White Paper

Biological treatment of filamentous bacteria in biological wastewater treatment plants

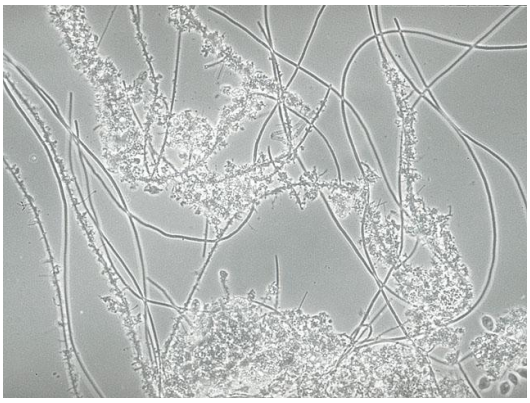
Biological wastewater treatment

The most widely used wastewater treatment process is activated sludge biological treatment. The performance of these systems depends on the microbial biomass composition and behavior. Poor biomass settling and foaming occur when "undesirable" microorganisms are prevalent in the biomass. Increased populations of filamentous organisms are an example of this. Although they are typically part of all indigenous biomasses, the uncontrolled propagation of these stringy microbes can cause major problems in activated sludge plant operation.

The Biology

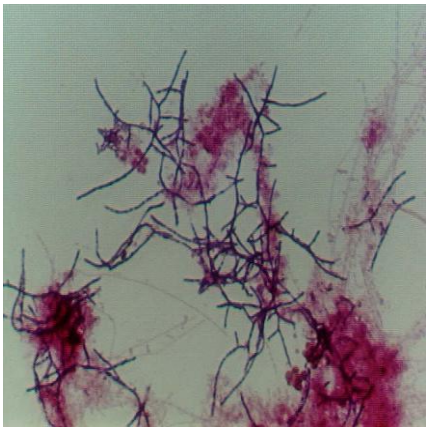
Filamentous organisms can be bacteria, fungi or algae whose cells have not detached following cell division or have "stretched" but have not divided. Filaments containing such cells occur frequently. In domestic wastewater treatment plants, there are more than 30 species of filamentous organisms. In industrial wastewater treatment plants, the number of species may be several times higher depending on the nature of the water being treated. Most species are bacteria.

Sphaerotilus natans



Type 0041

Nostocodia limicola III



Nocardia Sp.

Causes/Impacts

The proliferation of filamentous organisms typically occurs in particular situations or because of several factors that occur either singly or in combinations:

- Extreme weather conditions
- Equipment or process configuration changes
- Influent character variability, biocides
- Process shutdowns/restarts
- Shock organic loads or variable flow rates
- Excessive fat, oil, and grease(FOG) in the influent
- Septic influent (sulfides and volatile fatty acids)
- Excessive sludge age/low Food to Mass (F/M) ratio

Common problems faced by activated sludge plants "invaded" by filamentous organisms include:

- Persistent foam formation
- Poor settling (high sludge blanket, high suspended solids in effluent)
- Increase in polymer/floc aid consumption
- Decline in biomass activity
- Poor sludge dewatering – increased costs of sludge management
- Inability to control sludge age

Step-wise Solutions

When filamentous bulking occurs, detailed analyses of the wastewater system influent and biomass should be performed. Microscopic analysis of the mixed liquor and foam, if present, is recommended to identify the filaments present and to observe any floc formation problems.

With a diagnosis of the cause(s) of the problem, an application program for microbial bioformulas is determined, along with a process operation regimen. Addition of the bioformulas along with proper process operating practices reduce the favorability of the conditions for filamentous organism proliferation by increasing competition for food with non-filamentous species and/or by destabilizing their stringy filamentous structure.

Bioaugmentation products

Besides the traditional method of using flocculants to allow sludge to settle in the secondary clarifier, the use of bioaugmentation products in the biological section can help to restore the microbial balance inside the MLSS in which filamentous bacteria concentrations are reduced due to competition for food. Depending on the type of filamentous bacteria and its preferred food source MicroCat products can be added to the biological reactor to increase the consumption rate of these food sources by floc forming bacteria, thus reducing the number of filaments.