The Re-habilitation of 43 Year Old Waste Lagoons

by
Dale Klussman

In 1967 the City of Concordia, MO built a segmented lagoon system to handle the small town's waste requirements. The main industry in Concordia is a Tyson renderings plant, and the lagoon system was designed to also handle that plant's final waste and water polishing requirements. The lagoon system was a relatively standard design, consisting of an 18.7 acre primary lagoon, a 5.6 acre secondary, and a 3.2 acre final lagoon. All lagoons average 6 feet in depth, with the final outfall being received by a southeasterly flowing Panther Creek. A number of vertical spray aerators were placed in the primary lagoon in order to provide water turnover and dissolved oxygen (DO) to the system.

By 2003 the lagoon system began to exhibit outfall water quality that did not meet the state's DEQ permit limits. The key parameters of concern were BOD and TSS, and the permit requirements carried a 30/30 limit. In an effort to assist the city through this period of required rehabilitation, the outfall requirements were raised to a 45/45 limit. The City Administrators began to work with Tyson in an effort to make sure that the plant's waste was treated to such an extent that it did not produce an uncontrollable amount of untreated waste. Tyson was very cooperative in the requirements placed by the Administrators.

Also in 2003, a bio-augmentation program was begun in an effort to reduce the BOD/TSS outfall results. At first, this idea, while expensive, seemed to work, but it was soon realized that the added bacteria to the system worked fine, until the BOD and TSS both reduced to the low 40's, at which time the results seemed to 'hit a wall' in contaminant reduction capability. From 2004 through 2009 more aerators were added to the primary lagoon and two other brands of bacterial additive products were tried. At one point the City installed constant dosing systems that were designed to automatically feed bio-augmentation product to the lagoon system. Through all of this time and effort, the ability to get the BOD at the outfall consistently below 45 PPM and the TSS even close to that number seemed to get more elusive. Other negative characteristics of the lagoons began to surface – first, there was the inability of the primary lagoon to ever hold more than 7 PPM of DO, no matter what environmental conditions existed; and in the summer months that lagoon was beginning to exhibit a very heavy, waxy algal 'cap' that not only looked bad, but had a tendency to emit odors. Neighbors downstream of the lagoons, on Panther Creek, began to complain over the increased TSS and algae that was apparent in the water.

By 2009 the DEQ began to put pressure on the City to make major changes to the lagoon system and to get back to the 30/30 limits of the original permit. A local engineering firm was brought on board to help Concordia's Administrators deal with the added DEQ requirements, and develop a redesign of the lagoon influent structures. At the same time, I was introduced to a couple of new

products, offered by Reliant Water Technologies out of New Orleans, which were designed to specifically deal with the rehabilitation of old waste lagoon designs. After talking with representatives of the company, and providing the characteristics of the lagoon system and our problems, an officer of the company came to Concordia to meet with our City Council, our engineers and our water/wastewater treatment specialists.

Reliant began the discussion with breaking the waste lagoon process down to basics – explaining that what was really desired of a waste lagoon system was to do whatever possible to duplicate natural, flowing water – like a river. He described how the collecting waste solids in the primary lagoon were 'trapping' noxious ammonia and nitrogen gases, primarily because of the lack of aggressive water flow. He proposed that we consider how a river constantly moved solids that collected on the river bottom, thus allowing the natural nitrification of solids to oxidize in the river's water column. Our spray aerators were just not providing the flow and agitation that was required in our primary lagoon. So, sludge was just piling up, the natural bacteria on the bottom were being required to work in an anoxic environment, which allowed for the buildup of trapped ammonia and nitrogen gases. So, he proposed a new aerator design that is under patent protection.

Because of the urgency of our DEQ requirements he also proposed a patented bacterial mix that Reliant was introducing to the global wastewater treatment industry for the reduction of organic solids. It was explained that this very aggressive poly-microbial blend of enteric bacteria, that are common to all waste streams, if used immediately in our smaller secondary and final lagoons, would quickly bring our BOD and TSS outfall numbers into line with our permit goals. Then, with subsequent periodic treatments of the product in all three lagoons (not requiring constant feed devices) we should be able to meet the 30/30 requirements within 6 months or so. And, although our contracted engineering company was planning minor changes to our primary influent design, all of Reliant Water's changes could be put into place prior to those plumbing updates, without delaying or changing the new upgrades.

Figure 1 – Poly-microbial bacterial blend, Sewper Rx, in granular form.

The meeting with our City Council, staff, and engineer was extremely helpful in getting everyone on board with the new plan. In May of 2010 a proposal was provided by Reliant Water Technologies and our City Council approved it. I immediately began to work with our state DEQ to get approval to incorporate the required changes and additions. In early July, under the instruction of Reliant Water, we treated the 5.6 acre secondary lagoon with 400 lbs of Sewper Rx bacteria, and at the same time we added 300 lbs to the small final lagoon. At the time of this treatment our outfall was exhibiting in excess of 40 PPM BOD and over 70 PPM TSS. We were instructed to add another 350 lbs of Sewper Rx, total, to these two lagoons in another 30 days. Applying the bacteria was very simple – the granular product was just poured into the water from 25 lb shipping containers.

The City also ordered 4 Reliant Water Technologie's Model WQA Water Moving Aerators by the end of June (Figure 1). The aerator is unique in that it utilizes low energy regenerative blowers to force air through both coarse and fine bubble diffusers. There is a dedicated blower for each application. In other words, the coarse bubbles, following deflection off an underwater baffle, 'push' surface water. This fast moving surface water then counts on the weight of the moving water to 'fall' into the bottom sediments, or sludge – the force of which breaks up the sludge and frees ammonia and nitrogen gases to oxidize in the water column. The second regenerative blower on top of the aerator feeds air into 8 industrial grade fine bubble diffusers, which are located forward and at the bottom of the aerator. As these fine (1mm) bubbles attempt to rise to the surface, they cannot get through the larger coarse bubbles or the violent forward moving flow of the surface water. So, these fine bubbles diffuse DO into the water on their horizontal movement below the surface flow, eventually breaking the surface about 25' to 35' forward of the aerator. Reliant says that a single aerator will continually move the water within a 5 acre area, pass close to 9 million gallons of water through itself in a 24 hour period and put up to 20 lbs of DO per hour into the water. All of this with only 4 HP or energy total.

Figure 1 – Reliant Water Technologies Model WQA Aerator.

Our aerators arrived in August and were turned on by our electricians in September 2010. By this time our outfall was continually producing BOD of 30 PPM and TSS in the 40+ PPM range. The aerators were built to utilize the existing electrical feeds that we used on our primary lagoon. Each aerator was fixed to the same long bank, 'aimed' across the short length of the lagoon, about 200 yards. Thirty lbs of Sewper Rx was added in front of each aerator once they were turned on. The idea here was to 'drive' the new bacteria into the sludge so that it could assist in breaking down the sludge. This would supplement the natural bacteria in reducing our sludge in the primary lagoon.

Within a couple of days of aerator startup I visited to lagoons and was very surprised at what I saw. First, on the opposite bank of the lagoon the water was actually 'lapping' onto the shoreline, all the way along that bank – proof that the four aerators were moving all that water. The other thing that was very noticeable was that large 'bubbles' of gas were rising from under the water – the trapped ammonia and nitrogen gases were being released. Within a week it was apparent that the waxy globules of algae clusters were gone from the surface of our primary lagoon. During the first week in October our water/wastewater staff reported to me that the primary lagoon was now continually holding high dissolved oxygen, often reaching over 20 PPM.

We now treat all three lagoons with some Sewper Rx every month, only once per month. The aerators run continuously. In our December DEQ report we were pleased to see that our outfall BOD was 12 PPM and the TSS was 27 PPM, so we are now meeting our 30/30 permit requirements. And, a major Christmas present to me was that our neighbors are no longer complaining about the water color or quality in Panther Creek.

Dale Klussman is the City Administrator of the City of Concordia, MO, telephone 660-463-2228, concordiaadmin@myccvtv.net.

Reliant Water Technologies, Jim Dartez, 504-400-1239, jdartez@relaintwater.us.com, http://www.reliantwater.us.com