

Lagoon Sludge Removal with Biotifx™ P&P

ABSTRACT

A large pulp and paper mill in the upper Midwest was experiencing accumulation of solids in a wastewater treatment lagoon following their aeration basin and secondary clarifier. Core sampling was used to measure changes in sludge before and after the lagoon was dosed with Biotifx™ P&P 40B. Results included reduced sludge volume and increased hydraulic space.

BACKGROUND

The buildup of sludge was leading to hydraulic short-circuiting and loss of treatment capacity in the lagoon. The cause of excessive solids loading in the lagoon was due to unsettled solids and high BOD in the secondary clarifier effluent, as well as poor facultative digestion within the lagoon. A survey conducted in 2013, by a third party indicated that the entirety of the lagoon is 238 million gallons at 8'8" deep and 43.5% filled with sludge. Surveying and samples taken by MDG on Oct 7th, 2015 illustrated that solids loading in SSE portions of the lagoon were the most dramatic.

A recommendation in fall of 2015 was made to use bioaugmentation product, Biotifx™ P&P 40B, to enhance biological digestion of accumulated solids in the lagoon. In June of 2016, the SSE portion of the lagoon was treated with Biotifx™ P&P 40B in an effort to remove accumulated organic solids.

The objective of treatment was to demonstrate with quantifiable results, the digestion of accumulated solids after addition of Biotifx™ P&P 40B in a portion of the lagoon. Success is measured by increased hydraulic space (depth to sludge blanket) and removal of solids in the portion of the lagoon treated and monitored after 90 days.

METHODS

Vertical core samples of the strata in the top 3' of the lagoon (surface elevation 698.5') were taken from designated location numbers 1, 2, 3 & 4 within the treated area (Figure 1). Surface area of treated section is approximately 384,250 ft² (725'x530'). Only the top 3' of the lagoon was sampled because greater depths could not be consistently reached due to sludge density. The volume of the 3' strata of the lagoon monitored within the treated area is approximately 42,700 cubic yards. Core samples were taken prior to treatment with Biotifx™ P&P 40B and then again 90 days after to determine changes in sludge. Data recorded from core sampling included depth to sludge blanket (inches), total solids (mg/l) and % volatile solids.



Figure 1: map of treated area of lagoon with sampling locations marked

Product Application Procedure:

Biotifx™ P&P 40B was applied to treat the SSE portion of the lagoon directly north of activated sludge basin and west of the influent area (Figure 1) on June 20th, 2016. This section was chosen for its high sludge build-up and because it is a smaller, somewhat hydraulically short circuited from the rest of lagoon. The lagoon in this section was recorded to be approximately 9’ deep, however solids were coming very near the surface. To dose this section, 22.5 kg of Biotifx™ P&P 40B was diluted with water in a 55-gallon drum, mixed with an electric mixer, and allowed to rest for one hour. After resting period, solution was re-mixed and the entire solution was poured into the lagoon by pails along the west bank of the treated section.

Core Sampling Procedure:

Prior to the collection of the baseline samples, the lagoon depth was determined by recording the level at the point of discharge (Figure 2). A 1.5” clear, graduated, PVC sampler equipped with a 1.5” ball valve on the bottom (Figure 3) was used for taking core samples. At each sampling location, the sampler was slowly lowered into the lagoon until it reached a level of 3’ below the lagoon surface (elev. 698.5). The ball valve was then closed and the sampler removed from the lagoon. The core sample was released from the sampler into a 5-gallon bucket by opening the ball valve. Once the sample was collected in the bucket it was mixed via gentle swirling. A sub-sample of the mixture (~500 ml) was collected into a labeled plastic sample bottle and sent off to a third party laboratory for analysis of total solids (mg/l) and % volatile solids.

The core sampling process was repeated 90 days after treatment. Due to the lagoon level being approximately 0.5’ higher than it was for baseline sampling, the sampler was slowly lowered to a depth of 3.5’ below the surface before the ball valve was closed. The sampler was removed from the lagoon and placed into a 5-gallon bucket. The ball valve was slowly opened and only the bottom 3’ of the core sample was allowed to release into the bucket by closing the ball valve with the last 0.5’ of liquid inside the sampler. The sampler was then removed from the bucket and the remaining contents emptied back into the lagoon. Mixing, testing and subsampling of core sample was then conducted following the same procedure as before.



Figure 2: water level at second sampling



Figure 3: core sampler with core sample taken on 9/1/2016

RESULTS

By every measure, sludge was reduced in the treated section 90 days after application of Biotifx™ P&P 40B. The sludge blanket was lower, the amount of solids in the sludge blanket was reduced and the amount of organic content in the sludge was reduced. The sludge blanket within the strata lowered 8.4”. This drop in sludge blanket equates to freeing up ~9,900 cubic yards of hydraulic space (Figure 4). The concentration of solids within the monitored strata reduced 89% after treatment. This equates to ~1290 dry tons of solids being removed from the measured strata alone (Figure 6 & Table 1).

Of the 1290 dry tons of solids removed from the measured strata, 557 tons were volatile (organic) and 733 tons were inorganic (Table 1). Ninety (90) days after treatment the content of the sludge in the strata also changed. Prior to treatment, 43% of the sludge was volatile (organic), 90 days after treatment the volatile portion of the remaining sludge reduced to 41%.

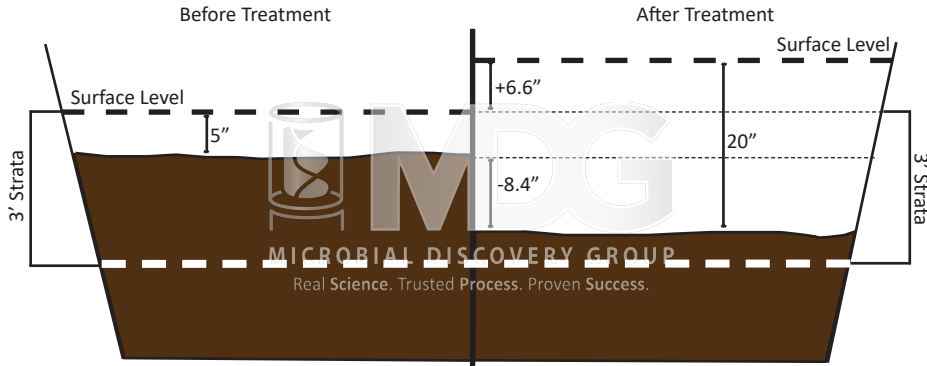


Figure 4: depth to sludge blanket from 698.5' elevation before and after treatment

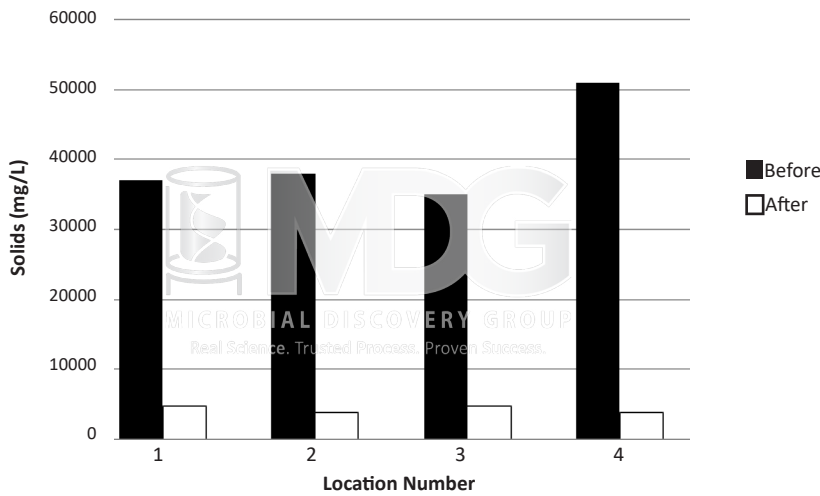


Figure 5: mg/l of solids within the 3' strata from each of the 4 sampling points

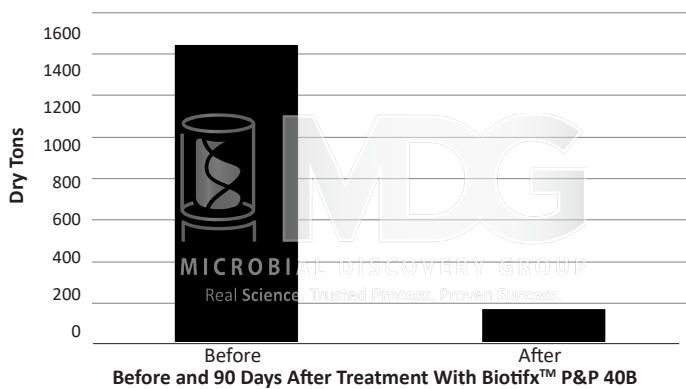


Figure 6: comparison of the dry tons of sludge within 3' strata before and after treatment

Table 1. Dry tons of sludge in measured strata by content

| | Before | After | Removed |
|-----------|--------|-------|---------|
| Organic | 623 | 66 | 557 |
| Inorganic | 827 | 94 | 733 |
| TOTAL | 1450 | 160 | 1290 |

CONCLUSION

Treatment of the lagoon with Biotifx™ P&P 40B was a success as there was a quantifiable increase in hydraulic capacity accompanied by significant solids removal within 90 days of a single treatment. It is important to understand that only the organic portion (volatile) of the solids are capable of being digested by the bacteria in Biotifx™ P&P 40B. The decrease in the percent volatile solids of the sludge remaining in the measured strata supports that the mode of action for solids removal was biological digestion. Of the 1290 dry tons of solids removed from the monitored strata, 557 were organic and likely digested by the bacteria. The 733 dry tons of inorganic sludge that was removed from the strata likely precipitated to lower depths as the organic sludge around it was digested. This precipitation of inorganic solids out of the 3' strata measured is also an indication that organic content below the measured strata was digested which allowed room for the inorganic portion to precipitate. This is further supported by the anecdotal evidence that during the second core sampling it was much easier to reach deeper depths of the lagoon.

It seems unlikely that the effects of the product were confined to the area of the lagoon monitored. Sludge that existed adjacent to the treated area and at depths lower than those measured were likely effected by the treatment and simply not captured by our data. Therefore it is reasonable to assume that the estimation of 557 dry tons of sludge removed from the lagoon is conservative.

Even at the conservative estimate of 557 dry tons of solids being removed, the customer received a return on investment in excess of 6:1 in comparison to their alternative of dredging the solids from the lagoon. Moving forward the paper mill chose to continue with treatments in order to further improve hydraulic capacity and reduce accumulated solids. Now that sludge has been removed, solids sampling can happen at greater depths for monitor solids reduction and success of Biotifx™ P&P 40B throughout ongoing treatment.