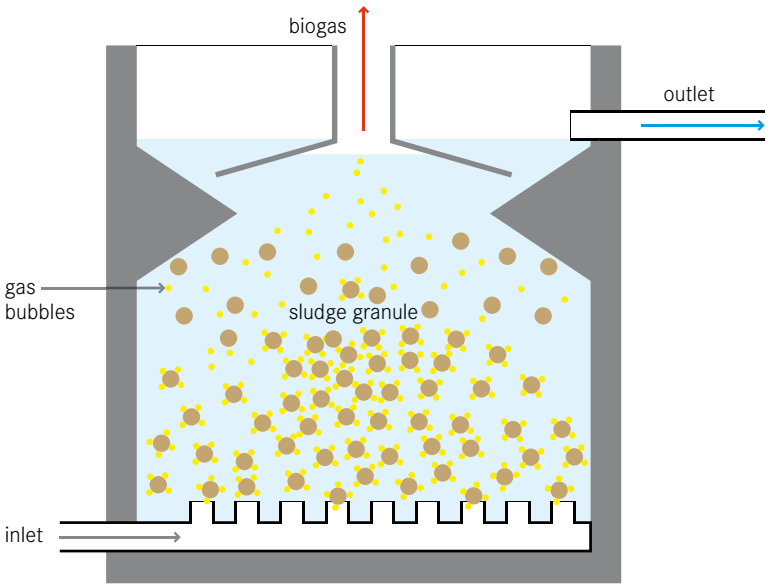
T.11 Upflow Anaerobic Sludge Blanket Reactor (UASB)

Applicable to: **Systems 1, 6-9**

Application Level:	**Management Level:**	**Inputs:** Blackwater Brownwater (+ Greywater)
Household Neighbourhood City	Household Shared Public	**Outputs:** Effluent Sludge Biogas



The upflow anaerobic sludge blanket reactor (UASB) is a single tank process. Wastewater enters the reactor from the bottom, and flows upward. A suspended sludge blanket filters and treats the wastewater as the wastewater flows through it.

The sludge blanket is comprised of microbial granules (1 to 3 mm in diameter), i.e., small agglomerations of microorganisms that, because of their weight, resist being washed out in the upflow. The microorganisms in the sludge layer degrade organic compounds. As a result, gases (methane and carbon dioxide) are released. The rising bubbles mix the sludge without the assistance of any mechanical parts. Sloped walls deflect material that reaches the top of the tank downwards. The clarified effluent is extracted from the top of the tank in an area above the sloped walls.

After several weeks of use, larger granules of sludge form which, in turn, act as filters for smaller particles as the effluent rises through the cushion of sludge. Because of the upflow regime, granule-forming organisms are preferentially accumulated as the others are washed out.

Design Considerations Critical elements for the design of UASB reactors are the influent distribution system, the gas-solids separator, and the effluent withdrawal design. The gas that rises to the top is collected in a gas collection dome and can be used as energy (biogas). An upflow velocity of 0.7 to 1 m/h must be maintained to keep the sludge blanket in suspension. Primary settling is usually not required before the UASB.

Appropriateness A UASB is not appropriate for small or rural communities without a constant water supply or electricity. The technology is relatively simple to design and build, but developing the granulated sludge may take several months. The UASB reactor has the potential to produce higher quality effluent than Septic Tanks (S.9), and can do so in a smaller reactor volume. Although it is a well-established process for large-scale industrial wastewater treatment and high organic loading rates up to 10 kg BOD/m^3/d, its application to domestic sewage is still relatively new. It is often used for brewery, distillery, food processing and pulp and paper waste since the process typically removes 80 to 90% of COD. Where the influent is low-strength or where it contains too many solids, proteins

or fats, the reactor may not work properly. Temperature is also a key factor affecting the performance.

Health Aspects/Acceptance The operators should take proper health and safety measures while working in the plant, such as adequate protective clothing. Effluent and sludge still pose a health risk and should not be directly handled.

Operation & Maintenance The UASB is a Centralized Treatment technology that must be operated and maintained by professionals. A skilled operator is required to monitor the reactor and repair parts, e.g., pumps, in case of problems. Desludging is infrequent and only excess sludge is removed every 2 to 3 years.

Pros & Cons

+ High reduction of BOD
+ Can withstand high organic and hydraulic loading rates
+ Low sludge production (and, thus, infrequent desludging required)
+ Biogas can be used for energy (but usually first requires scrubbing)
- Treatment may be unstable with variable hydraulic and organic loads
- Requires operation and maintenance by skilled personnel; difficult to maintain proper hydraulic conditions (upflow and settling rates must be balanced)
- Long start-up time
- A constant source of electricity is required
- Not all parts and materials may be locally available
- Requires expert design and construction
- Effluent and sludge require further treatment and/or appropriate discharge

References & Further Reading

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(Good technical overview – Chapter 5)