

## **HOW MICROORGANISMS HELP TO TREAT WASTEWATER**

At the Water Pollution Control Facility Laboratory, mixed liquor samples are analyzed microscopically, along with Total Suspended Solids (TSS,) 30 minute settling, and respiration rates. Microscopic examination can be as useful a tool for successful operation of the activated sludge system as these other tests. Much can be learned about the state of the aeration basins based on the type of protozoa and metazoans present. Other helpful information is the description of the floc size and shape, and type and amount of filamentous bacteria present.

In a healthy mixed liquor sample for the Water Pollution Control Facility, the microscopic examination should yield a predominance of stalked ciliates with moderate populations of other ciliates such as crawlers (creepers) or free swimmers. Other protozoa such as flagellates and amoebae should be found in small to scarce numbers. Although they are found in small populations, it is important that these other organisms be present with the ciliates in order to provide a more stable environment. For example, if an upset occurred that affected the higher life form, such as the D.O. dropping, a lower life form that can tolerate a low D.O. will survive.

The protozoa and metazoan have two important functions at a treatment plant. The first is to serve as indicator organisms to allow the viewer to determine the treatment level of the plant by microscopic evaluation. The second function is to clarify the effluent by feeding on the free bacterial cells in the solution that have not flocculated.

### **THE PROTOZOA**

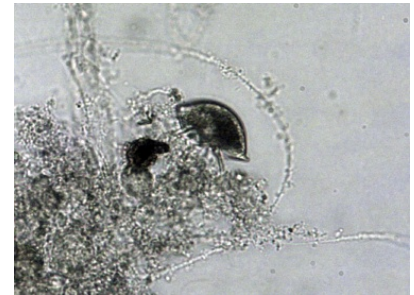
**Flagellates:** Flagellates are a group of primitive organisms, related to the amoebae. Flagellates get their name from "tail like" projections called flagella that extend from their bodies. The flagella are used for movement through the liquid. Like their relatives the amoebae, flagellates are present when there are large amounts of soluble food available (high food to microorganism ratio (F:M.)) They are found during start up when the sludge is young, or, perhaps after an upset. They will quickly predominate over the amoebae because they are mobile and are more efficient at encountering the food particles.

**Ciliates:** The Ciliates are more complex organisms than the amoebae and flagellates. They are classified as ciliates because of the tiny hair like projections called cilia that are found on their bodies. In examination of an activated sludge sample the three important groups of ciliates are stalked, crawling and free-swimming.

**Free-swimming ciliates:** Free-swimming ciliates are identified by the cilia that surround most or all of their bodies. Free-swimmers swim faster than flagellates so they can out-compete them for food. Free-swimmers are usually found when no large flocs have been formed so that it is easier to swim around.



**Crawling ciliates:** Crawling ciliates have cilia mainly on the lower surface of their bodies that make them appear to be legs. In order for crawlers to dominate there must be large flocs present that impede the free-swimmers and flagellates movement and provide a surface for the crawlers to "walk" on. This means the F:M is low and the bacteria have started to flocculate as a survival response. Crawlers also require a high D.O. content in the mixed liquor.



**Stalked ciliates:** Stalked ciliates feed on the stray bacteria cells. They are easily identified from other ciliates because the main body of the organism is attached to a stalk that is usually implanted in the floc. Stalked ciliates are very efficient feeders and will predominate when the ratio of food to microorganisms (F:M) is low. They also do best when there is a high concentration of dissolved oxygen in the water.



## THE METAZOA

**Rotifers:** Rotifers are very large as compared to other organisms. Unlike the protozoa, they are multicellular organisms. The rotifers are only found as the sludge age increases because it takes three days for their eggs to hatch, so if you waste 25% of your sludge a day you can lose 75% of the rotifer eggs.

**Nematodes:** Nematodes are also large in size as compared to the protozoa. Their reproductive cycle is longer than other micro organisms and therefore they more common when the sludge is retained longer, allowing for an older sludge age.

### **FILAMENTOUS BACTERIA**

Filamentous bacteria serve as the backbone of floc formation. These types of organism are long and thin resembling microscopic hair strands. Sludge settles most efficiently when it contains a moderate number of filaments which provide structure for the floc and aid in the stripping of the water column. The floc cannot form properly if there are too few filaments. An excessive amount of filamentous bacteria causes disperse, poor settling floc that will not compact properly on the bottom of the settling tank. The filamentous bacteria are analyzed in two ways: their effect on floc structure and their abundance.

