

Schematic representation of UASB reactor for the treatment of domestic wastewater. .



Top view of Mirzapur UASB plant. The UASB reactors are located largely underground.

# Anaerobic wastewater treatment

## Anaerobic wastewater treatment for industrial and domestic wastewater

**Anaerobic wastewater treatment differs from conventional aerobic treatment in that no aeration is applied. The absence of oxygen leads to controlled anaerobic conversions of organic pollutants to carbon dioxide and methane, the latter of which can be utilised as energy source. The main advantages of anaerobic treatment are the very high loading rates that can be applied (10 to 20 times as high as in conventional activated sludge treatment) and the very low operating costs. Anaerobic treatment often is very cost-effective in reducing discharge levies combined with the production of reusable energy in the form of biogas. Pay-back times of significant investments in anaerobic treatment technologies can be as low as two years. Anaerobic treatment of domestic wastewater can also be very interesting and cost-effective in countries where the priority in discharge control is in removal of organic pollutants.**

### Industrial wastewater

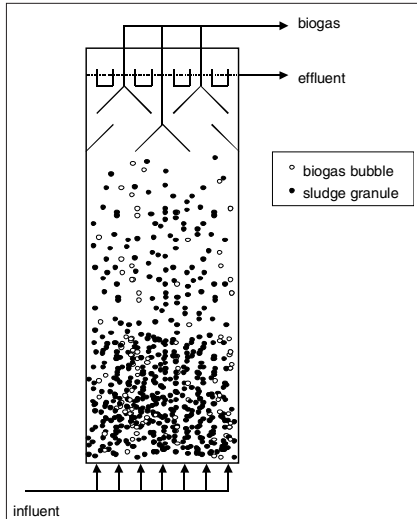
Anaerobic treatment of wastewater is very well suited for industries discharging highly concentrated (over approximately 1,500 mg COD/l) wastewaters, with nitrogen concentrations that are not too high. The food and food processing industry, beer breweries, soft drink producing factories and paper producing or processing factories, and some chemical industries all discharge wastewaters of this type. Several modifications of the UASB concept have been developed. Expanded

granular sludge bed reactors are a hybrid between fluidized bed and UASB reactors. For some effluents, especially those with little pollution or low temperatures, this type of reactor is extremely useful. Royal Haskoning has in-depth knowledge of both conventional as modified UASB processes. It has developed calculation methods to compute costs and cost-effectiveness for various treatment systems. It has also been involved in the design of a number of UASB plants, as well as in the development in new reactor types.



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Schematic representation of UASB reactor.

reactor technology offers a simple and effective way of reducing organic pollutant emissions. Today, UASB technology for domestic wastewater treatment has been implemented in India, Pakistan, China, Columbia, Brazil, Indonesia and Egypt. With investment costs as low as • 50,- per capita, and operational costs virtually only related to pumping energy and personnel, the technology is often considered the most cost-effective in organic pollutant removal. Some of these plants use the biogas that is generated from the conversion of the pollutants. The energy generated is more than sufficient for their energy demand.

tion plant of this type in Cali, Colombia, over the years 1982-1986. To date, Royal Haskoning has been involved in the design and construction of a number of these plants in India, Pakistan, Columbia and Egypt. The capacities of these plants range from moderate (8,000 m<sup>3</sup>/day) to downright huge (200,000 m<sup>3</sup>/day).



Construction of Kanpur UASB reactors.

### Domestic wastewater

Anaerobic treatment of domestic wastewater can be very interesting and cost-effective in countries where the priority in discharge control is in removal of organic pollutants. An important prerequisite is that wastewater temperatures should not be lower than 15 °C in the coldest months. The UASB reactor acts as a primary clarifier, a bioreactor and a sludge digester combined. Therefore, the sludge produced can be dried directly without any further treatment. In many tropical countries, UASB

### Modular construction

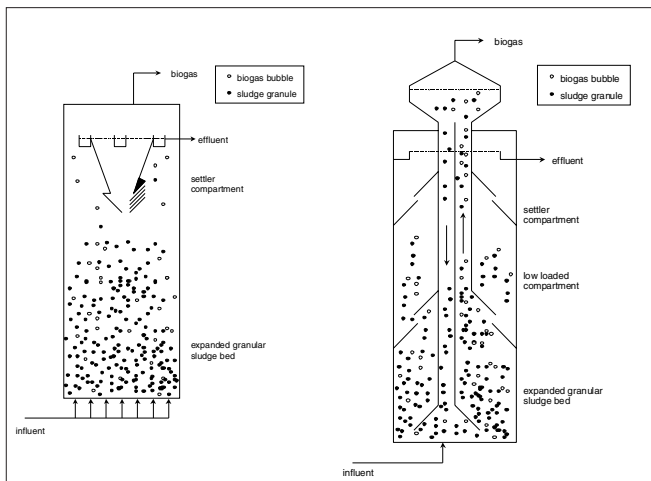
UASB reactors can simply be constructed in a series of identical modules. This allows for treatment schemes in which future expansion simply can be included. By constructing extra reactors, the capacity can be extended without many difficulties.

### Royal Haskoning

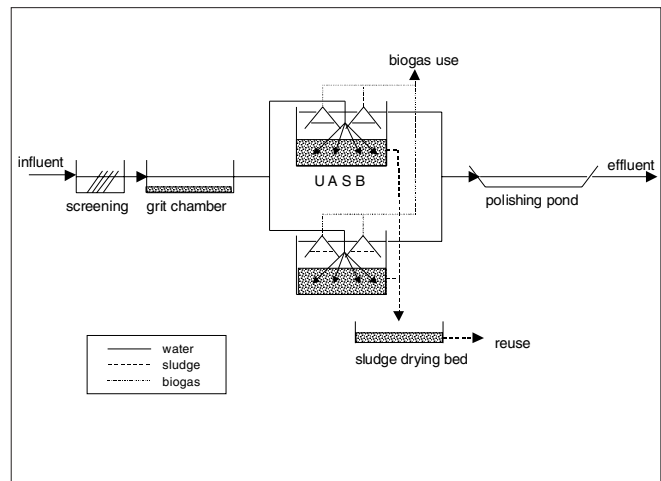
Royal Haskoning has contributed significantly to this development. It has designed, constructed and operated the world's first demonstra-

### Perspective

In the future, discharge standards are likely to shift from removal of organic pollutants to the inclusion of removal of nutrients. Appropriate technologies can be included in a treatment scheme to allow for more efficient removal of nutrients. The inclusion of polishing ponds, oxidation ditches and trickling filters may solve these problems for a large part.



Different types of UASB reactor modifications.



Inclusion of UASB in treatment plant.

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