A SIMPLE SOLUTION TO BIG SNAIL PROBLEMS - A CASE STUDY AT VSFCD’S RYDER STREET WASTEWATER TREATMENT PLANT

Timothy R. Tekippe, P.E.,* Robert J. Hoffman, P.E.,*
Ronald J. Matheson,** Barry Pomeroy**

*Carollo Engineers, 2700Ygnacio Valley Road
Walnut Creek, CA 94598

**Vallejo Sanitation and Flood Control District
450 Ryder Street, Vallejo, CA 94590

ABSTRACT

A treatment facility operating on the northern edge of the San Francisco Bay, in Vallejo, California, was experiencing excessive growth of trickling filter snails in the plant’s two biotowers. Downstream of the biotowers, the snail shells would settle in the plant’s aeration basins and secondary clarifiers and cause major maintenance problems. Periodically the entire aeration basin and clarifier structures were removed from service and manually cleaned to remove the snail shells. As part of a larger plant improvements project, the owner teamed with Carollo Engineers to develop and evaluate solutions to the snail shell problem. Several alternatives were developed, and the most promising alternatives were tested for effective removal or prevention of the snail shell issue.

Pilot testing of an alternative, which included baffles in the aeration basins and the use of grit pumps and classifier systems, proved very effective at snail shell removal. A similar system was designed for permanent installation at the plant, and for a relatively low cost, compared to the excessive manual labor requirements, the snail shell removal system was installed and is currently operating. Initial testing of the system and periodic monitoring of the downstream basins has shown that the custom-engineered snail removal system is very effective at long-term shell removal and disposal.

KEYWORDS

Snails, Snail Shells, Bio-tower, Trickling Filter, Maintenance Improvements

INTRODUCTION

The Vallejo Sanitation and Flood Control District (VSFCD) operates the Ryder Street Wastewater Treatment Plant, with dry weather flows averaging 10.5 mgd, and peak wet weather flows above 60 mgd. The plant has been historically challenged by the growth and subsequent sloughing of snail shells from its two bio-towers, the heart of its treatment process. If allowed to build-up, the shells cause major operational problems in the plant’s aeration basins and downstream processes, and removal of the shells has been a difficult and labor-intensive chore.
To address the problem, VSFCD and Carollo Engineers evaluated several alternatives to prevent or reduce growth of the snails, versus alternatives to provide better removal of the shells from the process stream. As a result, the preferred alternative has been implemented, and through an innovative use of existing tankage, the problems with snails have been greatly reduced, without major capital investment.

GOALS AND OBJECTIVES

In order to identify and address the issues caused by snail shells at the plant, VSFCD initiated an evaluation with the following goals and objectives:

1. Characterize and quantify the problems caused by snail shells in the processes downstream of the plant’s biotowers.

2. Identify and evaluate alternatives to prevent snail formation, or to provide simple and efficient removal of the shells from the flow stream.

3. Recommend and construct modifications to reduce or eliminate the O&M issues with snails in the aeration basins, clarifiers, and other areas of the plant.

IDENTIFYING THE PROBLEM

The plant’s two bio-towers are 105-feet in diameter, and use 24-feet of plastic cross-flow media to treat primary effluent and remove the majority of the soluble BOD and ammonia nitrogen coming to the facility. Unfortunately, several years after startup of the bio-towers, plant staff noticed the presence of snail shells settling in the downstream aeration basins and even floating on the surface of the secondary clarifiers. Periodic draining of the aeration basins and clarifiers revealed huge deposits of the snail shells in those tanks, after relatively short cycles of operation. Figures 1 and 2 depict a typical build-up of snail shells in the plant’s aeration tanks, as seen after draining.

Attempts were made to alleviate the snail problem and improve biotower performance by slowing down the trickling filter mechanisms, according to recommendations by Albertson1.
Slowing the mechanisms was accomplished by retrofitting the hydraulically-operated mechanisms with new, electrically-driven mechanisms.

The new mechanisms improved flushing within the trickling filter and some aspects of filter operation, but were ineffective at reducing the snail growth. For several years, the plant staff addressed the problem by shutting down and draining the aeration basins on at least a semi-annual basis. Staff then used shovels, buckets and hoses to remove the shells from the basins. One small drain line in each aeration basin was quickly overwhelmed during the cleaning process, by shells clogging the drain and blocking the approach to the drain. Similarly, the secondary clarifiers routinely experienced a build-up of the snail shells in the influent center wells, which required similar periodic draining and manual labor to remove.

An investigation into the layers of plastic bio-tower media revealed that the top four-feet of media contained thicker bio-growth but no snails, while the lower 20-feet contained very thin bio-growth, and an abundance of snails. The snails were thriving on the aerobic conditions in the lower portions of the towers, and large numbers were sloughing off. Due to a specific gravity slightly higher than one, the snails were being pumped by the plant’s intermediate pumps into the aeration basins, where the majority settled under the diffusers, while some became air bubble-entrained and were carried on to the secondary clarifiers.

**POTENTIAL SOLUTIONS**

As part of a larger improvement design project at the plant, Carollo Engineers initiated an evaluation of alternatives to address the problems with snail shells. Several alternatives were developed and compared, including ideas to limit or prevent the growth of the snails, as well as alternatives involving better containment and removal of the shells from the flow stream.

Alternatives to prevent or limit snail formation included ideas to flood the bio-towers with water periodically, or the addition of a chemical dosing station. The primary mechanism with these alternatives included isolating one of the bio-towers on a routine basis, then either flooding or recycling higher levels of ammonia through the process to kill the snails and prevent their growth. Carollo has implemented this process at other treatment facilities in the West, at times with very good success. However, at VSFCD, the original design of the bio-towers did not provide for flooded conditions, and potential issues with the chemical addition made these alternatives non-feasible, compared to alternatives involving more efficient removal of the shells.

When considering alternatives to provide more efficient and complete removal of the shells from the process, the properties of the shells were scrutinized. Although the shells settle in the aeration basin and have similar properties to grit, they are light enough to be pumped by conventional centrifugal pumps, and a small portion become air-entrained and float. Alternatives were considered to provide an intermediate snail removal process to the entire flow stream, similar to a grit removal process, but the existing site was constrained, and the piping re-configurations and pumping requirements were prohibitive.
Additional alternatives to provide for better removal of the shells were focused on improvements to the existing aeration basins. Improving the aeration basin drain system was considered, which would help get the shells back to the head of the plant during the cleaning cycles. However, improving the drain system did not eliminate the manual cleaning cycle or resolve any of the issues in the downstream clarifiers.

CONCLUSIONS AND RECOMMENDATIONS

The alternative with the most long-term advantages included modifications to the front sections of the plant’s two aeration basins, to provide a place for the shells to settle and to provide an
automatic mechanism to remove the snails. This was accomplished within the space available in the existing tanks (see Figure 3).

The plan included addition of redwood baffles to confine the snails to the first 20-feet of the rectangular aeration basins. The baffles were added by simply drilling and anchoring stainless steel angle iron to the walls of the basins, and fixing the redwood baffles between the angles. Baffles were added to the entrance sections of the basins to decrease the incoming velocity, and then at the 20-foot mark, to form a compartment to contain the shells. The floor of the 20-foot section was sloped to prevent the shells from piling in the corners and the fine-bubble aeration system was modified to promote settling of the shells and rolling velocity, to push the shells to pumps, for removal from the basins.

The shells are now directed to new submersible grit pumps, set near the center of the 20-foot sections, in the bottom of the aeration basins. The shells are pumped to a new grit cyclone and classifier system, located adjacent to the aeration basins’ influent pump station. Overflow from the grit system drains back into the influent pump station and is sent back to the aeration basins, maintaining the suspended solids concentrations in the basins. The grit classifier discharges the shells into bins that are emptied daily, with the plant’s screenings and grit, and hauled to a landfill for disposal (see Figures 4 and 5).

The new snail removal system was installed in the Summer of 2005, and during the first few days of operation, removed a large quantity of snail shells from the front of the basins (up to 13 cubic yards per day). Since the startup period, the quantity of shells being removed has stabilized.

Figure 3 – Modifications to Existing Aeration Basins

Figure 4 – New Grit Cyclone and Classifier

Figure 5 – Classified Snail Shells
to approximately 2 cubic yards per day, and the plant operators routinely empty the bins to remove the shells from the flow stream. Although during the recent wet weather season, staff has not had the opportunity to take the aeration basins down for inspection, it is expected that very few shells will have settled in the downstream portions of the basins, or in the clarifiers, thereby significantly reducing maintenance efforts and related costs.

REFERENCES

Albertson, O.E., ”Slow Down That Trickling Filter!”. WPCF Operations Forum, January 1989