Recycle Paperboard Manufacturer Midwestern United States

Summary of EBS Site Visit
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Purpose of Visit

- Mill has reduced water usage (discharge) by about 70% over the past year.
- As a result, performance of the wastewater treatment system (SBR) has deteriorated.
- Recently, effluent quality has been unacceptable relative to the mill's permit with the city.
- Consequently, no water had been discharged for the two weeks prior to my visit and untreated water inventory was reaching critical levels.

Technical Approach

- An initial observation was made that a leaking valve was making it impossible to maintain level in the SBR. Consequently, untreated wastewater was being introduced into the SBR during the treatment cycle.
- This problem was corrected. I then monitored a full batch every eight hours for the 48 hour period.
  - This batch was made up of 7 feet of influent added to 7 feet of MLSS at ~3000mg/l, which was a relatively highly loaded situation.
  - The batch was aerated until SOUR and soluble COD levels stabilized, which took 48 hours.
  - The air was turned off and 60 gallons (750 ppm) of coagulant was added and recirculated for one hour.
  - The recirculation was stopped and the tank settled until the next morning.
  - At that time the TSS was below 200 mg/l and 3 ft (~20,000 gallons) was discharged to the city.
- The remainder of this presentation summarizes my observations, comments, and recommendations regarding the system during this three day period.

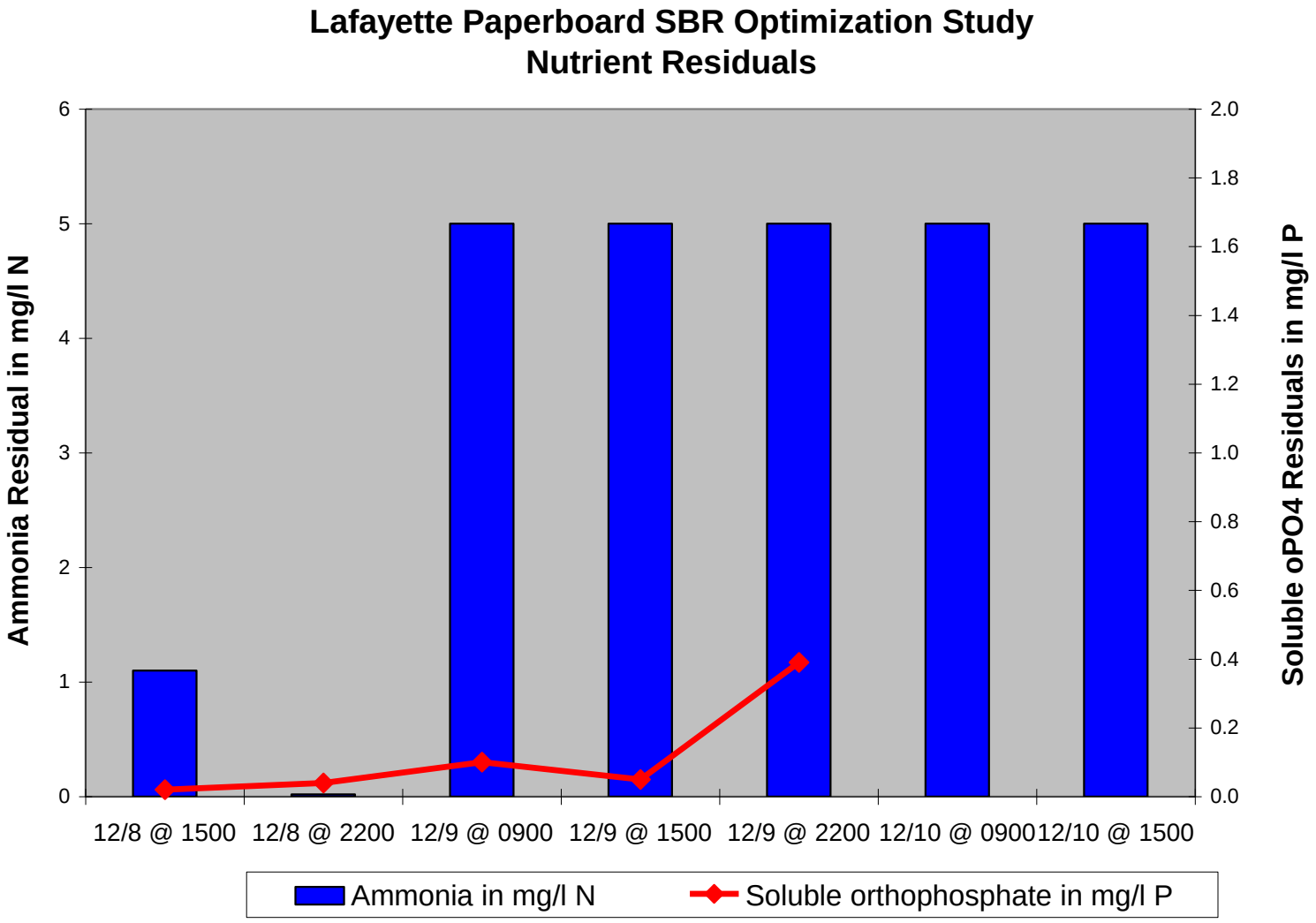
Key Issues or Areas of Importance

- Nutrient Control
- Loading Monitoring and Control
- Load Reduction to SBR
- Process Monitoring
- Short-term Operating Strategy
- Future Activities

Nutrient Control

- Phosphorus source questionable – poor solubility
- The mill should run N and P residuals on-site. Reagents have been ordered.
- Target residuals for both ammonia and soluble orthophosphate are 1 – 2 mg/l.

Nutrient Residuals During Test Batch



Loading Monitoring and Control

- Food to Mass ratio control in critical to consistent batch operation.
- Initially, it appears that limiting the influent content of a batch to 20,000 gallons and maintaining a MLSS of 3500 – 4500 will achieve an acceptable f:m ratio, but this is not based on real BOD loading values.
- Recommend monitoring BOD in and out of CSTR twice weekly for one month to get a handle on loading.

Load Reduction to SBR

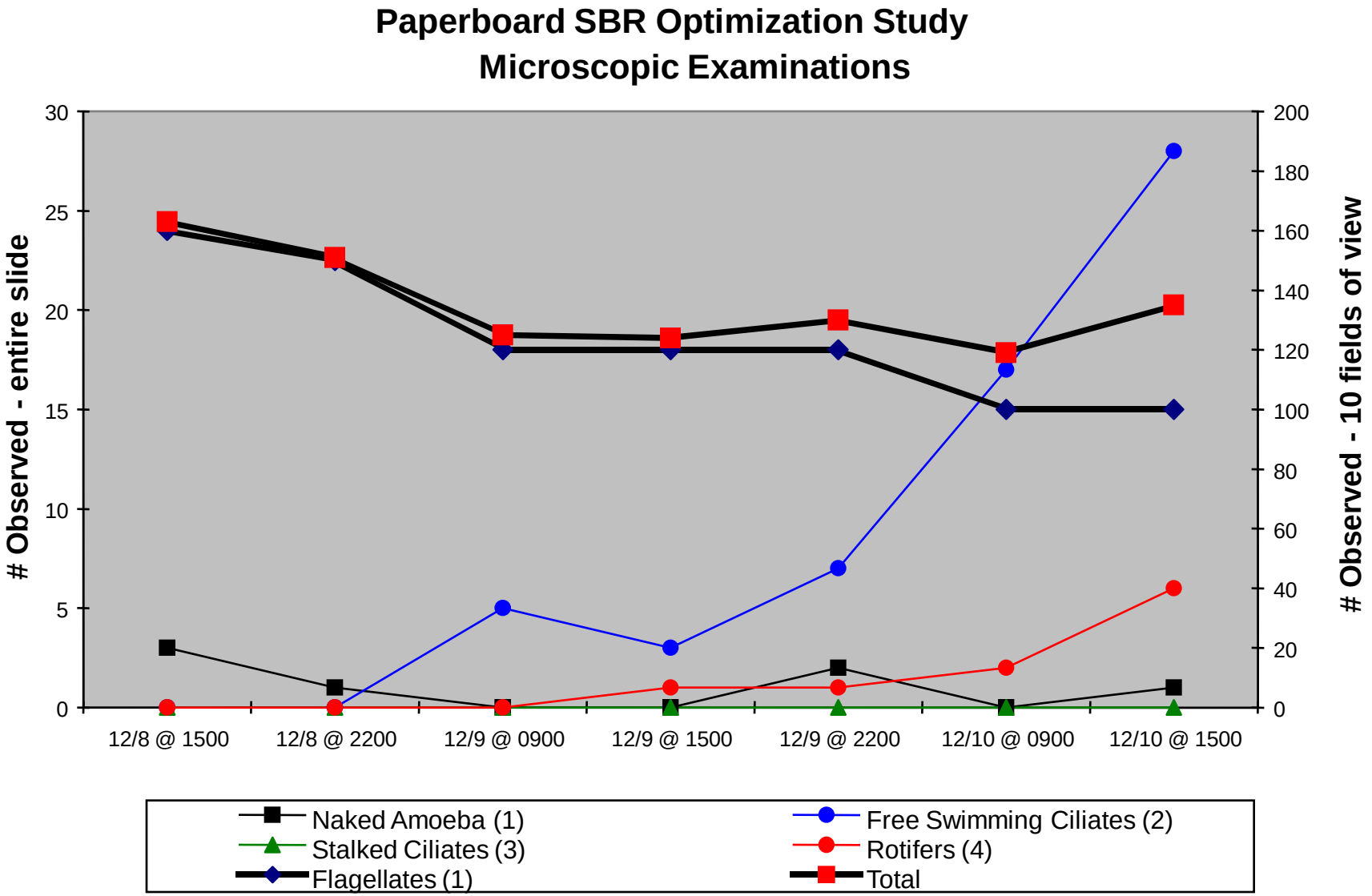
- Using 400k tank as CSTR for load reduction
  - Great concept, but may be counter productive if large amount of fiber are entering CSTR and forming BOD.
  - Recommend bioaugmentation to CSTR of 25 lbs per week.
- Reducing fiber to SBR
  - Side hill stream can be high in fiber, which contributes an delayed BOD, particularly with using CSTR as primary reactor.
  - If solids routinely exceed ~250 mg/l in process water, it may be worthwhile to evaluate using the 100K tank as a “primary clarifier.”

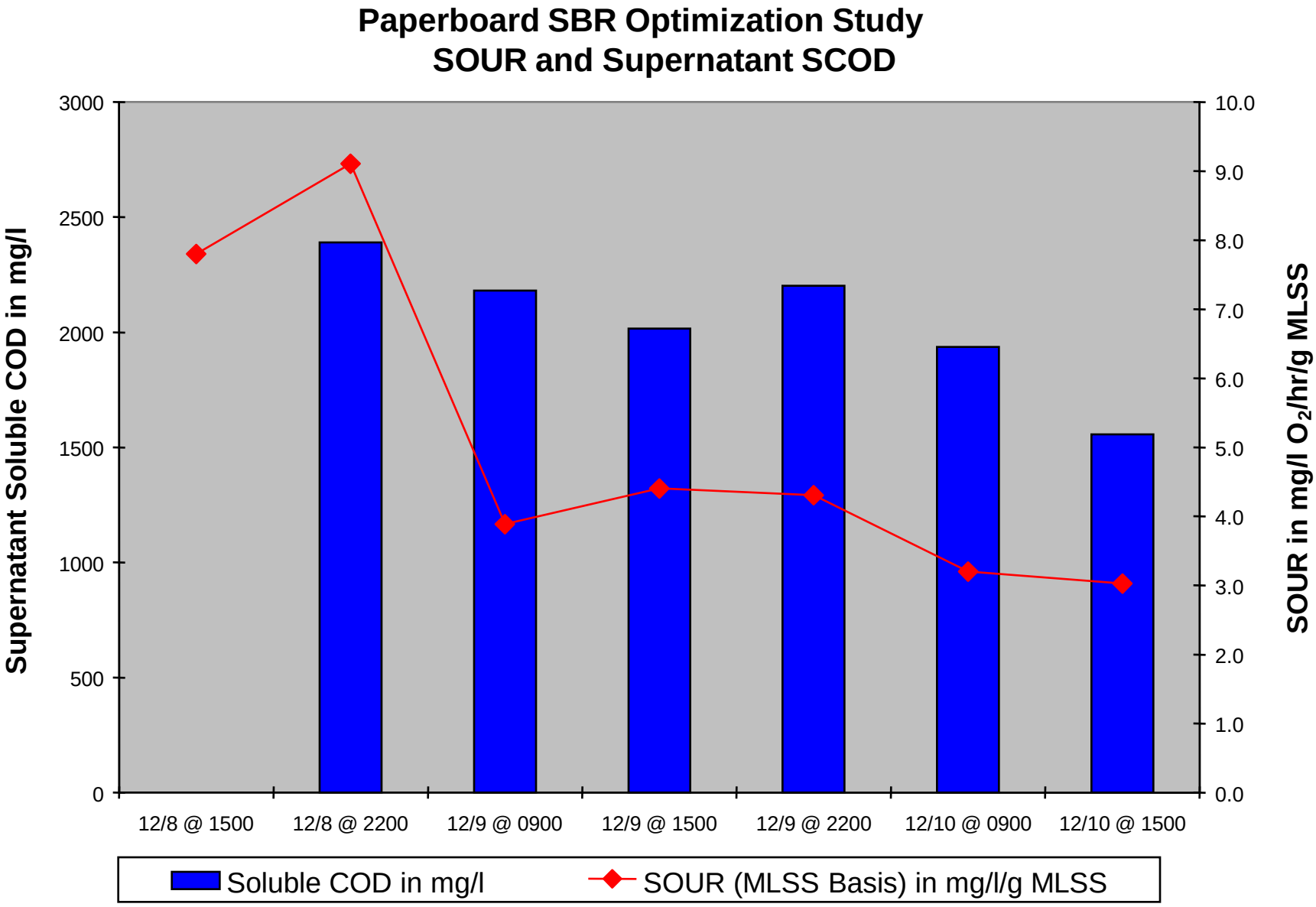
Process Monitoring

- A spreadsheet was developed that can serve as an operator log sheet for monitoring the process. For the next month or so, additional testing may be required as we attempt to better understand the loading to the system, but long-term, this sheet includes the critical parameters to ensure compliance.
- Monitoring the microbiology and determining the specific oxygen uptake rate are useful for determining the status of the batch in process.
- The mill's microscope inadequate for detailed examination, but is sufficient for basic assessment of advanced higher life forms. The microscope should be sent in for cleaning and service.
  - Poor ability to examine floc or quantify filaments
  - Useful only to find ciliates, stalks and rotifers
- EBS can provide more detailed microscopic examinations on an as needed basis in support of the nutrient/bioaugmentation program.

Process Monitoring Spreadsheet

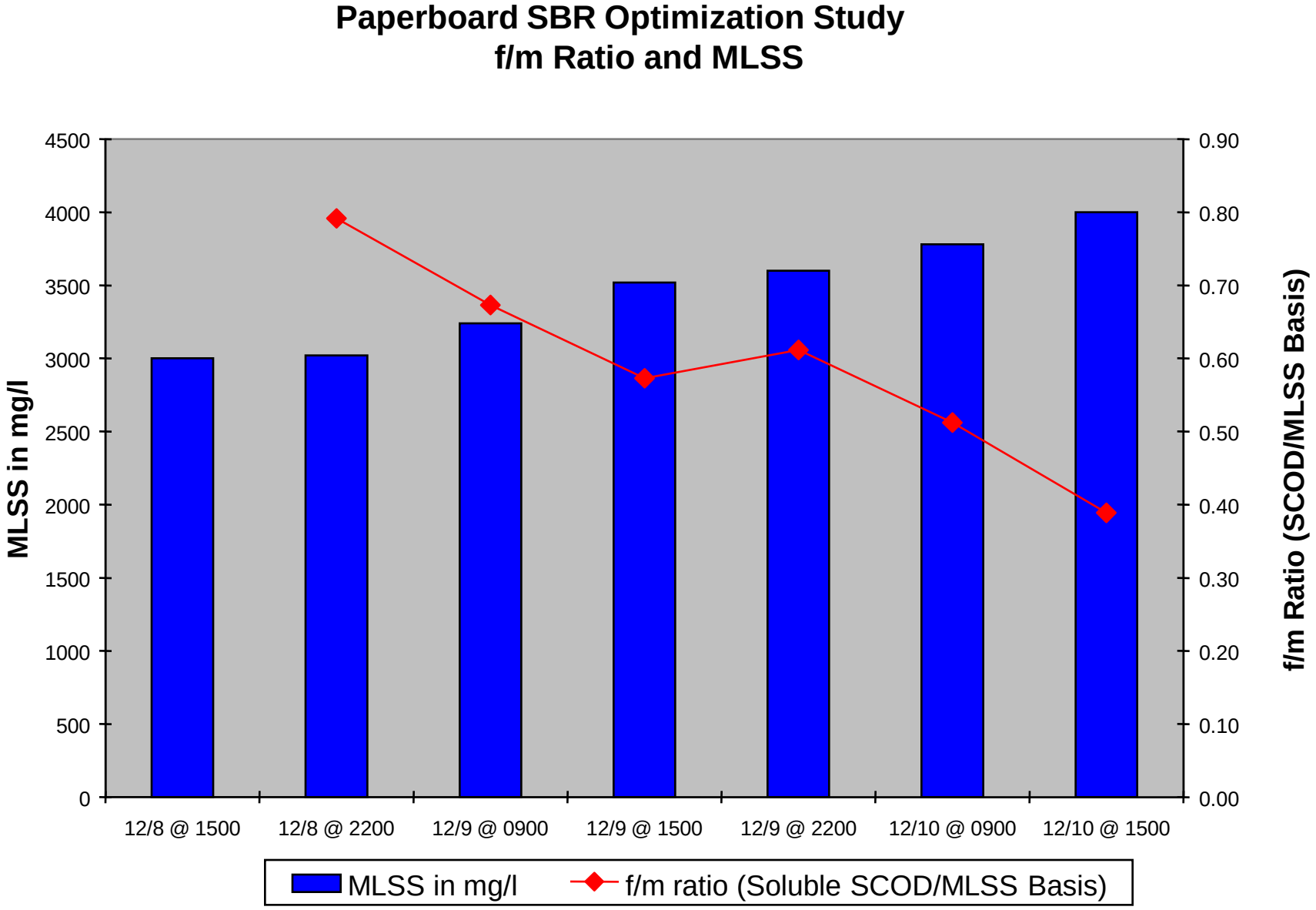
	12/8 @ 1500	12/8 @ 2200	12/9 @ 0900	12/9 @ 1500	12/9 @ 2200	12/10 @ 0900	12/10 @ 1500		
Naked Amoeba (1)	3	1	0	0	2	0	1		
Flagellates (1)	160	150	120	120	120	100	100		
Free Swimming Ciliates (2)	0	0	5	3	7	17	28		
Stalked Ciliates (3)	0	0	0	0	0	0	0		
Rotifers (4)	0	0	0	1	1	2	6		
Nematodes (5)	0	0	0	0	0	0	0		
Total	**163**	**151**	**125**	**124**	**130**	**119**	**135**	**Targets**	**Targets**
***Maturity Index**	**1.00**	**1.00**	**1.04**	**1.05**	**1.08**	**1.19**	**1.34**	**2.0 - 2.5**	**2.0 - 2.7**
Floc Structure (1 - 5)	1	1	2	2	2	3	3	**2**	**1**
Dispersed Bacteria or Pin Floc (1 - 5)	5	5	5	5	4	4	4	**4**	**5**
Filament Abundance (0 - 6)	1	1	1	1	1	2	2	**4**	**5 - 6**
India Ink Stain (1 - 3)	1	1	1	1	1.5	1.5	1	**2**	**3**
30 minute settling	480	500	550	480	600	600	600		
Supernatant TSS (1 hr) in mg/l	880	1040	930	1040	830	1260		**200 - 250**	**>250**
MLSS in mg/l	3000	3020	3240	3520	3600	3780	4000	**2500 - 3500, 4500 - 5000**	**<2500, >5000**
SVI	160	166	170	136	167	159	150	**200 - 250**	**>250**
Ammonia in mg/l N	1.1	0.02	5	5	5	5	5	**0.5 - 1.0**	**<0.5**
Soluble orthophosphate in mg/l P	0.02	0.04	0.10	0.05	0.39			**.25 - 1.0**	**<0.25**
Soluble COD in mg/l		2390	2180	2016	2202	1936	1556		
DOUR in mg/l/hr	23.4	27.5	12.6	15.5	15.5	12.1	12.1		
SOUR (MLSS Basis) in mg/l/g MLSS	7.8	9.1	3.9	4.4	4.3	3.2	3.0		
f/m ratio (Soluble SCOD/MLSS Basis)		0.79	0.67	0.57	0.61	0.51	0.39		
TSS w/ polymer in mg/l				360	245	246	247	**200 - 250**	**>250**


Paperboard SBR Optimization Study
Microscopic Examinations
Observed - entire slide
Observed - 10 fields of view
30
25
20
15
10
5
0
200
180
160
140
120
100
80
60
40
20
0
12/8 @ 1500
12/8 @ 2200
12/9 @ 0900
12/9 @ 1500
12/9 @ 2200
12/10 @ 0900
12/10 @ 1500
Naked Amoeba (1)
Free Swimming Ciliates (2)
Stalked Ciliates (3)
Rotifers (4)
Flagellates (1)
Total

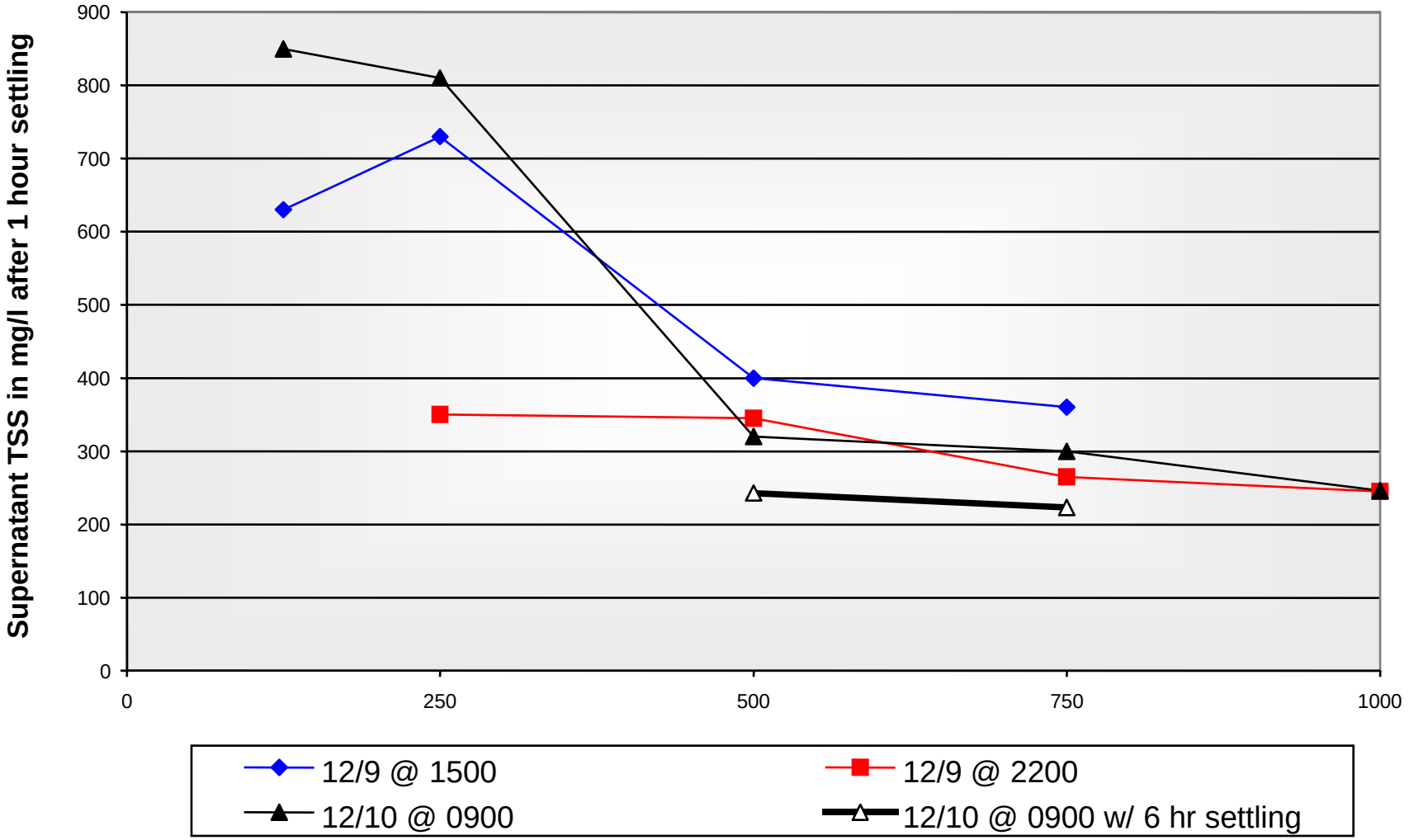

Paperboard SBR Optimization Study
SOUR and Supernatant SCOD
Supernatant Soluble COD in mg/l
SOUR in mg/l O2/hr/g MLSS
3000
2500
2000
1500
1000
500
0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12/8 @ 1500
12/8 @ 2200
12/9 @ 0900
12/9 @ 1500
12/9 @ 2200
12/10 @ 0900
12/10 @ 1500
Soluble COD in mg/l
SOUR (MLSS Basis) in mg/l/g MLSS

Short-term Operating Strategy

- SBR batches must be run as distinct batches. Adding influent during aeration cycle disrupts the process.
- Do not decant/add more than 20,000 gallons (3 feet) of CSTR water to SBR #2 until we have a better handle on the incoming BOD_5.
- Waste to maintain MLSS in range of 3500 - 4500 mg/l.
- Utilize coagulant to enhance clarification as needed. Current dosage requirement is 500 - 750 mg/l, but this should drop off as the system continues to mature and stabilize.


Paperboard SBR Optimization Study
f/m Ratio and MLSS
MLSS in mg/l
f/m Ratio (SCOD/MLSS Basis)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
12/8 @ 1500
12/8 @ 2200
12/9 @ 0900
12/9 @ 1500
12/9 @ 2200
12/10 @ 0900
12/10 @ 1500
MLSS in mg/l
f/m ratio (Soluble SCOD/MLSS Basis)

Paperboard SBR Optimization Study
Polymer Test Results



Future Activities

- Run BOD_5 entering the 400K tank twice weekly for one month
- EBS will submit a separate proposal for the following items:
  - A respirometry study to determine optimum f:m ratio, cycle time, and COD/BOD ratio
  - Bioaugmentation cultures
  - Liquid nutrient blend
  - Follow up site visit for additional training and refinement of process control strategy