Internship to Determine Source of Toxicity in Effluent at a Pulp Mill in Western Washington

TESC 496

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INTRODUCTION

Chronic bivalve toxicity was detected in the effluent of a western Washington pulping mill. The purpose of this internship was to compile data from decades of water sample testing and various sensors spread throughout the waste streams in the mill to determine a cause for the failed test. The bivalve test is one performed among six organisms that represent the aquatic life near the outfall and is required by the Department of Ecology to have that outfall license. These data series are results recorded during the time that the bivalve sample water was collected.

QUICK FACTS

> **BOD** Biological Oxygen Demand is a measurement of how much dissolved oxygen is consumed by bacteria during metabolism of matter in the sample.

> **COD** Chemical Oxygen Demand is like BOD but it measures how much the organic components in the sample can be chemically oxidized.

> **DO** Dissolved Oxygen is a measure of oxygen content in ppm. Aquatic organisms are sensitive to slight changes in this number.

> **TSS** Total Suspended Solids is the amount of undissolved solids that can be removed by a filter. This includes the bacteria (bugs) that eat the contaminants.

BIOPONDS DO

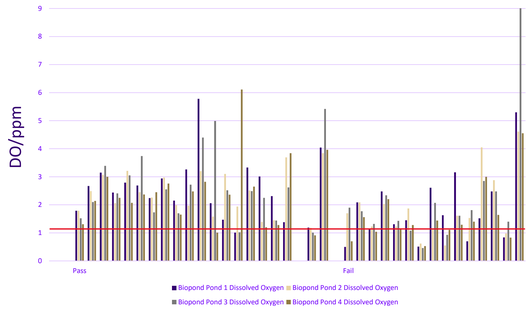

Figure 1: The red bar represents the level below which aquatic organisms experience developmental complications. This is the Dissolved Oxygen levels at the times when the bivalve testing took place.

RELEVANCE

- Aquatic organisms are highly sensitive to dissolved oxygen levels just like surface organisms are to the air they breathe.
- Dissolved oxygen levels can be affected by chemicals dissolved in the water, organics floating in the water, or anything else that can act as food for microorganisms.
- As microorganisms eat the "food" in the water, they consume oxygen and produce carbon dioxide. Aerators are used in treatment ponds to refresh the oxygen supply in the water and help the microorganisms continue to digest contaminants.
- During bivalve testing dates, Dissolved Oxygen was decreased, TSS flows were higher, and Biopond flows were higher on test fail dates.

Image 1: Water samples from various waste streams in the plant. Several tests are run on these including a five-day Biological Oxygen Demand test.

WASTE STREAMS TO THE BIOPONDS

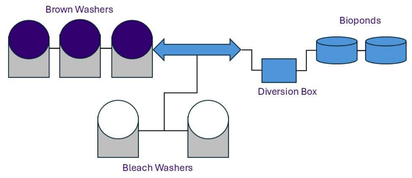

Figure 2: Example of a couple of the waste streams that get sent to the bioponds for treatment. The brown washers are the first waste streams after the chips are finished digesting. The bleach washers rinse away excess bleach later in the process.

BIOPOND TSS FLOW COUNTS

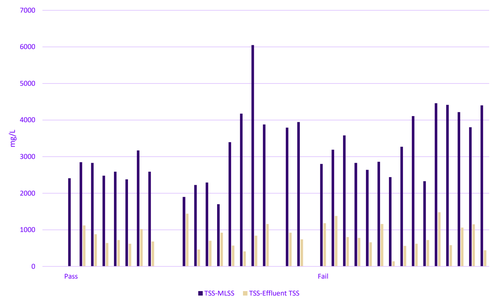

Figure 3: TSS flows in the bioponds measured in mg per liter. TSS flows in the bioponds are much higher than effluent TSS counts due to contaminants and recycled bugs used in the treatment process. These are the TSS counts during the bivalve testing dates.

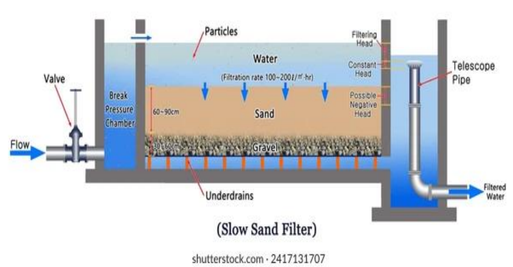

Image 2: This is an example of a water filtration system that could reduce the toxic response of the bivalves. Filtration systems like this one can remove particulates of 10,000 AMU's and larger which eliminated the toxic response being investigated.

BIOPOND FLOWS

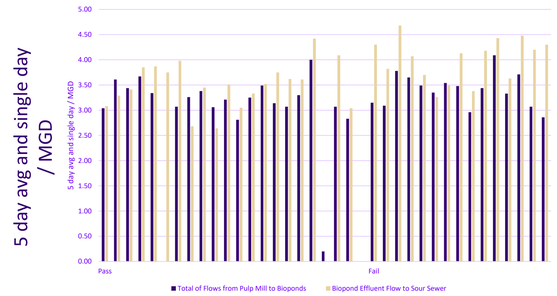

Figure 4: Increased flows to the bioponds can result in reduced treatment efficiency. The mill sends water to the bioponds at their max capacity most of the time to produce the most pulp. These are the influent flows to the bioponds during bivalve testing dates.

CONCLUSION

Findings suggest that operational conditions, specifically harder cooking processes which require more aggressive bleaching, led to increased toxicity. These changes resulted in higher flow and pollutant loads to the bioponds, pushing the system close to its capacity. Corresponding increases in Biological Oxygen Demand and decreases in Dissolved Oxygen on test fail dates supported this conclusion. Although time constraints limited a full evaluation of upstream processes or solution development, this analysis provides a critical foundation for future testing. The findings indicate that operational strain on bioponds may play a key role in effluent toxicity and can help guide further investigation and mitigation efforts by the mill's Technical and Environmental teams.

References: *Slow Sand filter*. (2024, January 23). wwwshutterstock.com. https://www.shutterstock.com/image-illustration/media-composition-slow-sand-filter-2417131707