Start Up and Control of Filamentous Organisms in a Pulp and Paper Treatment Plant in Romania

Plant Start up using MICROCAT®-XP Pulp and Paper Bioformula and Filament Control using MICROCAT®-DF Defoamer and MICROCAT®-XF Microbial Filament Degrader

QM Case study 122

Introduction

Activated Sludge

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.

Filamentous Microbes – Poor Settling/Foam

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.

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 perfomed. 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.

Case Study

System Description

The wastewater treatment plant is composed of a “continuous” type activated sludge biological treatment system including the following:

- 2 buffer/equalization tanks with coarse aeration to prevent settling and anaerobic activity
- 2 biological treatment tanks, B1 and B2, in series, volume each 0.924 MG (3500 m^3)
- Settling and sludge recirculation tank with equipment dedicated for this purpose, type Zickert

- Dissolved air flotation unit (DAF) acting as a continuous clarifier for the biological step, installed after the biological step B2
- Sludge dewatering plant with decanter centrifuge.

Nutrients are added in both aeration tanks to ensure a C/N/P ratio of 100/5/1. Periodically micronutrients are also added (e.g. Fe, K, Mg) in order to create a healthy biomass. NaOH is added via automatic pH control. Influent wastewater temperature is highly influenced by the seasons and ranges from 15° C up to 28° C. The entire treatment process is automated with a SCADA system.

Thanks to the two buffer/equalization tanks and the careful monitoring on the part of the operational staff of the treatment plant, daily flow rates and loads in the wastewater treatment plant are kept relatively stable taking into account that the wastewater contains a large quantity of chemicals with biocidal properties.

About a year after plant start up and commissioning, an abundant foaming occurred in both aeration tanks. The cause was determined by microscopic examination of the biomass to be excessive proliferation of filamentous organisms. Low ambient temperatures, with values down to -25° C, favored the proliferation of filamentous organisms. This led to the formation of a thick foam crust that could not be eliminated using conventional chemical defoamers.

Program Sequence

1) In October of 2013, the first product application program was initiated to accelerate the startup of the plant and normalize the operating parameters.

2) A year later, the second application program was undertaken. The goal was to reduce filamentous populations, remove foam, and to prevent further foaming in the winter of 2014/2015.

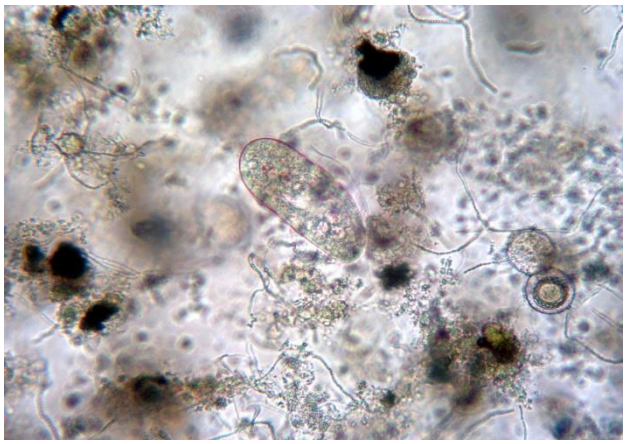
Procedure and Product Application

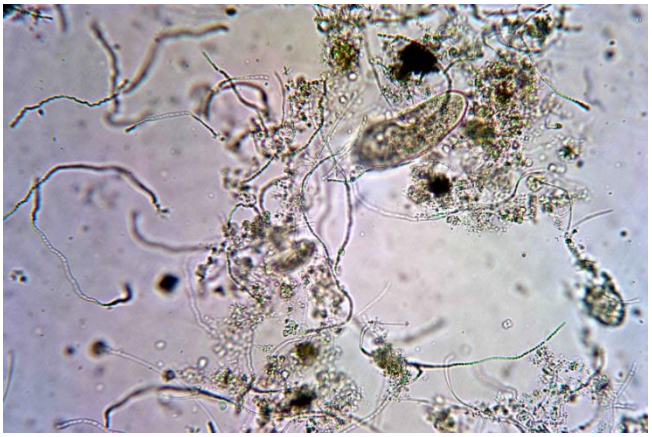
1. Plant start up/preventive maintenance

For wastewater treatment plant start up, a seed of MICROCAT - XP was added to the biological tanks. A daily preventive maintenance dosage of MICROCAT - XP was applied after start up.

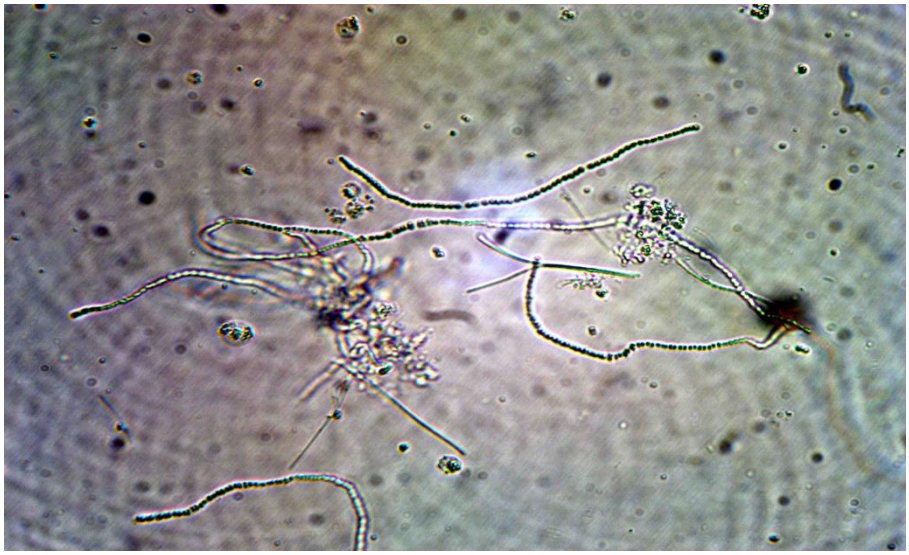
2. Foaming control and filamentous organism inhibition:

The filamentous populations present in the biomass were analyzed microscopically. Loose floc structures of small sizes characteristic of plants lightly loaded with organic substances (F/M < 0.05 kg/kg MLVSS) were observed and recorded. These structures may have indicated the presence of either poorly biodegradable or toxic substances in the wastewater, but could also be consistent with a nutrient imbalance. Within the floc particles, the filamentous bacteria (***Microthrix parvicella***) was seen in large numbers.





The presence of the filamentous species ***Microthrix parvicella*** is characteristic of wastewater treatment systems with low to medium organic loadings. Typically, this species is seen during the winter months when it is more likely to become dominant.



Paper making industry activated sludge plants seldom maintain ideal process conditions for preventing the multiplication of ***Microthrix parvicella***. Once the primary culprit was identified, the treatment program began. This consisted of:

1) Removing the crust, using MICROCAT - DF Biocompatible defoamer, and

2) The application of MICROCAT - XF Filament Degrader together with aluminum sulfate in the aeration tanks. This reduced the number of filamentous organisms and improved the settling characteristics of the activated sludge.

Results

1. Plant commissioning:

Despite the low prevailing ambient fall/winter temperatures, application of MICROCAT-XP Bioformula led to rapid plant startup and ensured microbiological stability. During the following winter, a minimum application of MICROCAT-XP and MICROCAT-XPCW Cold Weather (a cold season formula) bioformulas were used.

In May and June of 2014, the wastewater treatment plant was operating at government mandated parameters, while continuing with the preventive maintenance application of MICROCAT - XP and the basic nutrients.

2. Foaming control and filamentous organism inhibition:

Application of MICROCAT-DF Biodefoamer eliminated a significant portion of the foam, but the proliferation of the filamentous organisms continued due to the very low temperatures and the continued low organic loading on the plant.

In February 2015, application of MICROCAT-XF Bioformula started in aeration tank B1 with the simultaneous application of aluminum sulfate. Three weeks later, an organics reduction of about 50% was observed in the discharge from biological tank B1 and about 20% in the discharge from biological tank B2. After another 30 days, the reduction was over 80% in B1, and 50-60% in B2.

Current Activities

Work continues in the characterization and optimization of the biomass population in this treatment plant.

Conclusions

Excellent results were achieved in the plant treating wastewater from pulp and paper operations by using:

- MICROCAT-XP Pulp and Paper Bioformula at start up and for restart after process shutdowns,
- MICROCAT-DF Defoamer for foam control, and
- MICROCAT – XF Filament Degrader for filament control.

The rapid startup of the treatment plant provided three benefits: reduced energy costs, reduced chemical costs, and the plant quickly achieved operations consistent with government guidelines.

When there are flow and/or load variations and adverse temperatures, MICROCAT - XF application dampens filament infestation and prevents severe filamentous episodes in the plant. This reduces foaming and saves unplanned recovery costs and/or potential fines for out-of-compliance operations.