TRIAL TREATMENT REPORT
Improvement in the Operation of a Meat Processing Wastewater Treatment System using a Biocatalyst

Armour Swift-Eckrich Brown 'N Serve Sausage Plant
S1.Charles, Illinois

November 2, 1998

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1. Introduction

The purpose of this report is to present the results of a trial treatment of wastewater from the Armour Swift-Eckrich, Brown 'N Serve Sausage Plant (BNS Plant) located in St. Charles, Illinois (near Chicago). Armour Swift-Eckrich (ASE) is a division of ConAgra, Inc. The treatment uses a new biocatalytic technology provided by Worldwide Environmental Technologies Corporation (WETCO). Positive results were observed during the trial period including improved operating results and reduced costs of the BNS Plant wastewater treatment facility.

2. Plant Description

The BNS Plant blends different meats into sausage, cooks the sausage, flash freezes and packages the final product. The plant has been in operation for about 20 years. Design data from the plant operators indicated that the wastewater from the cooking process and from daily cleaning of the production equipment averages 150,000 gallons per day at about 4,900 ppm BOD and 640 ppm FOG. During daily cleaning the pH of the wastewater can reach 11 to 12. The wastewater is treated prior to discharge to the City of St. Charles municipal sewer.

During the trial period of March through early May of 1998, the wastewater treatment facility at the BNS Plant utilized an activated sludge type process with a 450,000 gallon 72-foot diameter circular concrete above-ground equalization basin, a similar sized aeration basin, and a 24-foot diameter, 16-foot high steel clarifier tank with a capacity of 42,000 gallons. Sludge was either returned to the aeration basin or dewatered with a belt filter press prior to landfill disposal. Aeration was provided with a combination of two Aeromix units (one unit was down for repairs during the trial), positive displacement blowers with a diffuser at the bottom of the basin, and supplemented by plant compressed air with a diffuser.

The wastewater treatment facility was originally designed with a Dissolved Air Floatation (DAF) unit to remove grease and oil prior to the equalization basin. This DAF unit had been out of service for over a year due to mechanical problems. As a result, the equalization basin had developed a four-foot thick grease cap and the organic load on the biological treatment process was quite high. Dissolved oxygen in the equalization basin was very low. Added to these problems was the difficulty in maintaining a biological population in the aeration basin due to the periodic high pH levels and the chemicals used to clean and disinfect the production equipment. Bacteria were periodically added to the aeration and equalization basins to help sustain biological activity.

In April 1998, construction began for an upgrade of the wastewater treatment facility at the BNS Plant. The upgrade includes a new lift station, pH adjustment tank, DAF unit, and clarifier. In addition, the former equalization basin will be retrofitted to become a new aeration basin. The upgraded facility will also treat wastewater from an adjacent dry sausage plant and is scheduled to be in operation by the end of 1998. None of these new upgrades were in operation during the trial.

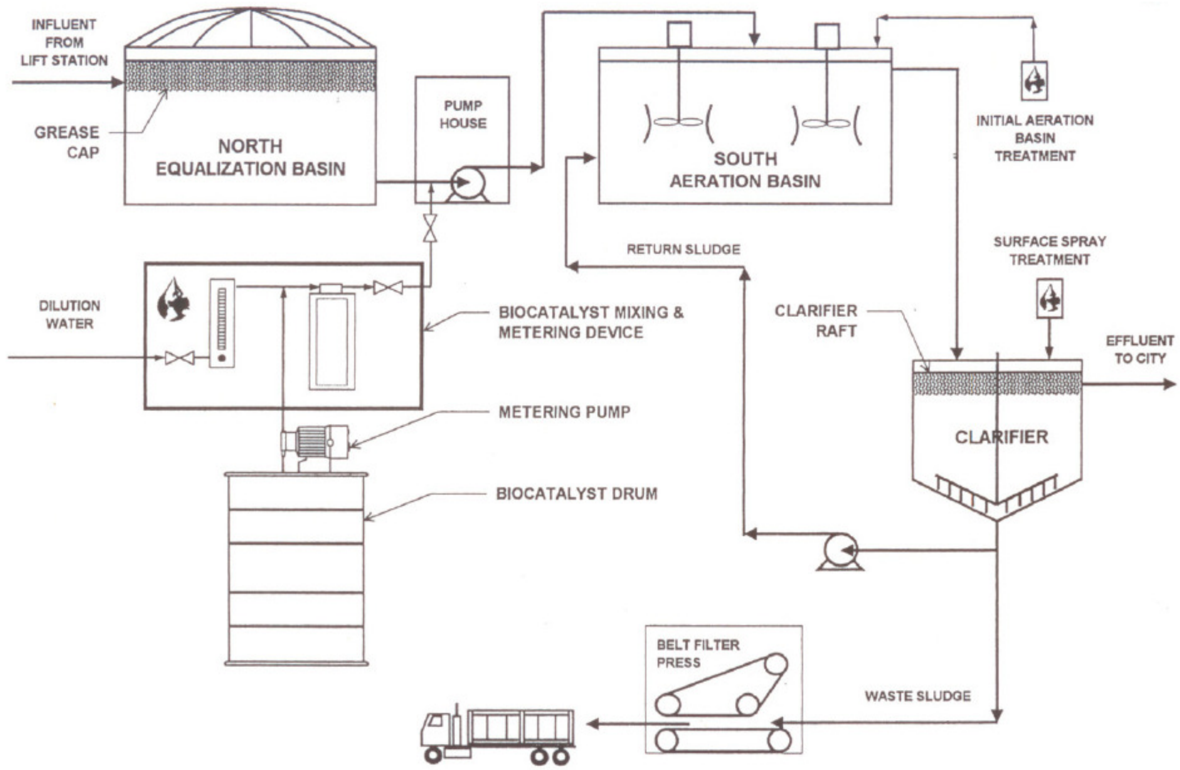
3. Trial Purpose and Development

The purpose of the trial was to demonstrate how the biocatalytic technology could reduce odor and improve the operation of the wastewater treatment facilities at the BNS Plant. Specifically, the trial was designed to examine the extent of reduction in the formation of floating (or "bulking") sludge resulting in the growth of a scum layer, or "raft" in the wastewater clarifier. The plant operators discovered through microscopic examination that this raft was caused by the growth of "filamentous" organisms in the treatment process. These organisms are characterized by long filaments that cause the biological flocs to be bulky and loosely packed, causing them to float rather than settle in the clarifier. This clarifier raft was a semisolid material high in fats and oils, and had been a source of high cost for the plant operators since the original DAF unit had been taken out of service. Historically, the raft would grow at a rate of about four feet in a month, or twelve inches per week. The raft would require removal with a vacuum truck every three to four weeks at significant expense.

The growth of filamentous organisms is caused by a variety of factors, the most typical of which are low dissolved oxygen levels in the aeration basin, and low food-to-microorganism ratio (see reference). In other applications, the biocatalyst treatment has been effective in reducing the presence of these organisms by improving the efficiency of wastewater aeration through the formation of catalytic micro bubbles and by solublizing organic materials in the wastewater to present them to the bacteria as food in a more easily digestible form. This trial was designed to monitor dissolved oxygen and BOD levels in the aeration basin, along with clarifier raft thickness. Dissolved oxygen levels were expected to increase and BOD levels were expected to decrease with more efficient digestion of organic matter.

In addition, in the warmer months, the wastewater treatment facility had odor problems. The biocatalyst has proven in other applications to be very effective in odor control by breaking down volatile organic compounds that cause odor. The trial was also designed to make observations of odor levels during the trial.

A Trial Treatment Plan for this facility was developed by WETCO in January 1998. The plan calls for an initial treatment of the aeration basin with a liquid biocatalyst; continuous injection of the biocatalyst; and surface treatment of the clarifier. Figure 1 illustrates the trial arrangement. The biocatalyst product used in the trial was EcoSystem Plus (ESP), manufactured by Neozyme, International, Inc. WETCO provided the mixing and metering device, set up the trial, and worked with the plant operators to monitor results. Dissolved oxygen was monitored three times per day in the aeration basin. In addition, the thickness of the clarifier raft was monitored weekly during the trial. Other data were also collected from plant operator logs and periodic sample analysis.



TRIAL TREATMENT APPARATUS **FIGURE 1**
ARMOUR SWIFT-ECKRICH PLANT, ST CHARLES ILLINOIS

4. Trial Operation

Six samples of wastewater from the North and South Basins were collected by the plant operator in the two weeks prior to the trial (3 in each week) and analyzed by a commercial laboratory for BOD and COD. These samples established a baseline reference for the treatment. The clarifier was cleaned out just prior to the trial and the raft was measured at 15 inches thickness at the trial start.

The trial began on March 9, 1998 and ran for eight weeks until May 4, 1998. The operator continued the treatment after the end of the trial period until May 27. The biocatalyst was diluted with clean water, then injected into the suction side of the transfer pump between the North and South Basins. The injection point was changed to the top of the South Basin on April 2. The biocatalyst was injected at an initial rate of7.35 gallons per day in a 0.25% solution creating a target concentration of about 48 mg/L of biocatalyst in the wastewater stream (at 150,000 gallons per day). Actual concentration varied with the actual daily wastewater flow rate, and with variations in the biocatalyst feed rate during the trial. The actual biocatalyst concentration averaged about 120 mg/L over the trial period with average daily concentrations ranging from about 57 mg/L up to 385 mg/L. The actual wastewater flow rate during the trial averaged about 82,000 gallons per day, significantly lower than originally estimated. The aeration basin treatment was carried out over the first two days of the trial, and the surface treatment of the clarifier was carried out on April 14.

The operator collected three samples from the North and South Basins in the week immediately following the trial period for comparison with the baseline samples taken prior to the trial.

5. Sampling and Analysis Results

a. Dissolved Oxygen

Dissolved oxygen levels observed in the South Basin in the month before the trial were quite low, averaging 0.2786 mg/L. These measurements were taken by the plant operator using a dissolved oxygen probe/meter at four different locations in the aeration basin three times each day. The observed levels were then averaged for the day. These low dissolved oxygen levels favor the growth of the filamentous organisms that caused the clarifier raft to form. Although still low, the average dissolved oxygen measured in the same manner during the final month of the trial was 0.3546 mg/L, an increase of about 27%. Figure 2 shows that the dissolved oxygen trended lower during the first four weeks of the trial as the biocatalyst encouraged more bacterial growth, then increased. The mechanical aeration equipment operated at the same rate during the trial as before the trial.

b. BOD

The South Basin BOD averaged 5,752 mg/L in samples taken before the trial, and 4,584 mg/L in the samples taken after the trial (a reduction of about 20%). Using COD as an indicator, the BOD level in the South Basin increased in the first several weeks of the trial, then decreased as biological activity increased. Figure 2 also shows this trend. The operator observed that samples from the South Basin during the first several weeks of the trial had poorer settling clarity indicating increased solublization of organic materials consistent with initially higher BOD results. These results are consistent with expectations, and indicate that the treatment increased the rate of organic matter breakdown in the aeration basin after an initial adjustment period.

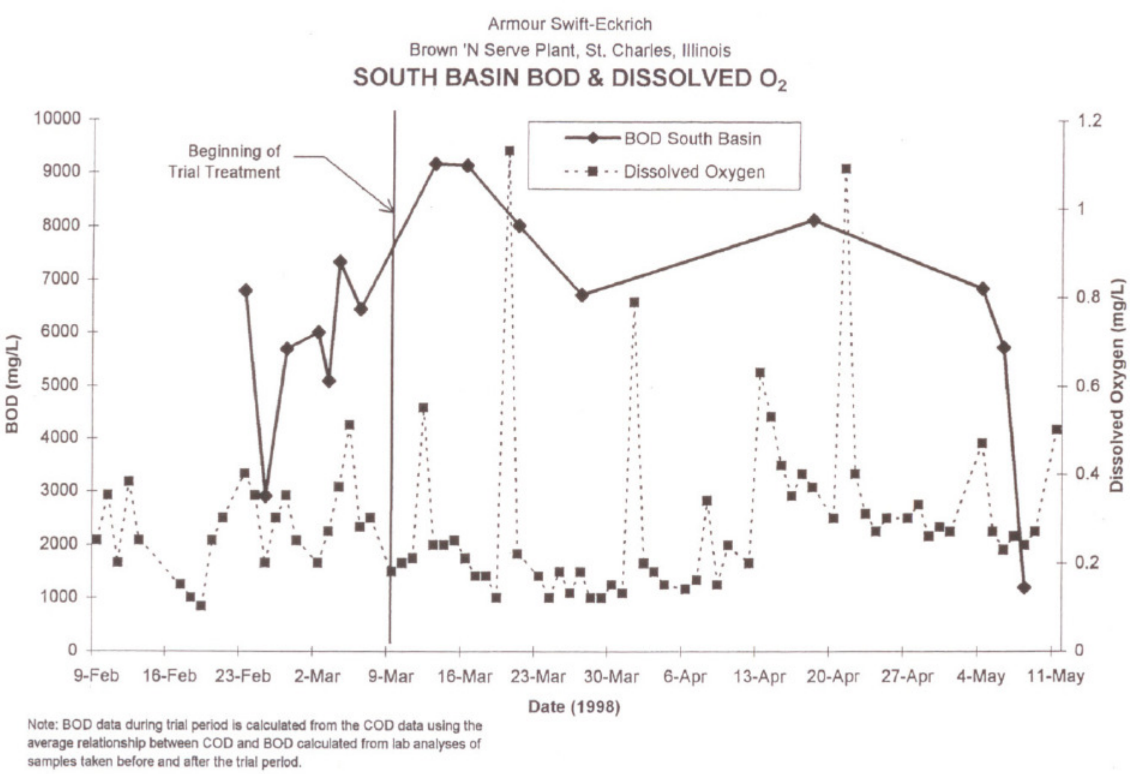


FIGURE 2

c. Clarifier Raft Growth

The growth of the clarifier raft was drastically reduced during the trial. Figure 3 is a graph of the data. Before the trial, the growth rate was a fairly constant 12 inches per week. During the trial, the raft did not increase in thickness at all for the first three weeks and only one inch in the fourth week. A temporary piping change on April 7 to accommodate the new construction caused a large amount of floating scum from the aeration basin to be pumped into the clarifier, adding 18 inches to the raft and invalidating the data for the following measurement. In the final three weeks of the trial, the raft thickness grew only ten more inches total. Operator logs indicate that the clarifier did not require clean out until June 2 when the raft reached 48 inches. This was the first clean out in 12 weeks since the trial began. Even with the additional 18 inches, the clarifier raft required removal only once in 12 weeks in contrast to every three to four weeks before the trial (a reduction in the growth rate of 75%). The plant operator also reported that microscope observations of wastewater samples taken from the aeration basin during the trial showed significant reduction in the presence of filamentous organisms which had been observed before the trial.

It appears that the modest increase in dissolved oxygen combined with the higher soluble levels of organic material in the aeration basin significantly reduced the presence of filamentous organisms, and drastically reduced the growth of the clarifier raft. It is important to note that when the biocatalyst injection was stopped after the end of the trial to allow for new plant construction, the clarifier raft growth rate returned to its previous level of 12 inches per week.

d. Odor

Observations of odor by the plant operators were also favorable. The operators reported significantly lower odor levels in general around the wastewater treatment facility. The operator also used a solution of the ESP product to successfully reduce odors during the cleanup of the old DAF unit as part of the new construction.

6. Cost Savings

The plant operator stated that the cost to remove the clarifier raft was between $4,000 and $6,000 every three to four weeks. Assuming an average of $5,000 every 3.5 weeks, the annual cost would be $74,300 per year. Assuming a 12-week clean out cycle with the biocatalyst treatment, the annual cost would be reduced to $21,700, a saving of $52,600 per year. The actual clean cycle could be longer with the treatment, indicating that savings could be greater than this estimate.

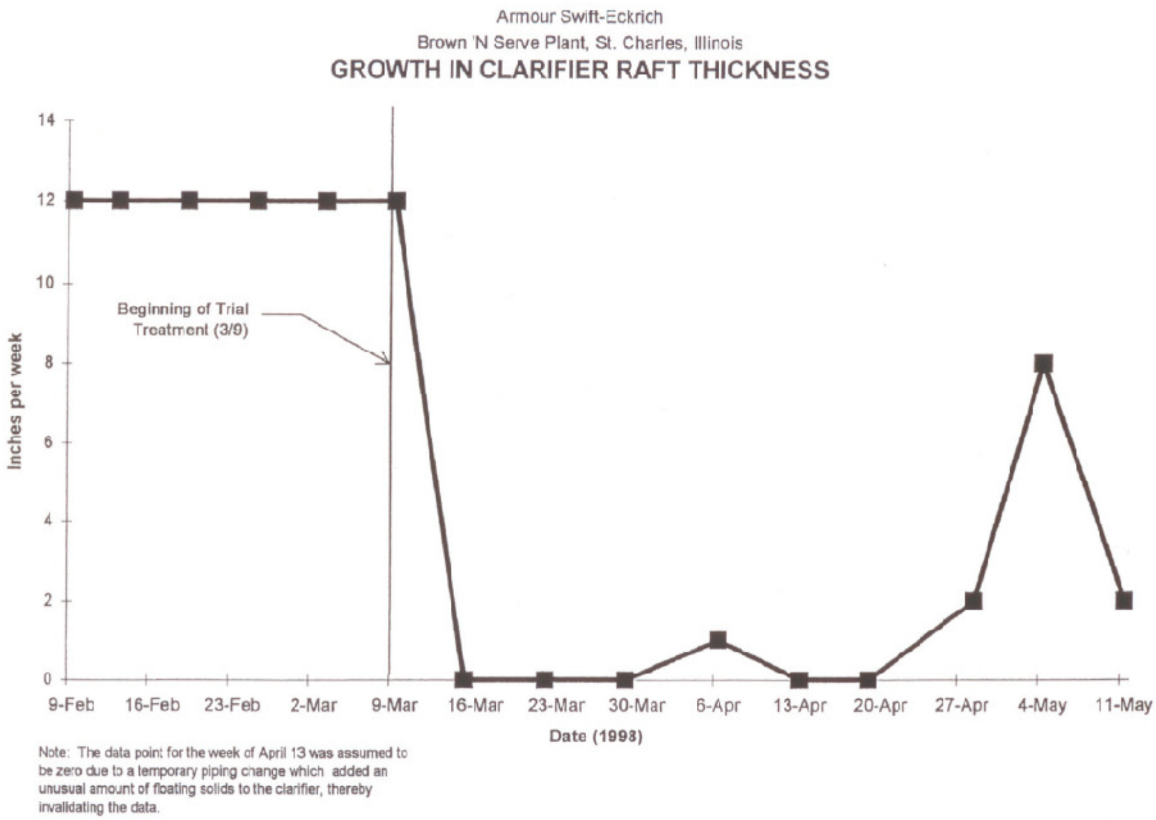


FIGURE 3

7. Conclusions

The treatment was successful in producing the following results;

- 27% increase in dissolved oxygen in the aeration basin
- 20% reduction in BOD in the aeration basin
- 75% reduction in the clarifier raft growth rate and cost saving of at least $52,600 per year
- Significantly reduced odor levels during the trial.

These results were accomplished without changing the operation of any mechanical component of the treatment facility.

It is likely that the biocatalyst treatment will produce even better results when the new treatment facilities are in operation. The new pH adjustment tank will reduce pH variations, and the new DAF will reduce the organic load on the facility. These changes should enhance the ability to maintain a consistent bacterial population. Since the biocatalyst operates with the bacteria in the system, its effects should also be enhanced. Additional cost savings could accrue from reduced power consumption of the aeration equipment due to increased aeration efficiency.

Reference:

G. Tchobanoglous, "Wastewater Engineering: Treatment, Disposal and Reuse", Metcalf & Eddy, Third Ed McGraw-Hill, New York. 1991, p. 554.

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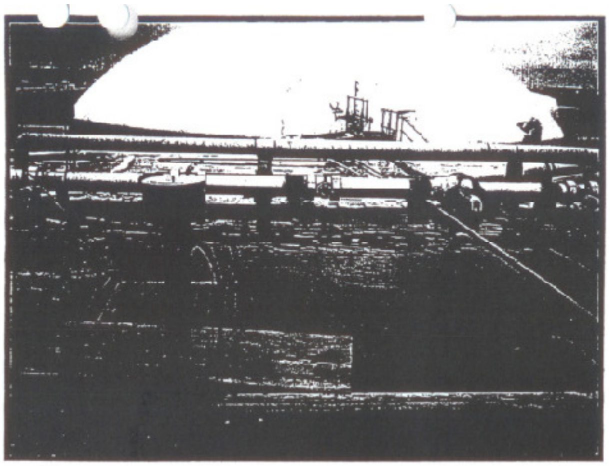

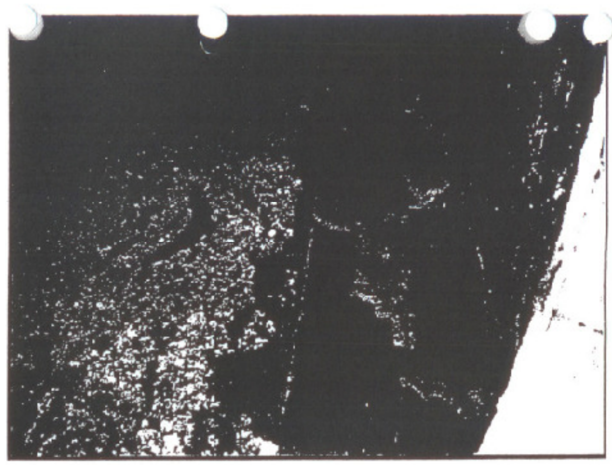

Photograph 1: South Basin (foreground) and North Basin (with cover). **Photograph** 2: Clarifier raft and discharge weir.

Photograph 3: Injection apparatus; Mixing and metering device (left) and biocatalyst drums with metering pump (right).