AQUAFIX INC
WASTEWATER LABORATORIES

Effectiveness of Qwik-Zyme D Application for Sludge Reduction in an Aerobic Digester

INDEPENDENT DATA COLLECTED AND SUBMITTED BY:

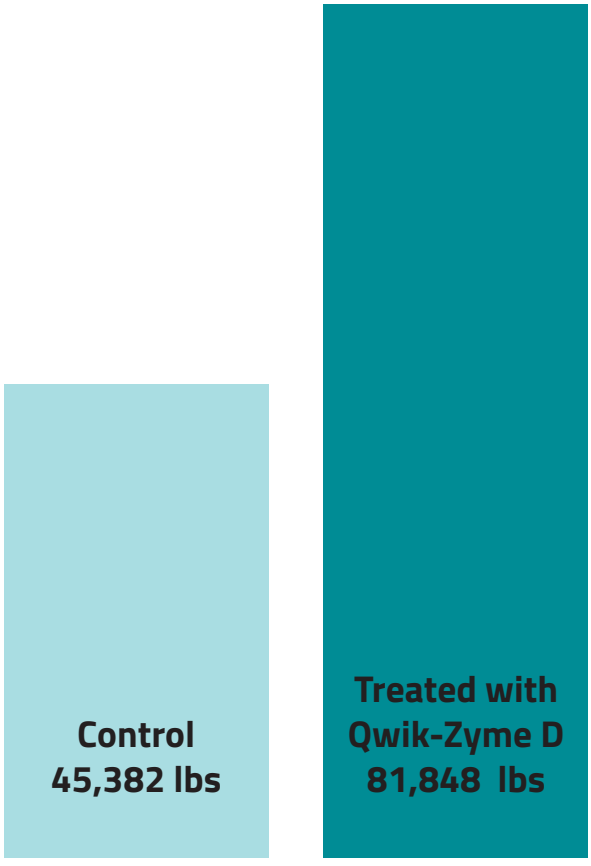
Columbus, WI

Abstract

This study aims to evaluate the on-site impacts of Qwik-Zyme D, a product by Aquafix, Inc., in an aerobic digester at the Columbus, WI Wastewater Treatment Facility. Qwik-Zyme Dis formulated to enhance the degradation of hard-to-degrade organic compounds and has shown promising results in boosting solids reduction in various field applications. Over a 12-week period (April 28 2024 - June 08 2024), the study was conducted using the plant's two aerobic digesters, with the South Digester treated with Qwik-Zyme D, while the North Digester served as a control. Additionally, operational changes were made which increased the number of decants in the South Digester, allowing for longer solids retention. Weekly composite samples were collected from both digesters, laboratory analysis focused on Oxygen Uptake Rate (OUR), Total Solids (TS), and Volatile Solids (VS). Additionally, sludge loading, holding, and pressing were monitored throughout the study. The results provide insights into the efficacy of Qwik Zyme Din improving solids reduction in aerobic digestion processes.

Qwik-Zyme D increased the digester's sludge loading capabilities by

80%



Introduction

The Columbus Wastewater Treatment Facility, located in Columbus, WI, is an extended aeration plant with two final clarifiers and tertiary treatment. The facility typically handles 0.7 to 0.9 million gallons per day (MGD), but during heavy rainfall, infiltration and inflow (1/1) can increase flows to as much as 5 MGD. The plant operates two aerobic digesters that feed into a gravity belt filter press for sludge dewatering. This study focused on optimizing solids reduction in these aerobic digesters.

Methods

SAMPLE COLLECTION

A weekly composite sample was prepared by collecting approximately 200ml of sludge from each digester daily. Over five days, the daily samples from the North Digester were combined to create a 1000ml composite sample. The same process was followed for the South Digester, resulting in a 1000ml composite sample as well. These samples were picked up weekly and transported to the Aquafix, inc. lab.

OXYGEN UPTAKE RATE (OUR)

The Oxygen Uptake Rate was evaluated by transferring 20ml of the weekly aerobic sludge composite sample to a Biological Oxygen Demand (BOD) bottle. The bottle was then filled to its maximum volume (~300ml) with room temperature tap water. Dissolved oxygen (D.O.) was evaluated over the course of an hour with data collected every minute. Each sample was prepared and run in triplicate. The resulting slopes from the OUR runs were examined for outliers and then averaged to determine the final OUR values.

TOTAL SOLIDS (TS) AND VOLATILE SOLIDS (VS)

Total solids were evaluated by first weighing an empty ceramic crucible. The crucible was filled approximately half full of sludge sample and the weight was recorded. The crucible containing the sludge was then dried in an oven at 10S°C for a minimum of 24 hours. After cooling, the weight of the crucible and dried sludge sample was recorded. The weights were then used to calculate total solids in g/kg. Volatile solids were then determined by placing the crucibles with dried solids in a muffle furnace set to SS0°C. After 90 minutes the crucibles were removed and allowed to cool, then weighed. The weights were then used to calculate% volatile solids and% fixed solids.

ON SITE DATA COLLECTION

Starting in Week 3 and continuing through the remainder of the 12-week study, the pounds of sludge loaded into the digesters, held in the digesters, and removed for dewatering/pressing were recorded. This data was recorded daily, and weekly averages were used for data interpretation.

Results

Figure 1: Oxygen Uptake Rate

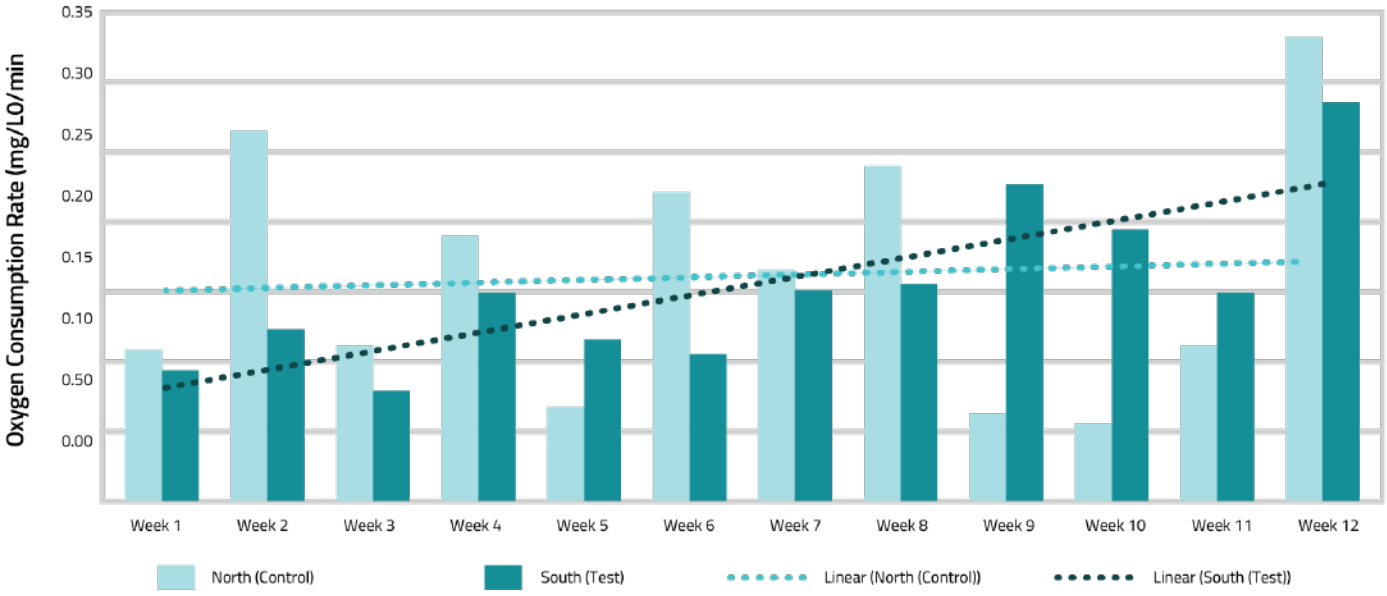


Figure 1: Average oxygen uptake rate of the triplicate runs for the North Digester and the South Digester throughout the 12-week study. While the trendlines show a gradual increase in uptake rate for the South Digester, the R values (0.6291 for the South Digester and 0.0049 for the North Digester) do not suggest that the data is linear. The variability from week to week is relatively consistent between the two digesters. Overall, the data does not show a significant difference between the North Digester and the South Digester.

Figure 2: Percent Volatile Solids

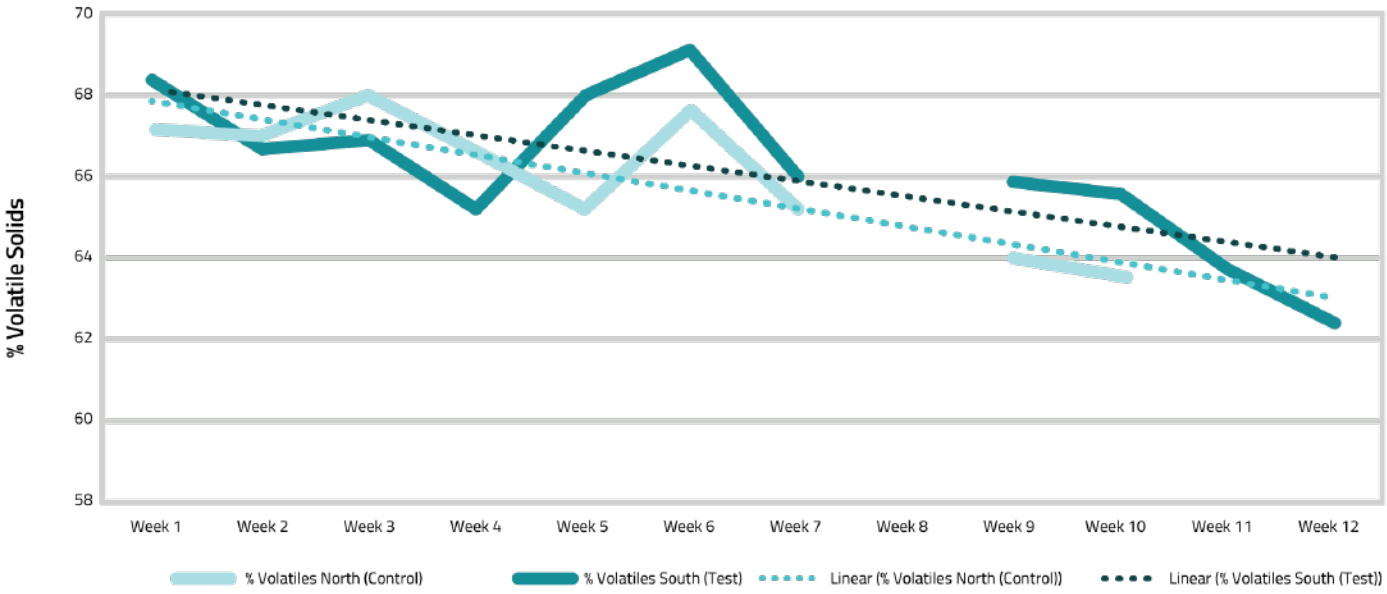


Figure 2: Both digesters showed volatile solids reduction over the course of the study. At the end of the study, the North Digester had a volatile solids concentration of 62.58% and the South Digester was at 62.36%. There was no significant difference in volatile solids between the two digesters. Week 8 VS data was lost due to human error and week 11 North Digester VS data was lost due to equipment failure.

Figure 3: Pounds of Sludge Loaded, Cumulative

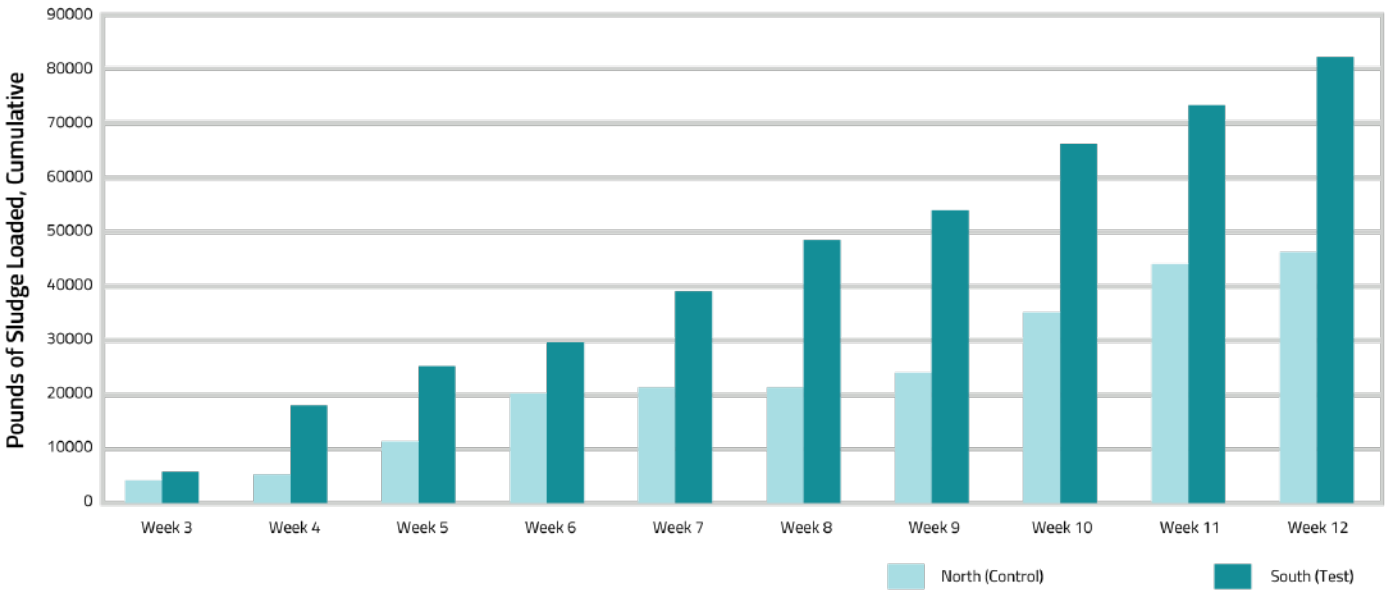


Figure 3: This figure depicts the week-to-week cumulation of loaded sludge in each digester. At week 12 a total of 45,382lb of sludge had been loaded into the North Digester, while a total of 81,848lb of sludge was loaded into the South Digester. Approximately 80% more sludge was added to the South Digester compared to the North Digester.

Figure 4: Average Sludge Held, Pounds

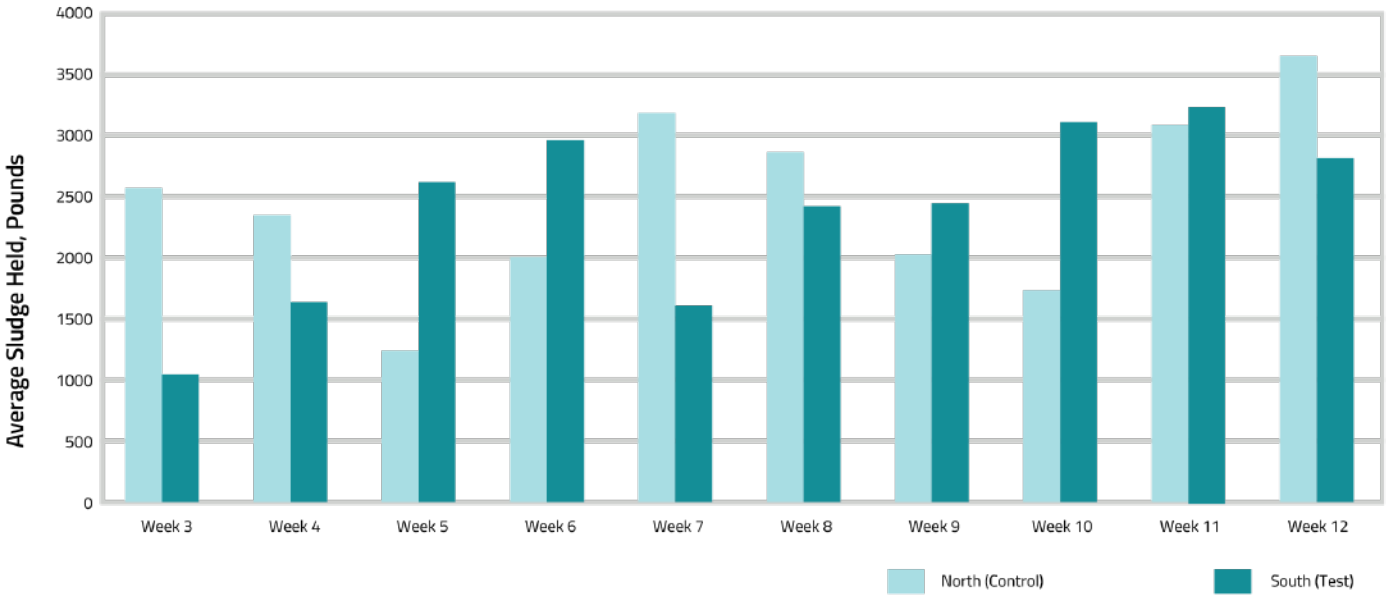


Figure 4: This figure depicts the week-to-week average of sludge held in each digester. The cumulative 12-week average of sludge held in the North and South Digesters were 2,451lb and 2,384lb, respectively. No significant difference was observed in the pounds of sludge held in the digesters despite the increased sludge loading into the South Digester.

Figure 5: Pounds of Sludge Dewatered, Cumulative

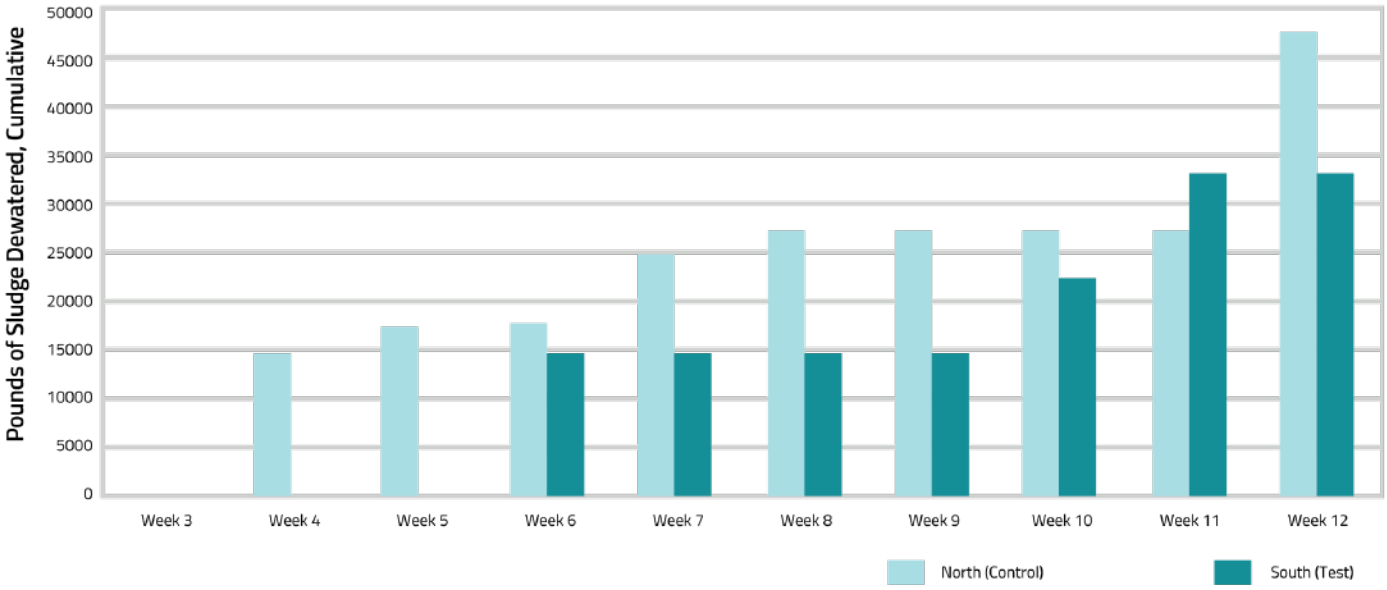


Figure 5: This figure shows the week-to-week cumulative total pounds of sludge removed via dewatering (belt pressing) in the North Digester and South Digester. At the end of the 12-week study a total of 45,302lb of sludge had been dewatered from the North Digester and a total of 32,863lb of sludge had been dewatered from the South Digester. Despite increased loading in the South Digester, and held solids remaining equivalent, more solids had to be removed and dewatered from the North Digester. No sludge was dewatered week 3 for both digesters, no sludge was dewatered from the South Digester Week 4 and Week 5. Sludge was dewatered from the basins on an as-needed basis based on inability to load more sludge.

The study found that while OUR (Figure1) and VS Ppercentages (Figure 2) remained similar between the North and South Digesters, the South Digester received 36,465 pounds more sludge than the Nore Digester 9Figure 3). Additionally, while the sludge held in the digesters varied based on dewatering and loading cycles, the average pounds of sludge between the digesters was not significantly different (Figure 4).

After 12 weeks, the total sludge loaded into each digester was compared to the total sludge removes via pressing/dewatering. Given that the sludge volumes were relatively comparable, this difference represents the amount of sludge reduced. The South Digester, treated with Qwik-Zyme D and subjected to operation changes, achieved a significant 59.85% reduction in sludge, equating to 48,984 pounds of sludge removed via biological activity. In contrast, the North Digester, which served as the control, saw only 0.18% reduction, amounting to approximately 80 pounds of sludge removed.

Conclusion

The OUR between the North and South Digesters showed no significant difference in this study. However, it is important to note that the South Digester received nearly twice as much sludge over the 12-week test period. The performance of the South Digester suggests the addition of Qwik-Zyme D improved the metabolic health of the bacteria and mitigated the expected negative impact of the additional loading. Most importantly, the South Digester achieved an impressive 59.85% reduction in sludge, suggesting that this significant decrease was due to the combined effects of operational changes and the addition of Qwik-Zyme D.

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