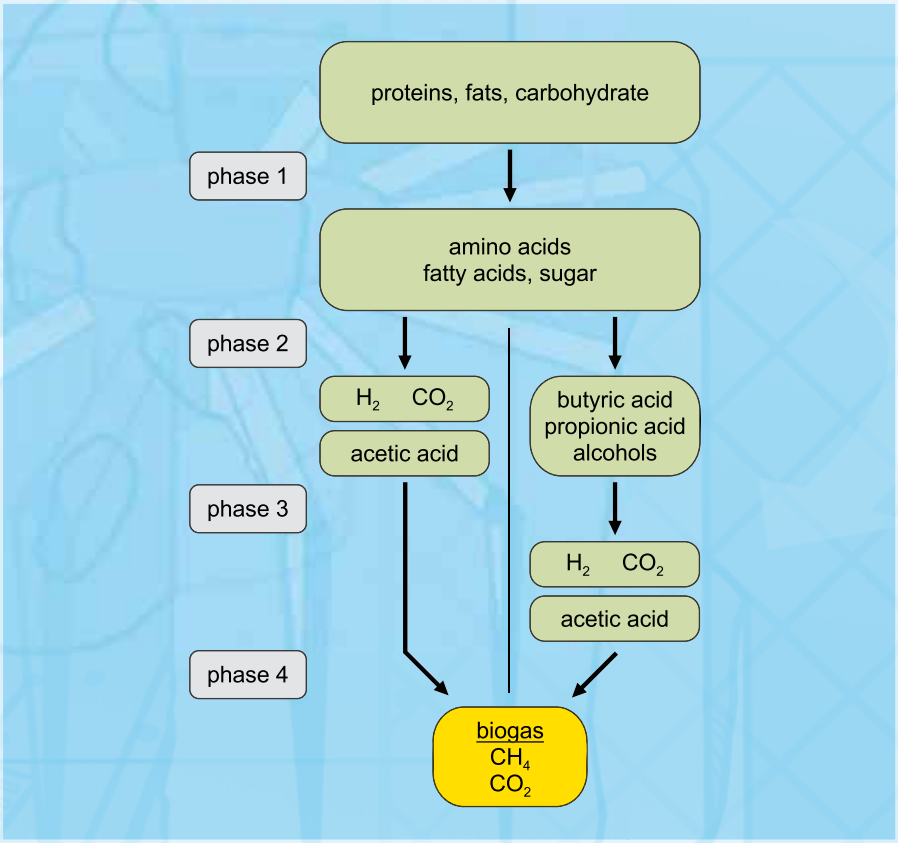
BASIC KNOWLEDGE

ANAEROBIC PROCESSES

In contrast to the aerobic processes, the anaerobic degradation of organic substances takes place in the absence of oxygen. The anaerobic microorganisms use the organic substances as a source of nutrition, and so degrade them. This produces biogas, mainly comprised of methane (60 %) and carbon dioxide (35 %). Biogas can be used as an energy source. The complex processes involved in anaerobic degradation can be simplified by dividing them into four phases (illustration). The metabolism is carried out in eech phase by different microorganisms.

Anaerobic processes are suitable for wastewater with very high concentrations of organic substances, such as occur in the food and paper industries. They are also often employed upstream of an aerobic process such as the activated sludge process.



Fundamental principle of anaerobic degradation

■ Phase 1: Hydrolysis

Long-chain, often undissolved substances such as proteins, fats and carbohydrates are converted into dissolved species such as amino acids, fatty acids and sugar.

■ Phase 2: Acidification

Acid-forming microorganisms convert the hydrolysed substances into short-chain organic acids such as butyric acid, propionic acid and acetic acid. Small quantities of hydrogen and carbon dioxide are also produced.

■ Phase 3: Acetic acid formation

Methane (CH_4) can be produced by methane bacteria using acetic acid or hydrogen and carbon dioxide. Therefore acids and alcohols produced in phase 2 first have to be converted into acetic acid.

■ Phase 4: Methane formation

Methane bacteria produce methane using hydrogen, carbon dioxide and acetic acid.

The microorganisms of the individual phases place different demands on the ambient conditions. This relates especially to the pH value and the temperature. Accordingly, the first two and last two phases are each consolidated into one stage (table).

Ideally, therefore, the process should take place in stages, in two separate reactors. All four phases can also, in principle, take place in a single stage in one reactor. A compromise must then be found with regard to the ambient conditions, resulting in a lower degradation rate. The microorganisms of the first two phases can undergo metabolic processes both with and without oxygen. The microorganisms of the third and fourth phase, by contrast, are strictly anaerobic, and react very sensitively to oxygen and fluctuating pH values.

parameters	stage 1 phase 1 + 2	stage 2 phase 3 + 4
pH value	5.2 ... 6.3	6.7 ... 7.5
temperature	25 ... 35 °C	35 ... 60 °C