

Biogas production - a complex process

Biogas is the end product of an aerobic decomposition process. This process can be divided into four distinct phases. During each phase, various microorganisms and a range of enzymes work symbiotically.

Biogas is produced in four phases

In a first step, known as the hydrolysis process, carbon hydrates are broken down into simple sugars, proteins into amino acids, and fats into fatty acids. The products of the **hydrolysis** undergo an acidogenic process (**acidogenesis**) where organic acids and low alcohols are produced. The subsequent acetogenic process (**acetogenesis**) leads to the production of methane. The products of the acidogenic process are converted into acetic acid, carbon dioxide and hydrogen, which are the compounds required for the methanogenic process (**methanogenesis**). If the process is well balanced, these phases are synchronised.

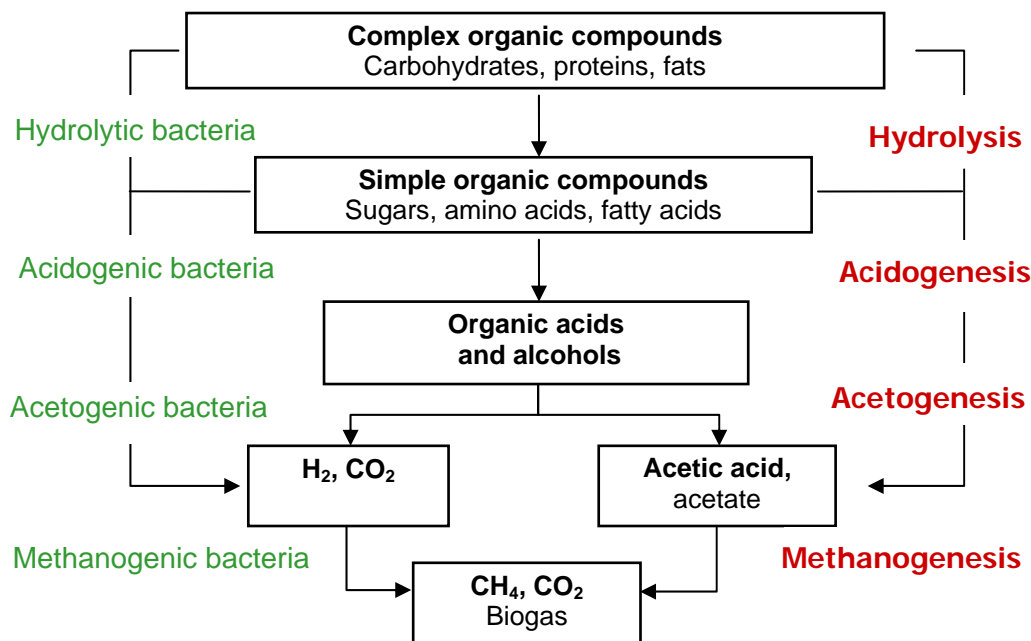


Fig. 1: Conversion of fermentation substrate to biogas

Optimised nutrient supply ensures smooth processing

In order to ensure that the above processes are completed properly, stable process conditions must be established. The supply of nutrients and essential trace elements to the microorganisms involved in the processes is thereby a key factor.

Trace elements are vital for the production of cellular material, and in particular for the production of enzymes and coenzymes, which in turn act as versatile catalysts for individual reactions in the processes described above. The production of methane from CO₂ and H₂ for example involves seven different enzymes and three coenzymes.

Just the right amount - getting the nutrient balance right

The fermentation process is governed by Liebig's "Law of the Minimum". It states that, if there is a deficiency of only one nutrient, it is not possible to achieve potential yield, as this nutrient is the limiting factor. On the other hand, it has been shown that excess availability of minerals can have a toxic effect on microorganisms.

For some elements, the optimum supply and toxic quantities are however very close to each other, accurate analysis and precision dosing of the trace elements is required to achieve optimised methane production. From the point of view of soil protection, excess concentrations of micro and macro-nutrients should be avoided in order to prevent damage to the environment.

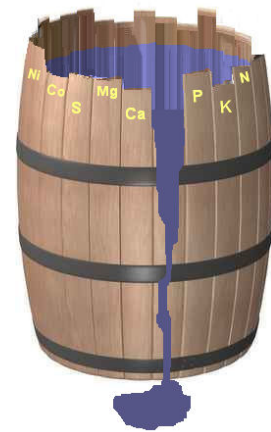


Fig. 2: Liebig's barrel