Motivation

Dutch water boards have expressed a strong incentive to improve the energy efficiency of their wastewater treatment plants. This incentive could be met if sewage organic matter is converted into the energy carrier methane. The aerobic sludge process has been the most common treatment technology for sewage during the last decades, mainly because it is robust and provides an effluent quality that meets the discharge demands. However, the activated sludge process hardly can be considered a sustainable technology: it largely destroys the potential energy of the organic compounds present in the sewage, while at the same time it consumes energy for aeration. Therefore a new process has to be developed to efficiently use the energy present in the sewage and convert it into an utilizable energy carrier.

Technological challenge

In the activated sludge process microorganisms metabolize the carbon organic matter present in the wastewater to produce more biomass. Microorganisms grow on the dissolved and readily available organic matter and will produce bioflocculants to further flocculate the waste solids via polymers such as extracellular polymeric substances. The membrane bioreactor (MBR) process combines the biological degradation step done by the microorganism with direct solid-liquid separation by membrane filtration. The MBR process offers a process that could produce higher quality effluent compared to conventional treatment process and requires a much smaller footprint.

Methane is produced under anaerobic conditions. Anaerobic treatment is common in practice, but limited to high-strength (typically >1000 mg/L of COD) and warm (typically >20 °C) industrial wastewaters. With an appropriate pre-concentration step for suspended and colloidal organic matter, anaerobic treatment technology could also provide a suitable treatment technology under moderate climate conditions.

The technological challenge is to develop a treatment system which combines a high loaded MBR bioflocculation process with the production of methane under anaerobic conditions (figure 1).

Fig. 1 Aerobic bioflocculation combined with anaerobic methane producti