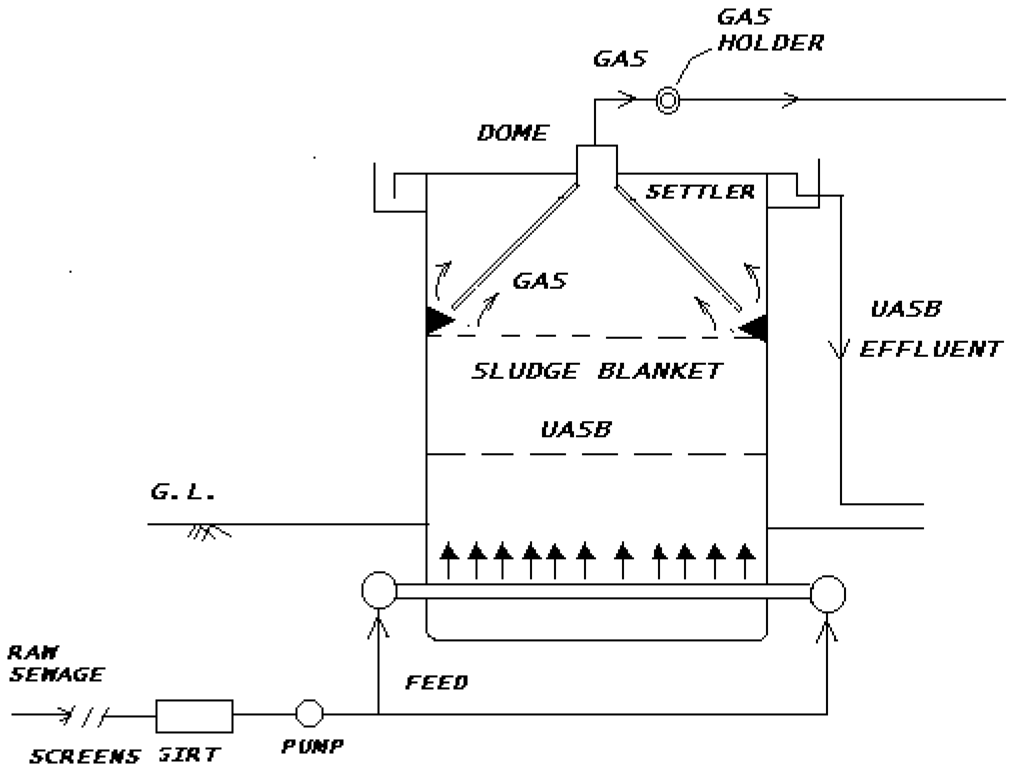
PROCESS DESCRIPTION



UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR

The schematic diagram of a typical UASB reactor is shown in Figure. UASB reactor has three major components *viz*. (1) sludge bed, (2) sludge blanket, and (3) three phase separator consist of Gas-Solids Separator (GSS) and settling compartment. The sludge bed is the layer of biomass settled at the bottom of the reactor. In this zone, the organic compounds in the influent are converted to end products, such as biogas and cellular biomass, as flow passes upward through a highly active biomass. Bulk of stabilization occurs in this zone. Very high sludge concentration is maintained in this zone, of the order of 60 to 100 g SS/L. On the top of sludge bed there exists a zone called as sludge blanket zone. The sludge blanket is a suspension of sludge particles (at lower concentration 2 to 5 g SS/L) mixed with gases produced in the process. Degradation of residual organic matter from sludge bed takes place in the sludge blanket zone. Mixing in this system is caused by the evolved biogas.

Gas is separated from the liquid by the Gas-Solid-Separator (GSS) device provided at the top of the reactor. The inverted cone acts as gas-solids separator, where the sludge is separated and the gas is released to the gas collector. The sloping bottom provided below the inverted cone allows the gas to pass only through the gas solids separator. Thus, a quiescent zone called the settler is maintained in the space outside the inverted cone and inside the outer walls of the reactor. This zone allows the separation of solids from liquid phase. Most of the sludge particles that have entered the settler compartment can settle back to the reactor, while the rest are washed out via the effluent. Thus, longer solids retention time is maintained in the reactor. The GSS device generally occupies 16-25 % of the reactor volume [Hashemian and James, 1990]. The settler volume affects the start-up and steady state performance of UASB reactor, because sludge recirculation is entirely depends on the functioning of the settler. Selection of adequate settler size and design to promote aggregation is utmost importance in process design [Hamoda and Berg, 1984].

This inbuilt arrangement in the UASB reactor has the following advantages:

- Sloping bottom of the settler serves as gas separator.
- No additional space is required for settling. The process can be carried out in the reactor plus settler forming one composite compact unit.
- The sludge separated in the settler can flow back directly in to the reactor without mechanical means, such as pump or scrapers, and
- The sludge is not exposed to alien environment as it remains within the system.

Due to slow growing characteristics of anaerobic bacteria, the washing out of sludge from the reactor effluent may result in decrease in amount of sludge inside the reactor and hence, deterioration of efficiency. To prevent this the quantity of washout sludge must be lesser than the sludge growth. This can be achieved by properly designing the settling compartment taking in to consideration the settling properties of the sludge.

To have better retention of the sludge inside the UASB reactor several modifications of the conventional UASB process have been tried. Improvement in sludge retention was observed by providing packing (support) material in the settler compartment in the UASB reactor. This process is named as combined UASB-Anaerobic filter process [Fiebig and Dellweg, 1985]. This arrangement is reported to have enhancing effect on granulation of the sludge. Providing the media layer at the top of sludge bed was also tried successfully [Lo *et al*., 1994]. Modification such as compartmentalized UASB reactor called as upflow staged sludge bed had also been tried successfully. The advantages offered by this arrangement are uniform effluent quality because of plug flow nature and also very less volatile fatty acids concentration in the effluent [vanLier *et al*., 1994].