ratio (AGV/TAC) and temperature.

The FOS/TAC (VFA/TAC) ratio is one of the most important indicators for controlling the digester because it takes into account:

- Volatile Fatty Acids (VFA or FOS in German), which are essential for methane production but whose excess leads to a drop in pH that is toxic for methanogenic bacteria.
- Total Alkalinity (TAC), which indicates the buffer capacity of the medium, i.e. its ability to resist a variation in pH.

## CERES Diagram of the principle



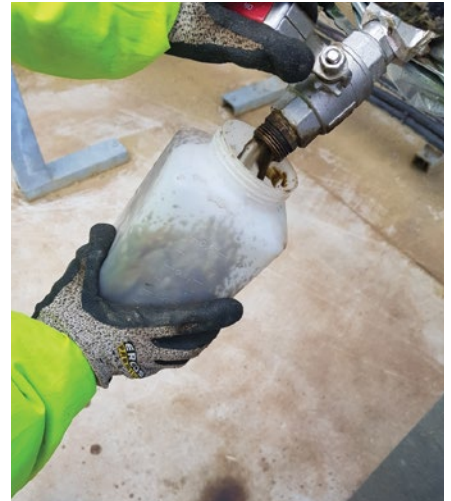
Digester diagram

## Operation of the digester

The FOS/TAC ratio is calculated by dividing the VFA by the TAC. If the VFAs increase but the total alkalinity in the medium is sufficient, the pH will not decrease significantly enough to put the digester at risk.

The FOS/TAC ratio can be easily monitored over time and interpreted using a table provided in the literature. The table below gives recommendations for feeding the digester according to the evolution of the FOS/TAC ratio. These recommendations are based on empirical studies of the operation of digesters.

Samples are taken from 3 different locations in the digester tank to check the homogeneity of the digestate and to modify the mixing if necessary. Measurements of pH, redox and FOS/TAC ratio are carried out on the Hach® AT1000 titrator which allows results to be delivered in a few minutes. The objective of the control is to always have a FOS/TAC value below 0.6 for a safe operation of the digester.



### Interpretation of the FOS/TAC ratio (empirical values according to Deula-Nienburg)

FOS/TAC Ratios	Background	Suggestion/Counter Action
>0,6	Highly excessive biomass input	Stop adding biomass
0,5-0,6	Excessive biomass input	Add less biomass
0,4-0,5	Plant is overflowing	Monitor the plant more closely
<b>0,3-0,4</b>	<b>Biogas production at the maximum</b>	<b>Keep biomass input constant</b>
0,2-0,3	Biomass input is too low	Slowly increase the biomass input
<0,2	Biomass input is far too low	Rapidly increase the biomass input



Sampling and measuring on the AT1000 titrator

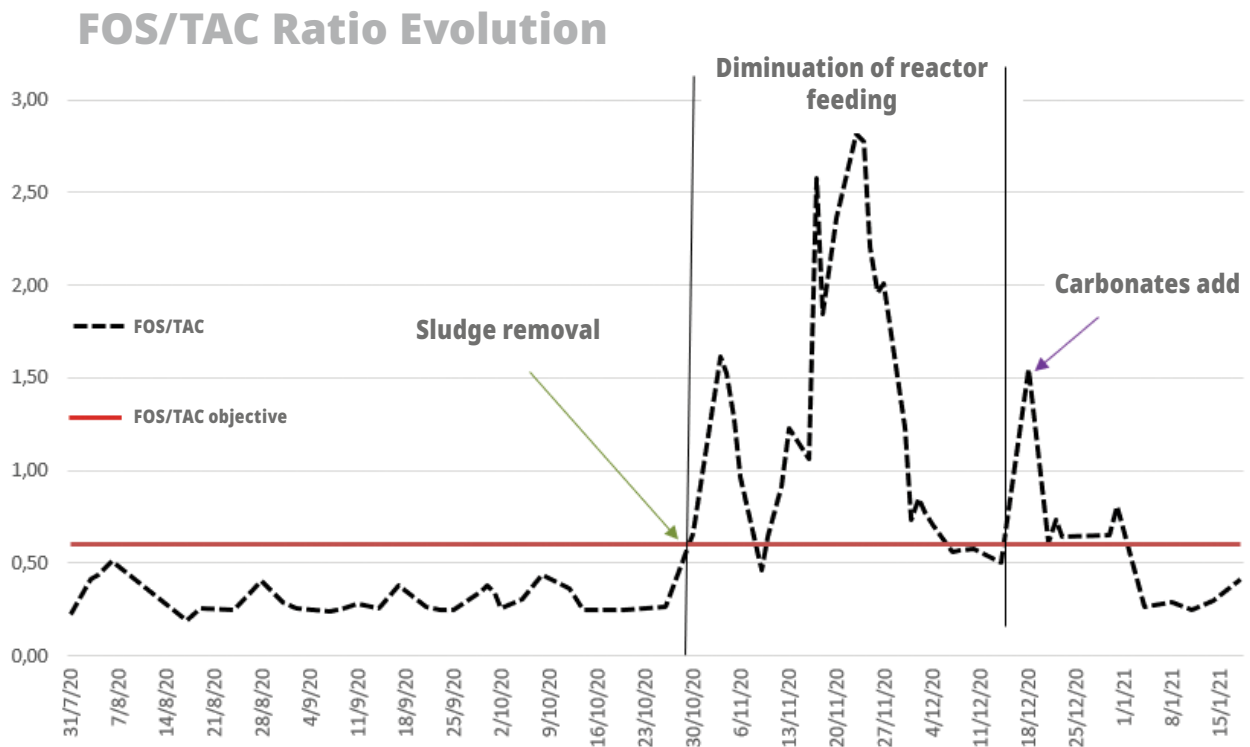
## The problem

Monitoring the FOS/TAC ratio was crucial during an incident that could have had serious consequences.

CERES has only one tank which serves as a digester and digestate storage. It is therefore oversized. On the other hand, at the end of the autumn spreading operation, the operator noticed an increase in FOS/TAC. The application of too much methanogenic bacteria unbalanced the bacterial populations and the digester began to acidify. The FOS/TAC ratio very quickly showed this anomaly by rising above the limit value of 0.6. If the feed was not stopped immediately, the risk was that all the methanogenic bacteria would be killed and the tank would have to be emptied and reseeded. This would have meant 3 months of downtime.

## The solution

To get the digester back to full efficiency as quickly as possible, the users took very frequent measurements of the FOS/TAC (2 to 3 times a day) with their AT1000 titrator. They adjusted the inputs as closely as possible in order to feed the digester according to the evolution of its capacity. Thanks to this monitoring, the time required to bring the digester up to full capacity was reduced to a minimum, without taking any risks, with a return to normal in early December. In mid-December the FOS/TAC ratio also increased but the acidosis was quickly controlled by adding carbonates.



Monitoring of the FOS/TAC ratio with the AT1000 titrator

## Conclusion

I am an agricultural engineer and operator of biogas plants. During these years I have noticed that many digesters are fed below their capacity to avoid the risks of acidosis.

I have been using the FOS/TAC ratio since 2009 to monitor the digesters within my operational control. It is an easy-to-measure and simple-to-interpret parameter to manage a digester efficiently, i.e. to obtain maximum profitability, without taking risks. Unlike other parameters, it allows us to see the dynamics of fermentation and to anticipate the onset of acidosis several days in advance.

At the Germigny site, the AT1000 Biogas Titrator is utilised by all the operators because it is very easy to use, reliable and inexpensive. It is useful when commissioning digesters, changing ratios and ensuring that the biological process is under control without being overly cautious.

As it is versatile, we also use it to measure pH and redox.



M. Viaut - Manager of Ceres