CAUSES OF FILAMENTOUS BACTERIAL BULKING IN THE AERATION TANK OF THE SWTP AND ITS CONTROL

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Filamentous bulking in the aeration tank may be caused by the excessive fat, oil, and grease coming through the paper mill water. The presence of abundant filamentous bacteria can reduce flock settling as reported by Pal, P. (2017). Normally, the additional discharge of sugar into the aeration tank could lead to rapid filamentous growth but with the long lasting effects (Foot & Robinson, 2003). Gas bubbles may also be found trapped under the filamentous bacterial bulking mat and enhance its floating.

Filamentous growth in the aeration tank of the Secondary Water Treatment Plant (SWTP) can easily be detected by calculating the Sludge Volume Index 30 (SVI30). SVI30 index depends on the two values such as 30-minutes settleability test result and the activated sludge Mixed Liquor Suspended Solids (MLSS) test result. The SVI30 values where the filamentous bulking begins varies from treatment plant to plant (Clifton, 1988). Filamentous growth causes major disruption and does not allow solids to settle down at the base of the clarifiers, thus causing the supernatant solution to be more turbid. Therefore, due to filamentous bacterial bulking, suspended solids laden waste water is a costly disposal option.

Currently, the upper limit of SVI30 for Opal's SWTP is 120 mL/g. The Sludge Volume Index (SVI30) of the aeration tank is measured twice a week. However, if the SVI30 values are higher than 120 mL/g, it is monitored daily until the rectification of trouble shooting. If we find the values of SVI30 are consistently higher than 120 mL/g for at least 3 days, then a microscopic analysis is conducted in Opal's Wet Chemistry Laboratory to ascertain the stage of the filamentous bacterial growth using the subjective scoring system per Jenkins et.al. (2004). After 3 days, upon filamentous growth confirmation, filamentous growth reduction treatment is applied. For this purpose 12.5% sodium hypochlorite @ 15 L/hour was found effective to overcome the excessive filamentous bulking in the aeration tank without killing the microbial population.

Filamentous bulking at the start of sodium hypochlorite dosing is shown in figure 1 and the reduction of filamentous growth after the 1 week of treatment application is shown in figure 2. Figure 3 shows the effectiveness of hypochlorite treatment after 12 days with the reduction of sludge volume index to 59 mL/g. It is suggested to apply this dose through the sludge recirculation line and not directly into the aeration tank to avoid the excessive disruption to the microbes. The application of sodium hypochlorite may prolong up to 2 weeks or more depending on the phase of the filamentous bulking in the aeration tank.

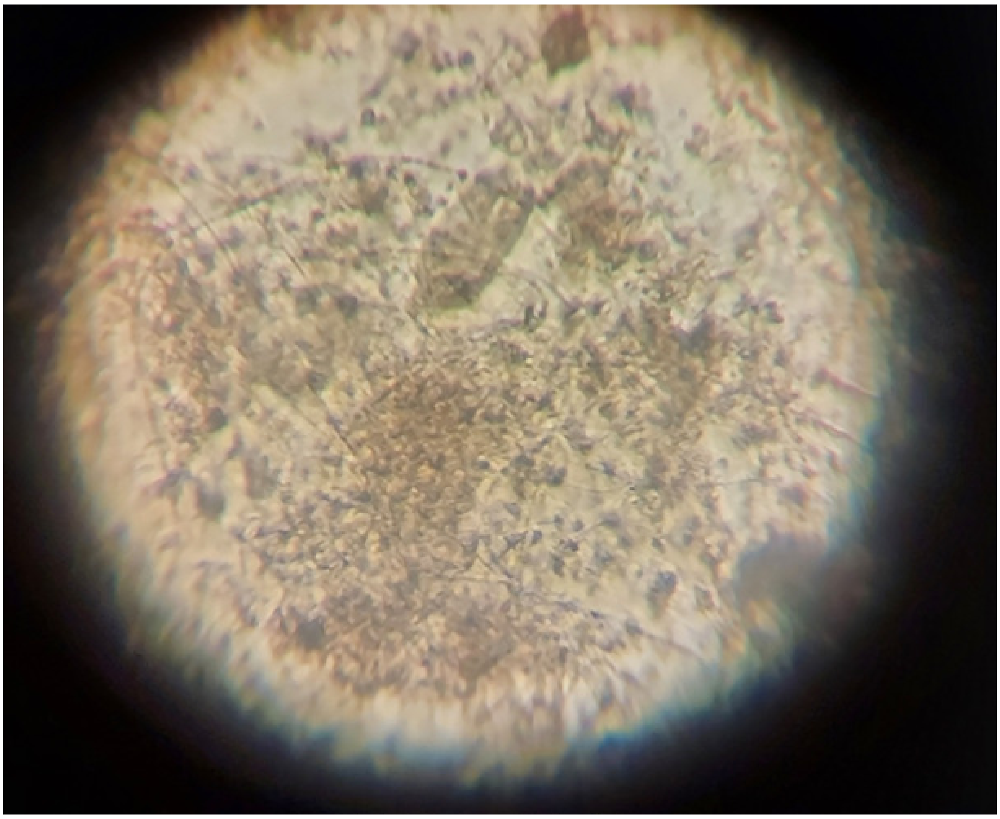

Figure 1: Filamentous bacterial growth in the MLSS sample under the compound microscope at the start of sodium hypochlorite treatment.

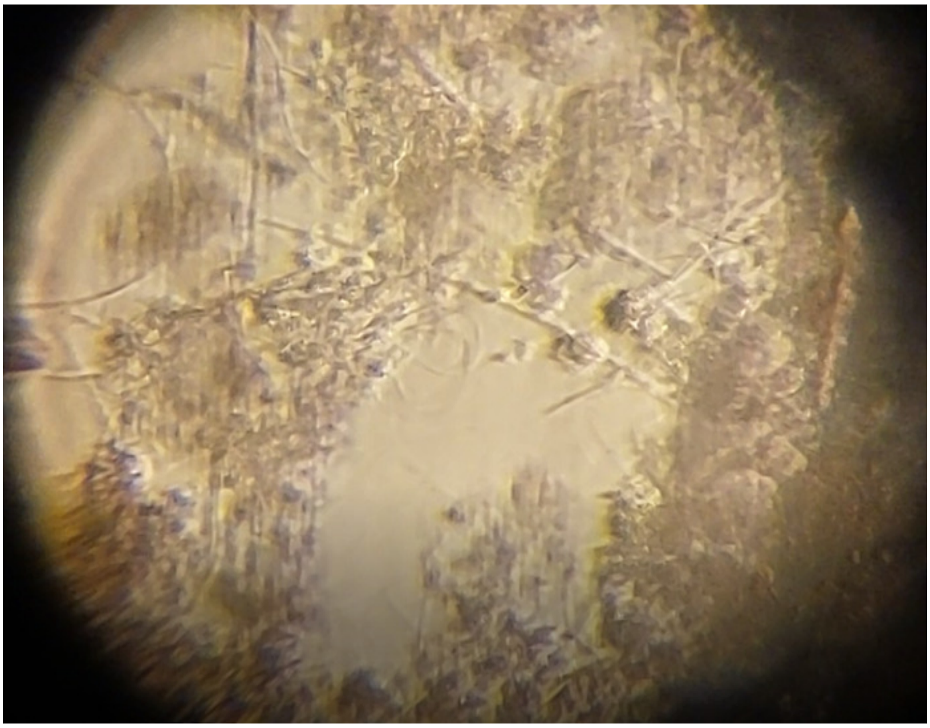

Figure 2: Filamentous bacterial growth in the aeration tank after the one week of treatment.

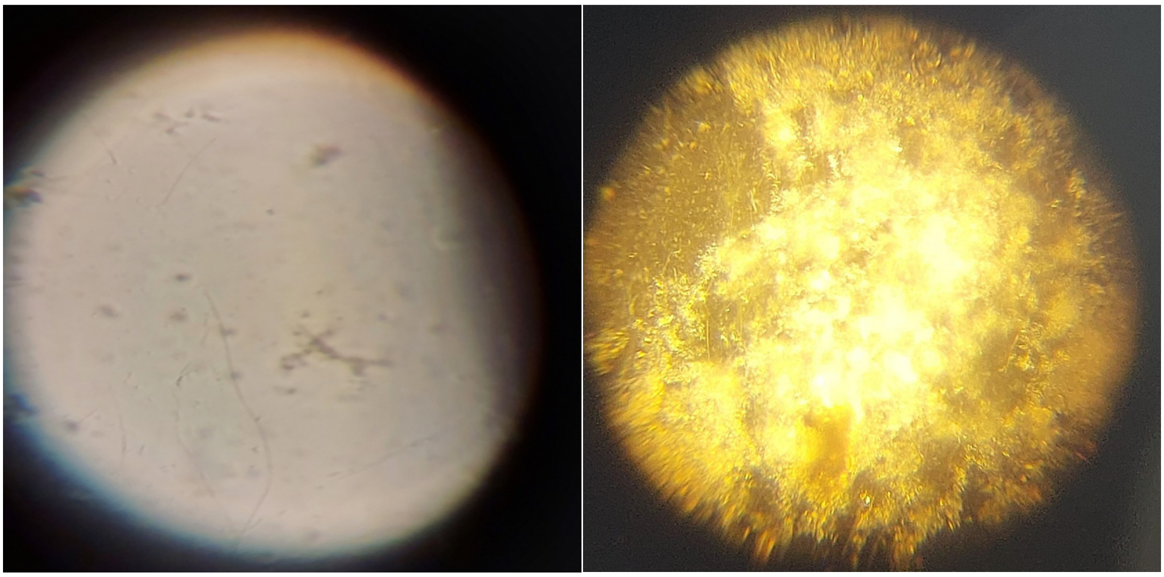

Figure 3: Scanty filamentous bacterial growth in the aeration tank after the 10 days of treatment. SVI 30 reduced to 59 mL/g.

Other signs of filamentous bacterial bulking include a misty odor coming from the surface of the aeration tank and the clarifiers. Production of foam at the surface of the aeration tank may also indicate filamentous bacterial growth. Misty odor and foam formation issues were observed during filamentous growth in our aeration tank of the SWTP. Furthermore, the clarifier surface looked muddy and the supernatant solution became turbid. The sludge at the base of clarifier was difficult to see, especially when SVI30 was 203 mL/g as shown in figure 4.

Figure 4: Muddy surface of Opal's SWTP Clarifier due to the filamentous bulking @ 203 mL/g SVI30.

It is important to note that after the tenth day of the sodium hypochlorite treatment, suspended solids in the treated effluent or the disposal water reduced to 528 ppm from 796 ppm (34% reduction) in the disposal water. The SVI30 reduced to 121 from 231 mL/g. The reduction in Sludge Volume Index (54%) showed the effectiveness of the treatment after 10 days. The higher TSS concentration may be due to the suspension in the mesh or nest like filamentous structure, reducing the amount of solids to settle down at the base of clarifier. Sodium hypochlorite treatment was found effective to reduce the high cost associated with the disposal of wastewater containing solids of more than 600 ppm. However, the effect of degree of bacterial filament abundance in the aeration tank on the solid concentration in the disposal water is inconclusive and needs more research.

CONCLUSIONS

- The growth of filamentous bacteria in the aeration tank can be controlled by the application of 12.5 % sodium hypochlorite @ 15 L/day.
- High Total Suspended Solids (TSS) in the clarifier supernatant solution can be reduced quickly to save money paid to Sydney Water due to the high TSS load.
- It is a cost effective method and a quick solution for the filamentous growth problem in the aeration tank of the SWTP.

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