

## 1. Online biosensor for anaerobic digester

<b>Title and name of product or technology</b>
Ecofys Digester Monitoring System
<b>Abstract</b>
<p>The EDMS targets the commercial development of a new process sensor for anaerobic digesters. The sensor is an advanced process monitor consisting of an electronic sensor device connected to a digital processing unit. The EDMS translates a biochemical process parameter (derived from the bacterial/biochemical processes which take place in a digester) into an electronic signal that can be processed, transmitted and integrated into an operator supervisory monitoring system.</p> <p>The sensor can predict the failure of an anaerobic digester and can also be used for daily operational management. No such devices are available on the market as yet. The current accepted practice for digester monitoring is by sampling, followed by laboratory analysis (e.g. of Volatile Fatty Acids and Total Alkalinity) in conjunction with pH, temperature, gas production and composition. Not only is the current practice intensive in operating cost, it is also slow as there is a delay of at least several hours between the moment of sampling and the process information becoming available for making a control decision. For high-rate processes such as UASB and EGSB applications this could be a critical time.</p> <p>An on-line process monitor provides real-time information and also reduces the operating cost through the availability of real-time process information. Many attempts to develop an on-line process monitor have been confined to university research. Most attempts to predict digester failure have been restricted to measurement of parameters (such as hydrogen, carbon monoxide and F420 cofactors etc) that issue a warning at the moment that it is 'already too late', so this type of sensors do not have any predictive value.</p> <p>The EDMS Digester Monitoring System is intending to change this.</p>
<b>Description including main features/advantages</b>
<p>The main benefits of the EDMS are in the better utilization of installed capacity (improved return on investment) and reduced operating costs</p> <p><i>Better utilization of installed digester capacity</i> Getting more out of an existing digester. Because of the difficulties often experienced in monitoring of digesters many systems are over-designed so that they operate at sub-optimal loading rates. The EDMS will allow for higher loading rates (near optimal) and thus signifying a better utilization of installed plant capacity.</p> <p><i>Lower operating cost</i> Many digestion plants (e.g. co-digesters) are not large enough in capacity to justify the appointment of qualified personnel for routine monitoring. As a result digesters are operated by technicians or farmers with very limited knowledge of digester operation management. This could lead to undesirable situations and digester instability as a result of inadequate monitoring.</p> <p><i>Remote monitoring of un-manned installations: co-digesters, sewage sludge digesters and anaerobic wastewater treatment plants</i> The EDMS allows the connection of remote digesters to existing Supervisory Control and Data Acquisition systems and Man Machine Interfaces (MMI) (Beeldscherm Besturingssystemen in Dutch). This would be very beneficial for power generating organizations with ownership of multiple digesters located at distributed locations.</p>
<b>Innovative aspects</b>
<p>The sensor measures the transfer of biochemical compounds which takes place between different groups of bacteria that are active in the anaerobic digestion process.</p>

When a digester becomes overloaded, the transfer rate of such biochemical components becomes saturated leading to accumulation intermediates. The sensor determines the current rate of transfer of intermediates as well as the saturation point. The operation of the sensor system can be compared with a speedometer in an unknown car. The driver sits in the car but doesn't know either the current speed nor the maximum speed of the car. The sensor determines the maximum speed of the car as well as the relative scale position of the current speed in comparison with the maximum speed of the car.

For digesters this translates into the current loading rate to the digester relative to the maximum attainable organic loading rate. Is the ratio low, then it means that the digester operation is very stable and that there is capacity to increase the organic loading rate. Is the ratio high then the (near) maximum loading rate of the digester has been reached and the digester runs the risk of becoming unstable or overloaded.

**Current and potential industrial users/domains of application**

The EDMS can be applied to both low-rate as well as high rate processes:

- Completely Stirred Tank Reactor (e.g. co-digestion and sewage sludge digestion)
- Anaerobic Lagoon Systems (e.g. industrial wastewater treatment)
- UASB (Upflow Anaerobic Sludge Blanket)
- EGSB (Expanded Granular Sludge Blanket)

**Current state of development**

A proof of Principle is build and a patent application is filled. Prototypes, testing and final design of the sensor still needs to be done.

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