Patented Bioreactor uses Q-PAC Randomly Packed Media and Application-Specific Bacterial Cultures for Treating High Strength Industrial Waste for BOD and Odor Reduction in a Cheese Manufacturing Plant

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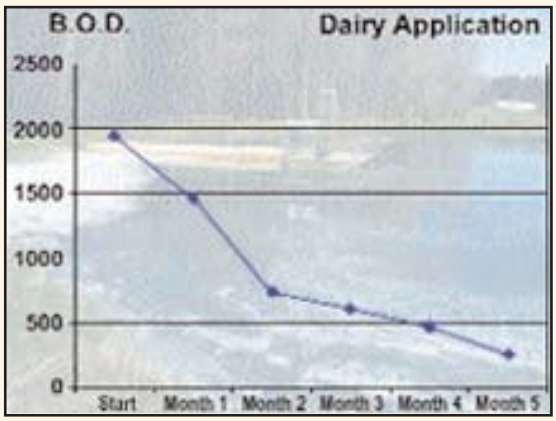
A cheese manufacturer in Upstate New York with one three million gallon lagoon is testing a bioreactor (TVT-BIO 32) from TVT US Corporation. The concept is essentially the same as bacteria eating an oil spill. However, the difference is that the TVT-BIO system is an active one versus other processes, which are passive. The field research goal is to determine how much odor control and BOD reduction can be achieved with this equipment during winter and summer conditions.

The bioreactor is filled with Q-PAC polypropylene packing media, which act as a substrate for biofilm growth. The TVT Bio-Boost System acts as a bioreactor by providing optimum conditions for rapid continuous growth of application specific microbial cultures. Appropriate cultures are combined to act on the target contaminate (high strength waste water).

The bacteria chosen for production are target specific, not pathogenic, and are proven safe. Repeated applications will lead to their dominance, outgrowing indigenous species, including pathogens. The resulting enhancement leads to the rapid breakdown of undesireable BOD and malodorous compounds, converting them to CO_2 and H_2O, thereby decreasing the residual sludge formation by as much as 50%. The bacterial cultures and microbial activity can be tracked throughout the bio-remediation process, and can be correlated with contaminant degradation.



The three million gallon lagoon has two five horsepower splashers operating during the Department of Environmental Conservation (DEC) Summer Permit discharge conditions from May to November. During the summer, the undiluted whey-waste water in the lagoon is drawn down and sprayed onto the adjacent meadow, which is owned by the cheese manufacturer.

One splasher near the discharge pipe into the lagoon has been replaced with the Oxy-BIO-32™ Bioreactor. Within the bioreactor, continuous aeration and re-circulation of the whey-waste-water creates a biofilm on the media, which eat the whey-waste. The Oxy-BIO™ process continually regenerates application specific bacterial cultures at a high rate, which slough off the mature bacteria into the lagoon, thereby also discharging the sludge for constant re-circulation. This enables sludge reduction within the lagoon system.

The round pin-like elements on the Q-PAC media provide a surface geometry on which the constantly thickening biofilm can provide an increasing surface in contact with the waste water. As the biofilm increases in mass, it will eventually slough off the small diameter plastic needles before the biofilm is too thick to facilitate oxygen transfer to the microbes at the plastic-biofilm interface.

The second splasher located at the far end of the lagoon remained for additional continuous aeration and agitation. Typically the lagoon establishes an active dark green algae population during summer operations. During winter operations, the capacity of the lagoon allows for no discharge until next summer season.

The whey collection tank in the factory has fluctuating BOD loadings from 3,860 up to 10,600. In 1999 the pH in the collection tank ranged from 9.8 up to 11.6. At this range no microbiology exists. The periodic, undiluted discharge from the tank into the lagoon averaged 6,000 GPD. During winter operations the lagoon has no aeration treatment as is completely covered by ice. Aeration treatment startup in Spring regularly created odor until sufficient aeration has transferred oxygen into the whey-waste treatment lagoon.

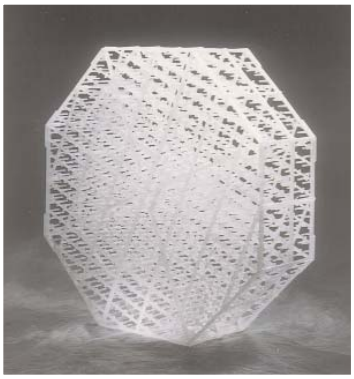
The TVT-BIO 32 was installed on February 26, 1999 and field commissioned on March 8, 1999. The initial lab tests from Waste Stream Technology yielded the following grab sample from the lagoon: BOD at 1,950, oil and grease at 71.5, pH at 6.22, and a lagoon temperature of 34°F.

As the warmer weather comes to Upstate New York, the severe but typical odor problem develops. The TVT Bio 32 Bioreactor's enhanced the oxygen transfer into the lagoon waste water until July 2nd (summertime in New York). Not only were all odors absent but the third party independent laboratory tests showed a 90% reduction in BOD levels.

The lab tests from July 2nd, 1999 show: BOD of 463, oil and grease of 11.5, and a pH of 7.71 at the TVT-BIO 32 location in the lagoon (see chart on front). The final lab test on July 21 showed BOD of 251.

The initial result of the TVT-BIO 32 Bioreactor is the reduction of the ice cover in the lagoon by two thirds, and odor removal (Oxygen transfer) started even during cold water temperatures. Under the previous year's lagoon operations, when the ice cover had melted, and two five horsepower splashers had been re-installed in May, odor would persist for several weeks. For the first time during the operation of this lagoon, with the new system, there was no odor.

On April 5th, 1999 the temperatures in the lagoon exceeded 55°F and TVT augmented 100 pounds of Application Specific Bacteria for the lagoon, based on the recommendation from Dr. Jim Hyzy. Another 50 pounds during May, and a final 50 pounds were added in June to establish application specific dominant bacterial cultures.



Between June 7-11, 1999 it became visible that the dominant existing green algae in the lagoon had been replaced by the application specific bacterial cultures from Waste Steam Technologies and converted the lagoon into a secondary aerated treatment lagoon. The change in color was dramatic. From the first day, a light beige color transformed to a saturated brown activated sludge by the fifth day.

The plastic Q-PAC biofilm substrate has 30 ft^2/ft^3 of round surface area when new. As biofilm builds up on the Q-PAC, the round surfaces of the biofilm in contact with the wastewater increase geometrically with the thickness of the biofilm. This enlarged surface can expand the effective surface of the Q-PAC to 60 to 90 ft^2/ft^3. As the mass of the biofilm increases, it will eventually slough off the Q-PAC elements, aided by the laminar flow streams inside the bioreactor and the action of the air bubbles created by the aeration system.

A by-product of oxygenated, activated, flocculation and activated sludge is retention of valuable solids as fertilizer, which stay within the root zone instead of percolating down into the ground water below.

Conclusion:
The concept of combining oxygen enriched wastewater grown on an extended surface plastic substrate (Q-PAC) in a bioreactor with application specific bacteria increased operational efficiencies in this test up to 73%.

Additional benefits of the TVT-BIO 32 include:

- Installation in existing lagoons without cranes or special equipment.
- Operation with minimum monthly maintenance.
- Controlling nitrification.
- Increasing dissolved oxygen to meet the biological oxygen demand.
- Controlling of odor.
- Controlling of fats, oils, and grease (FOG)
- Improvement of settling ability of the sludge
- Reduction of operational costs.

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