Client: A Large International Water Company

Application: Beverage Manufacturer in Kentucky

Services Requested:

- **Identify Cause of WWTP Failure**
- **Fix Operation**
- **Prevent Lawsuit**

Type of Treatment:

1. **Chemical – Neutralization**
2. **Biological – Anaerobic PreTreat followed by Aerobic Activated Sludge**

This beverage manufacturer produces fruit flavored drinks. Wastewater is discharged to a treatment system designed and supplied by a large multinational water company. Alkalinity and pH control are carried out in the equalization tank prior to biological treatment in a compartmentalized anaerobic lagoon for BOD (organics) reduction. The lagoon discharge is polished by an activated sludge treatment system featuring motor-speed surface aeration with mixed liquor pumped up to the final clarifier prior to final discharge to a receiving stream.

Anaerobic treatment processes routinely require many months to reach an acceptable level of performance because the microbial growth kinetics are so slow; this is a problem when trying to build working biomass but becomes a long-term advantage as sludge disposal costs are minimal.

These slow startups pose a real challenge for the designer of this type of 2-phase treatment: the anaerobic pretreatment process is used to achieve 80% to 90% organics removal. Therefore the aerobic polishing plant need only be designed to remove the remaining 10% to 20% and can thus be relatively small and less costly. However, an unexpected decrease in the actual BOD-removal efficiency through the anaerobic lagoon – say from the design rate of 85% down to 55% - would make the load to the aerobic polishing plant actually triple that of the design value.

Of course this is not a problem if the polishing plant is designed for such inefficiencies, but then the polishing plant is three times larger than required most of the time. And of course building it three times

larger will cost three times as much, and it will then run inefficiently at the low loading it receives when the anaerobic process works properly.

Of course there are ways to design for these issues but ultimately they cost more – and this reflects the great trouble-maker in the industry: when projects come to bid, safety factors and allowances which are compelling to a Design Engineer are too often deleted by Process and Equipment Suppliers in order to reduce Bid Price and *Get that job!* And it comes from the Owners too, as they tell their design engineer to *Get that project under the budget allowance!*

In any event, at this facility the process supplier could not make the system perform properly after many months of intensive effort. The Owner rightly refused to pay the significant balance owed for the supply and installation of the plant. This involved hundreds of thousands of dollars and continued for many months past the original scheduled contract completion date. As often occurs in such situations, the Supplier pointed to influent parameter violations or inconsistencies as the causative problem; and the Owner simply put it on the supplier to make his system work, regardless. To their credit, the supplier lavished attention on the plant, sending technicians and technical specialists to the site with orders to *make that plant work!*

Unfortunately, the symptoms of the treatment plant upset conditions kept changing – and the poor effluent quality did not improve. Thus each team came away with a different conclusion, and their conflicting recommendations simply added to the overall angst. The Owner was paying heavy costs to supplement the poor operation of the plant. Meanwhile the effluent permit violations brought the attention of the State DNR (Department of Natural Resources). Fines began mounting and the pressure increased. Eventually, the mounting tensions and financial debacle motivated the system supplier to turn to ***Wastewater Experts, Inc.*** for assistance.

The initial plant site visit and lab results revealed a number of issues:

- ✓ Certain essential nutrients were missing or inadequate.
- ✓ The metering pumps responsible for dosing the nutrients and alkalinity critical to the biological activity in the system rarely functioned properly and needed to be replaced.
- ✓ These failures caused the poor anaerobic process performance – which in turn resulted in poor biogas formation. The biogas was the source of heat for the lagoon (anaerobic processes are inefficient below 28°C) and the amount produced was inadequate to maintain the required liquid temperature within the reactor. So performance decreased further.
- ✓ Operation of all available aerators in the polishing plant aeration basin was inadequate – more had to be brought in due to the underperformance of the anaerobic lagoon.
- ✓ The cation mineral balance was inadequate to support reliable, flocculent, biomass morphology.
- ✓ Lift pumps carrying mixed liquor to the clarifier were inappropriate for the task and caused additional disruption of the biological floc structure.

Wastewater Experts provided a letter report with conclusions and a list of recommendations to improve plant performance. Two months later (the minimum amount of time required to evaluate results in such a case), the plant operation had stabilized significantly. However, a second visit by

Wastewater Experts was necessary since the final effluent had improved only partially. An extensive series of observations and tests was carried out, including microscopic examination of the sludge and characterization of the microbiological consortia. This information provides an insight into the *population dynamics* of the biological treatment system*: knowing which microbes are at work, how many there are, and what shape they are in, reveals a great deal about the whole wastewater treatment process – and what has been going on when the 'experts' are not around*.

From the information collected, a second series of conclusions was reached:

- Some of those essential nutrients were *still* missing, though the Operators maintained the nutrients had been added in quantity.
- The metering pumps had been replaced, but the operating regimen still allowed unacceptable variations in the acidity of the system.
- Some of the mixers in the anaerobic lagoon were not operating properly.
- The anaerobic process operation had improved greatly – but needed to do better.
- The mineral balance was improved, the clarifier pumps had been replaced, and thus the biomass morphology was much better; but needed more improvement.
- One recommendation from the first report had been carried out with a vengeance: alkalinity addition had been increased and maintained at maximum levels; the resultant intermittent excursions in pH levels combined with nutrient overdosing were causing demonstrable incidences of toxicity and inhibition.

RESULT

There were many other action items identified, and eventually (after several more site visits and wrangling with the Owner) the plant operated successfully. Discharge violations ceased, fines stopped, and litigation was avoided.

It is interesting that such a simple application such as a beverage wastewater could result in so many complications. It is easy to assume that a food waste should be easily treated, but that is often not the case.