BIOFILTERS

Biofiltration was first introduced in England in 1893 as a trickling filter for wastewater treatment and has since been successfully used for the treatment of different types of water. Biological treatment has been used in Europe to filter surface water for drinking purposes since the early 1900s and is now receiving more interest worldwide. Biofiltration is also common in wastewater treatment, aquaculture and greywater recycling, as a way to minimize water replacement while increasing water quality.

Biofiltration process

A biofilter is a bed of media on which microorganisms attach and grow to form a biological layer called biofilm. Biofiltration is thus usually referred to as a fixed–film process. Generally, the biofilm is formed by a community of different microorganisms (bacteria, fungi, yeast, etc.), macro-organisms (protozoa, worms, insect's larvae, etc.) and extracellular polymeric substances (EPS). The aspect of the biofilm is usually slimy and muddy.

Water to be treated can be applied intermittently or continuously over the media, via upflow or downflow. Typically, a biofilter has two or three phases, depending on the feeding strategy (percolating or submerged biofilter):

- a solid phase (media);
- a liquid phase (water);
- a gaseous phase (air).

Organic matter and other water components diffuse into the biofilm where the treatment occurs, mostly by biodegradation. Biofiltration processes are usually aerobic, which means that microorganisms require oxygen for their metabolism. Oxygen can be supplied to the biofilm, either concurrently or countercurrently with water flow. Aeration occurs passively by the natural flow of air through the process (three phase biofilter) or by forced air supplied by blowers.

Microorganisms' activity is a key-factor of the process performance. The main influencing factors are the water composition, the biofilter hydraulic loading, the type of media, the feeding strategy (percolation or submerged media), the age of the biofilm, temperature, aeration, etc.

Types of filtering media

Originally, biofilter was developed using rock or slag as filter media, but different types of material are used today. These materials are categorized as inorganic media (sand, gravel, geotextile, different shapes of plastic media, glass beads, etc.) and organic media (peat, wood chips, coconut shell fragments, compost, etc.)

Advantages

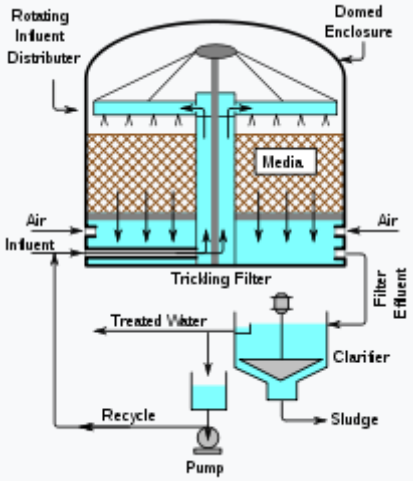
Although biological filters have simple superficial structures, their internal hydrodynamics and the microorganisms' biology and ecology are complex and variable.[6] These characteristics confer robustness to the process. In other words, the process has the capacity to maintain its performance or rapidly return to initial levels following a period of no flow, of intense use, toxic shocks, media backwash (high rate biofiltration processes), etc.

The structure of the biofilm protects microorganisms from difficult environmental conditions and retains the biomass inside the process, even when conditions are not optimal for its growth. Biofiltration processes offer the following advantages:

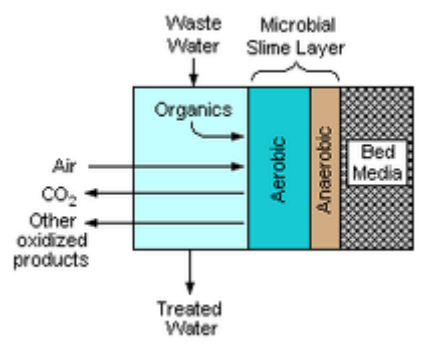
- Because microorganisms are retained within the biofilm, biofiltration allows the development of microorganisms with relatively low specific growth rates;
- Biofilters are less subject to variable or intermittent loading and to hydraulic shock;
- Operational costs are usually lower than for activated sludge;
- Final treatment result is less influenced by biomass separation since the biomass concentration at the effluent is much lower than for suspended biomass processes;
- Attached biomass becomes more specialized (higher concentration of relevant organisms) at a given point in the process train because there is no biomass return.

Drawbacks

Because filtration and growth of biomass leads to an accumulation of matter in the filtering media, this type of fixed-film process is subject to bioclogging and flow channeling. Depending on the type of application and on the media used for microbial growth, bioclogging can be controlled using physical and/or chemical methods. Whenever possible, backwash steps can be implemented using air and/or water to disrupt the biomat and recover flow. Chemicals such as oxidizing (peroxide, ozone) or biocide agents can also be used.



A typical complete trickling filter system for treating wastewaters.



A schematic cross-section of the contact face of the bed media in a trickling filter.