

BLACK & VEATCH CORPORATION

TECHNICAL MEMORANDUM

**Fountain Sanitation District
Master Plan Enhancement Study
Task 801 – Wastewater Treatment Plant Process Evaluation**

**B&V Project 137033
November 22, 2004**

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Workshop

A workshop was held at the District and a follow up conference call was held to discuss the District's wastewater treatment plant process. Prior to the workshop and conference call, Black & Veatch sent requests to the District for information on the District's plant process. The workshop and conference call were used to discuss questions and procedures with the District staff about the plant process. Following is a discussion of items discussed at the workshop, summary of data analysis performed and conclusions derived from the discussions.

Introduction

We have completed our preliminary process evaluation of the FSD WWTP. Our evaluation was limited to the activated sludge and aerobic digestion processes and focused on changes that might better achieve treatment objectives with regard to meeting the vector attraction reduction required for compliance with the EPA 503 regulations.

To summarize our results, it appears that additional digester volume is required to allow for a 20 day SRT in order to produce stabilized solids with an SOUR less than the regulatory limit of 1.5 mg/g/hr. Increasing SRT in the activated sludge system does not appear to be sufficient. Based on the modeling results, it also appears that the bench-scale testing to evaluate changes in VS destruction may show a change greater than 15%. The results from the testing by the District on the VS destruction will be evaluated when the test is concluded to see how the results compare with predicted performance.

Task Approach

B&V's activated sludge model (CMAS) and aerobic digester model (AERDIG2) were used for this evaluation. Our modeling approach consisted of:

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- **Monitoring Data Analysis** - Available monitoring data were analyzed to determine influent characteristics and key treatment performance indicators. Various calculations were used to prepare data for model input.
- **Model calibration** - Total existing aeration basin volume of 2.54 million gallons and aerobic digester volume of 220,500 gallons were used in combination with current operating data to validate the models.
- **Predict performance for the following operating scenarios:**
 - Increase SRT in activated sludge basin to 19 days, keeping existing aerobic digester volume and operations the same.
 - Increase total aerobic digester volume to 1,000,000 gallons to predict performance at an aerobic digestion SRT of approximately 20 days: operate activated sludge system at a 12 day SRT and at a 19 day SRT
 - Increase total aerobic digester volume to 2,000,000 gallons to predict performance at an aerobic digestion SRT of approximately 40 days, operate activated sludge system at a 12 day SRT and at a 19 day SRT

Data Analysis and Model Validation

We were provided with the dataset that was used for our modeling efforts. The influent wastewater characteristics dataset was limited to January and February of 2004. FSD provided operating data for the span of January 2004 to the end of June 2004. Table 6-1 below provides a summary of the influent wastewater characteristics used in our modeling efforts.

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Table 6-1 Influent Wastewater Characteristics			
Parameter	Value	Units	Data Source
Flow	1.10	MGD	Average of flows provided by FSD for period of 1/1/04 to 6/30/04
BOD	353	mg/l	CBOD provided by FSD for period of 1/2/04 to 2/25/04. Average increased by 20% to estimate BOD which is typically more than CBOD due to suppression impact of inhibitor added to test.
TSS	339	mg/l	Calculated from previous average TSS loading data (3,092 lbs/day determined by T. L. Johnson in 6/24/02 e-mail) and above average influent flow. The data set provided for Jan and Feb indicated an average TSS of 400 mg/L which does not correlate with other operating information.
TKN	40	mg/l	Assumed
VSS/TSS	0.85	-	Assumed. CMAS calibration run supported this ratio based on predicted MLVSS/MLSS.

Based on the 6-month dataset, it appears that FSD is wasting activated sludge at an average rate of 2,134 ppd. Using this wasting rate in combination with the reported mass in the aeration basins, the system SRT was calculated to be 12 days. Using the influent characteristics noted previously, the activated sludge model predicted an SRT of 9.3 days and an average WAS rate of 2700 ppd which is approximately 27% above the reported values. This SRT and WAS rate was based on matching the MLSS and MLVSS (1,223 mg/l and 976 mg/l, respectively). Increasing the SRT to 12 days reduced the WAS quantities to 2600 ppd and increased the MLSS to 1500 mg/L.

Using the output from the 9 day and 12 day SRT activated sludge model runs as input to the aerobic digester model yielded the following performance:

- WAS generated from modeling a 9 day SRT in the activated sludge system yielded 15% VS destruction and an SOUR at 20°C of 4.2 mg/g/hr.

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- WAS generated from modeling a 12 day SRT in the activated sludge system yielded 13% VS destruction and an SOUR at 20°C of 3.3 mg/g/hr.

The performance using the solids characteristics from the 12 day SRT is close to the 11% VS destruction and SOUR at 20°C of 3.3 mg/g/hr reported in the data set. As a result, it would appear that the biology in the activated sludge basins is operating at around 12 days and the discrepancy in sludge quantities between the data and the modeling is a function of insufficient influent data to accurately model what is fed to the plant. In addition, WAS quantities are only available once per week so the numbers could be slightly off also.

Alternative Evaluation

Because the predicted performance of the digester matched well with reported performance, it was decided that while the absolute values might not be correct with respect to sludge quantities, the biological quality of the sludge could be predicted well enough to evaluate alternative operating scenarios. As noted previously, we evaluated various options including increasing the SRT of the activated sludge as well as increasing the volume of the digester. The results are presented in Table 6-2 below.

Option	AS SRT, days	Dig SRT, days	VS Destruction, %	SOUR, mg/g/hr
Current Operation	12	4.6	13	3.3
1 – Increase AS SRT	19	5	10	2.3
2a – Increase AS and Dig SRT	19	20	14	0.7
2b – Increase AS and Dig SRT	19	40	15	0.4
3a – Increase Dig SRT	12	20	19	1.1
3b – Increase Dig SRT	12	40	20	0.6

Conclusions from this predicted performance include:

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- Increasing the SRT of the activated sludge system alone will not meet regulatory SOUR requirement of 1.5 mg/g/hr (Option 1).
- Increasing the SRT of the activated sludge system and the digester SRT would increase VS destruction and reduce SOUR to less than 1.5 mg/g/hr (Option 2a).
- Keeping the activated sludge SRT at 12 days and increasing the digester SRT to 20 days could yield a significant increase (46%) in VS destruction (Option 3a).
- It appears that FSD may have difficulty meeting the bench-scale test criteria of <15% additional VSS destruction outlined in 40 CFR 503.33(b)(3) at the current activated sludge operations as well as with an increased SRT in the activated sludge system unless additional digestion capacity is provided.
- Additional digestion capacity to allow for a 20 day SRT is probably required to meet vector attraction reduction requirements.
- Increasing the digester SRT to 40 days does not yield significant benefit over the 20 day operation; however, the bench-scale test may be the preferred method of compliance as the SOUR values will be close to the regulatory requirement.

Recommendation

In order to develop a better understanding of the District's treatment process additional analysis need to be performed:

- Since our evaluation is limited to steady-state operation of the aeration basins and aerobic digesters, a more detailed analysis would consist of additional case scenarios using the same models as before.
- For master planning efforts, we recommend evaluating monitoring data from the most recent 3 to 5 years. This allows assessment of seasonal fluctuation along with long-term loading trends. For the District, the recommended dataset would consist of daily average values for parameters some of which include:
 - Aeration Basin Influent Flow
 - Aeration Basin Influent BOD5
 - Aeration Basin Influent TSS
 - Aeration Basin Influent VSS
 - RAS % Volatile
 - RAS Flow
 - WAS Flow
 - Aerobic Digester Volume In-Service

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- Aeration Basin Influent TKN
- Aeration Basin Influent NO₃-N
- Aeration Basin Influent Alkalinity
- Aeration Basin Volume In-Service
- Solids Retention Time (SRT)
- MLSS
- MLSS % Volatile
- Mixed Liquor Temperature
- Mixed Liquor DO
- Mixed Liquor SOUR
- RAS TSS
- Aerobic Digester Temperature
- Aerobic Digester DO
- Aerobic Digester TSS
- Aerobic Digester SOUR
- Aerobic Digester % Volatile
- Hauled Sludge Volume
- Hauled Sludge % Solids
- Hauled Solids Mass
- Final Clarifier Surface Area In-Service
- Final Effluent BOD₅
- Final Effluent TSS

We recommend fairly frequent flow measurements, approximately one per day. Other parameters can be less frequent, approximately one per week, and still be adequate.

- If the scope of the evaluation is expanded to look at transient phenomena (wet-weather events, diurnal fluctuations, etc.) then a dynamic model such as GPS-X will need to be used for analysis.

These analyses should provide more information to help determine what changes may be needed to the process to deliver a better overall performance. Another option will be to have a Black & Veatch operator work with the District staff for a period of time to offer additional suggestions of process changes that can be made to deliver a better overall performance.