Checking Parameters : 1045

R1 INF
pH – 7.34
Turb – -10
Cond – 1.34 mS/cm
DO – ~7.0 mg/L

R1 INT
pH – 7.45
Turb – -10
Cond – 1.33 mS/cm
DO – 3.0 mg/L

R1 EFF
pH – 7.55
Turb – -10
Cond – 1.36 mS/cm
DO – 1.34 mg/L
T – 21.2°C
Sal – 0.06 % (?)

R2 INF
pH – 7.39
Turb – -10
Cond – 1.29 mS/cm
DO – 5.25 mg/L
T – 20.8°C
Sal – 0.05%

R2 INT
pH – 7.62
Turb – -10
Cond – 1.25
DO – 1.67 mg/L
T – 21.2°C
Sal – 0.05%

R2 EFF
pH – 8.07
Turb – -10
Cond – 1.31
DO – 0.83
T – 21.5°C
Sal – 0.05%

1115 – 1300 offsite to pick supplies & get lunch.

1315 Noticed flowmeter for R2 is not registering flow. Flow through R2 seems OK, though based on flow going into Eq tank (by R1 eff valve shut).

1345 Resume pumping through R2. Flowmeter now reading flow OK.

1430 Empty contents of dilution feed tank (~450 gal) + some tap water (to clean tank) into Baker Tank.

1530 Added ~200 gal OK treated tap water to nutrient feed tanks along with 330 g $(NH_4)_2PO_4$.

1600 Diluted make up water in substrate feed tank for reactor #2 – Added ~1/2 of tank vol of treated tap water.

1615 ~~[illegible]~~ Forward flow resumes.
Was off for about 1 hour
due to using freshwater feed
pump to fill feed tanks.

1630 D. Tinnes on-site.

Check system totalizer readings:

R1 1918.1 gal
R2 3519.2 gal

Final system check - OK.

1640 D. Tietje offsite.

D. Tietje

WEDNESDAY AUGUST 28

0730 Andre on-site. P. Timmes already on-site.

System Check — Influent Feed Pump is off. Ex Tank #1 is full, & #2 is high. High ΔP through bag filter apparently backed up the system & caused the influent flow to stop.

Check #gallons treated:

R1 2913.1 (tot)

R2 9444 (tot)

ΔQ ≅ 1000 gal for R1

930 gal for R2

Assuming an avg. flow of 2.5 gpm the forward flow was ok for about 6.5 hrs.

Substrate & Nutrient Feed Rates Appear to be OK.

Pressure into bag filter is 20 psi

Install flow meter on discharge from bag filter

830 Q through bag filter is 5.5 gpm.

Total Q processed ~ 650 gallons.

920 Q through reactors stops due to high water level in Ex tank #1.

940 Changed bag filter. Noticed w/ a few minutes Q Ex tank & drops below 5 gpm. This could be due to excess biomass passing through filter from high growth during time after forward flow was started this AM / since nutrient / substrate feed continued for many hours when influent pump was down — + no forward flow.

1100 Check system parameters. Calibrated flow meter — OK.

R1 INF		R2 INF	
pH	7.66	pH	7.48
Turb	1	Cond	0.909
Cond	1.42	Turb	∅
D.O.	5.25	DO	5.56
Sal	0.06%	Temp	20.6°C
Temp	20.7°C	Sal	0.04%

* INFLUENT PUMP STOPPED DURING TESTING

R1 INT		R2 INT	
pH	8.00	pH	8.04
Cond	1.41 (DT)	Cond	.949 (DT)
Turb	2	Turb	3 (DT)
DO	1.36	DO	2.32
Temp	21.2°C	Temp	21.0°C
Sal	0.06%	Sal	0.04%

R1 EFF		R2 EFF	
pH	8.2 (DT)	pH	8.27
Cond	1.40	Cond	0.968
Turb	3	Turb	5
DO	1.04	DO	0.94 (DT)
Temp	21.7°C	Temp	21.5°C
Sal	0.06%	Sal	0.04%

Collect samples for laboratory analysis:

SP # 1 - 1145
#2 - 1147
#3 - 1148
#4 - 1150
#5 - 1153
#6 - 1155
#7 - 1200

* Adding treated (GAC) water to substrate feed tank #1 to dilute NaAc. Adding about 1/2 tank full water. DID THIS CONCURRENT w/ COLLECTING SAMPLES

1215 Depart site to drop off samples @ MWH Labs, get lunch, PU supplies.

1420 Return to site. Slow Wheel en route to site. He said we should go ahead & remove the filter from the housing - and monitor how the systems performs. (The GAC can act as a filter and we can always change out for another type of GAC if necessary).

1440 Took out bag filter & turned on pump (for ex Tank 2). Q is still < 5 - too low, probably b/c there is too much head for

this pump — GAC, IX, Baker Tank.
Decided to replumb system
so flow from first EQ Tank
goes through the GAC (effluent
the "Aerobic" bioreactor), then
the flow from the second
EQ tank goes through the
IX. . . Actually, plumbed
system so flow goes from
EQ Tank #1 through GAC
and IX into EQ Tank #2
and from EQ Tank #2 into
Baker Tank. Flow from
pump ~~out~~ of EQ Tank #2
is now > 5 gpm.

1600 Add ~ 200 gal GAC — treated
tap water to nutrient feed
tanks along w/ ~ 330 g $(NH_4)_2HPO_4$.
Note: Tanks pumped down about
200 gal in 24 h or 8.3 gph.

1700 Installed flowmeter on pipeline btwn.
EQ Tank #1 & GAC vessel.

This flow must be greater than the
flow from the reactors (in 5 gpm)
and less than or equal to flow coming out
of EQ tank #2. Work on
balancing this flow.

1745
Check Flow Meter Readings
R1 Inf Q – 2.40 gpm
Q_{cum} – 3968.3 gal

R2 Inf Q – 2.5 gpm
Q_{cum} – 5491 gal

~9500

EQ Tank 1 effl – Q – VARIES *
Q_{cum} – ∅ (reset)

* will need to balance

Check capacity in Baker Tank – OK
~ 4' to top of water

Check Q for 1 pump cycle.
@ ~~Tank full~~ Pump Start – 6.6 gpm
@ ~~Pump~~ Pump stop – 4.9 gpm (lowest it reached)

This appears OK as EQ Tank 2
is not @ high condition.

THURSDAY AUGUST 29

0720 D. Tietje, P. Times onsite.

System check — OK

Check flowmeter readings

R1 INF — 5761 gal Δ = 1793 gal

R2 INF — 7527 gal Δ = 2036 gal

3829 gal

Q EQ TANK = 3829 gal ⇔ ? AVG. 47 gpm

Flow meter for R1 inf. is not recording flow.

Nutrient Feed Tank Pump Down

~115 gal / 13.5 h = 8.5 gph

Substrate Feed Tank Pump down

Appears OK

Flow through

This line was throttled back — opened up valve & meter started recording. Flow might have been too low though this line for meter to read as back P in line increased. About 200 gal more pumped through R2 overnight

Re Balance flows through R1, R2.

STU have to throttle back flow through R1 inlet piping.

0800

TANK PARAMETER READINGS:

R1 INF

pH — 7.03
Cond — .933
Turb — -8
DO — 5.61
T — 19.4 °C
Sal — 0.04 %

R2 INF

pH — 7.13
Cond — .843
Turb — -8
DO — 5.84
T — 19.3 °C
Sal — 0.03 %

R1 INT

pH — 7.68
Cond — .923
Turb — -4
DO — 1.43
T — 19.4 °C
Sal — 0.04 %

R2 INT

pH — 7.53
Cond — .824
Turb — -4
DO — 2.90 *
T — 19.4 °C
Sal — 0.03 %

* Nutrient bucket + air bubbles exiting Reactor 2 #1

prior to sampling.

R1 EFF		R2 EFF	
pH –	[redacted] 8.01	pH –	7.84
Cond –	[redacted] .916	Cond –	[redacted] .811
Turb –	[redacted] 20	Turb –	Error
DO –	0.60	DO –	1.10
Temp –	19.[redacted]°C	Temp –	19.3°C
Sal –	0.04 %	Sal –	0.03 %

Valve & Primer Corp – San Clemente
[800 – 478-7458]
Orange Cty Valve & Fitting

Call re valve throttling

SIW Mark Lost

* P.O. Change For Acetate
~~Need More Acetate~~
Think About Other Things
We Could Do – TOC, bug counts [redacted], PCR (diversity of bug species)
PCR – was conceived for Ph. 1 experiment, but may cost $ now.
Will [redacted] be on-site to drop off 50 kg Acetate tomorrow.

905 Left message for Dennis R. / Mark indicating that we will be dropping off samples tomorrow AM.

Turn back metering rates for Substrate Feed to ~0.7 * speed/stroke, and for nutrient feed to ~0.5 speed/stroke. NOTE: There are about 170 gal water in Nutrient Feed Tanks currently. Re-check this @ end of day.

0915 Compute mass of NaAc we need for rest of project
Approx 183 kg → 200 kg – 50 cfm
has = 150 kg – stock (– 30 kg) =
= (120 kg NEED) =
Compute mass of $(NH_4)_2PO_4$ we need for remainder of experiment
– 3439 g – compare vs inventory
– have 28 × 500 = 14000 g – OK

1400 Noticed that flow into R1 had decreased slightly (about 0.2 gpm) and flow no longer has to be throttled to balance.

Finished installing pipe to convey water into first empty Baker Tank

* Since this combination produces about 8 gph based on nutrient feed results – close to the 6 gph target for NaAc.

- across street.

1430 Slw Losi / Vitthal - will put system in recirculation mode for the weekend. Need to add enough $(NH_4)PO_4$ for conc. of 1 mg/L P, 0.5 mg/L N, and 500 mg/L Ac - BIF

Starting up Tuesday, can verify biological activity by checking D.O. in and out of reactors

1445 Throttled back flow into R2 to better balance flows - flow was ~0.2 gpm higher into R2.

1500 Begin filling second holding tank @ ~5 gpm.

Noted ΔP through CAC is 6 psi - check this again tomorrow.

1530 Check Parameters.

R1 INF		R2 INF	
pH -	7.31	pH -	7.33
Cond -	↓ ~6	Cond -	.725
Turb -	.756	Turb	~7
DO -	5.06	DO -	5.02
Temp -	21.6	Temp -	21.1
Sal -	0.05	Sal -	0.03

R1 INT		R2 INT	
pH -	7.78	pH	7.61
Cond -	.740	Cond -	.718
Turb -	-1	Turb -	Error.
DO -	1.32	DO -	3.27
Temp -	21.9°C	Temp -	21.4°C
Sal -	0.03%	Sal -	0.03%

R1 EFF		R2 EFF	
pH -	8.01	pH -	7.94
Cond -	.743	Cond -	.699
Turb -	Error.	Turb -	Error.
DO -	.91	DO -	1.33
Temp -	22.2	Temp -	21.7°C
Sal -	0.03%	Sal -	0.03

1610

Check Fluid Level in Nutrient

Feed Tank = 72 + 75 = 147 gal

Δ from 900 AM = 23 gal 17 hr ≅

3 gal 1h OK

Mark Fluid Levels in Substrate Feed Tanks:

1610 P. Tinnes off-site.

1615 Final system check - OK.

P. Tint

16-2 TUESDAY SAMPLE [redacted] PU 30L

DROP 2 SETS OF BOTTLES TOMORROW.

8-29

Acetate Addition, for final [Ac−] of 1 mg/L

$$250\ gal \times \frac{1\ L}{.2642\ gal} \times \frac{1000\ mg\ Ac^-}{L} \times \frac{1\ g\ Ac^-}{10^3\ mg\ Ac^-} \times \frac{1\ mol\ Ac^-}{59\ g\ Ac^-}$$

$$\times \frac{1\ mol\ NaAc}{1\ mol\ Ac} \times \frac{136\ g\ NaAc}{1\ mol\ NaAc} = \boxed{1315\ g\ NaAc}$$

82

$(NH_4)_2HPO_4$ addition for final [HPO_4−P] of 1 mg/L

$$250\ gal \times \frac{1\ L}{.2642\ gal} \times \frac{1\ mg\ P}{L} \times \frac{1\ mol\ P}{31\ g\ P} \times \frac{1\ mol\ HPO_4}{1\ mol\ P^-} \times$$

$$\frac{1\ mol\ (NH_4)_2HPO_4}{1\ mol\ HPO_4} \times \frac{132\ mg}{1\ mol\ (NH_4)_2HPO_4} = 4029\ mg\ (NH_4)_2HPO_4 \cong 4\ g$$

$$250\ gal \times \frac{1\ L}{.2642\ gal} \times \frac{1\ mg\ N}{L} \times \frac{1\ mol\ N}{14\ g\ N} \times \frac{1\ mol\ NH_4}{1\ mol\ N}$$

$$\times \frac{1\ mol\ (NH_4)_2HPO_4}{2\ mol\ NH_4} \times \frac{132\ mg\ (NH_4)_2HPO_4}{1\ mol} = 4460\ mg \cong 4.46\ g$$

$$\frac{4029\ mg\ (NH_4)_2HPO_4}{946\ L} \times \frac{kg}{10^3\ mg} \times \frac{1\ mol\ (NH_4)_2HPO_4}{132\ g} \times \frac{2\ mol\ NH_4^+}{1\ mol\ (NH_4)_2HPO_4}$$

$$\times \frac{1\ mol\ N}{1\ mol\ NH_4} \times \frac{14\ g\ N}{1\ mol\ N} = 0.9\ \frac{g\ N^-}{L}$$

$$250\ \text{gal} \times \frac{1\ \text{L}}{.2642\ \text{gal}} \times \frac{1\ \text{mg N}}{\text{L}} \times \frac{18\ \text{mg NH}_4}{14\ \text{mg N}} \times \frac{136\ \text{mg}\ (NH_4)_2HPO_4}{36\ \text{mg NH}_4}$$

$$= 4596\ \text{mg}\ (NH_4)_2HPO_4$$

$$= \boxed{4.6\ \text{g}}$$

$$250\ \text{gal} \times \frac{1\ \text{L}}{.2642\ \text{gal}} \times \frac{1\ \text{mg P}}{\text{L}} \times \frac{96\ \text{mg HPO}_4}{31\ \text{mg P}}$$

$$\times \frac{136\ \text{mg}\ (NH_4)_2HPO_4}{96\ \text{mg HPO}_4} = 4151\ \text{mg}\ (NH_4)_2HPO_4$$

$$= 4.1\ \text{g}$$

$$4.6\ \text{g}\ (NH_4)_2HPO_4 \times \frac{31\ \text{g P}}{136\ \text{g}\ (NH_4)_2HPO_4} \times \frac{1}{(250 \times 3.785)\ \text{L}}$$

$$= 0.001\ \text{g P/L} = \underline{1.1\ \text{mg P/L}}$$

FRIDAY AUGUST 30

0730 D. Tietje, P. Times onsite.

System check –

* Q_{R1} = 1.9 gpm
Q_{R2} = 2.83 gpm
✓ 4.7 gpm

$Q_{TOT,R1}$ = 9054 gal ; ΔQ = 9054 – 5761 = 3293 = 2.3
$Q_{TOT,R2}$ = 11348 gal ; ΔQ = 11348 – 7527 = 3821 = 2.65 gpm

From Yesterday AM

$Q_{TOT,\ EQ\ TANK\ 1}$ = 8172 gal (vs. 3029 24 hrs prev.) = 5143 gal = 3.57 gpm

Check Vol water in Nutrient Feed Tanks:
55 + 57 = 112 gal
Δ From 1600 hrs yesterday = 147 – 112 = 35 gal / 16 hr = 2.2 gal/h ; May increase settings slightly on Tues.

Drawdown for substrate feed appears ok.

* Need to see if flow should be throttled back through R2 to better balance flows.

0815

Check parameters:

R1 INF
pH – 7.16
Cond – .813
Turb – Error
DO – 5.41
Temp – 19.2 °C
Sal – 0.03%

R2 INF
pH – 7.19
Cond – 704
Turb – Error
DO – 5.49
Temp – 19.2 °C
Sal – 0.03%

R1 INT
pH – 7.74
Cond – .799
Turb – Error
DO – 1.18
Temp – 19.3 °C
Sal – 0.03%

R2 INT
pH – 7.47
Cond – .701
Turb – Error
DO – 3.25
Temp – 19.2 °C
Sal – 0.03%

R1 EFF
pH – 8.65
Cond – .784
Turb – Error
DO – .78
Temp – 19.3
Sal – 0.03

R2 EFF
pH – 7.82
Cond – .696
Turb – Error
DO – 1.43
Temp – 19.3
Sal – 0.02

0850
Collect Analytical Samples
#1 - 855

#4 - 857
#5 - 859
#6 - 900
#7 - 902

915 P. Tinnes departs site to drop off samples @ MWLE Labs & PU parts to fix GFI's

920 Called Letitia ISR & ~~[illegible]~~ informed her that Del Mar courier will be onsite between 10 A and 2P Tuesday.

925 D. Tietje offsite.

1400 D. Tietje back on-site.
Preparing to put system back in recirculation mode.
Pumping down Influent Eq Tank.
S/w Vilthal while away from site.
He said we should try to continue to balance flows through R1 / R2 system & if necessary we can eliminate 1 reactor train later on. Also we should sample for acetate on each sampling event from here on out.

1430 Reviewed results of Lo... Said that we need to start adding NaOH to the effluent CrO_4 - samples.

Confirmed we need to add 4.0 g $(NH_4)_2PO_4$ to make 1 mg/L NH_4-N (& 1.1 mg/L PO_4-P)
Also will add 2.2 kg NaAc to make 1 g/L Ac.

1530 Put system in recirculation mode.

TUESDAY SEPT. 3

0740 Onsite.

Noticed water is black circulating through reactor 2 system. It probably did not have enough air & too much heat over weekend —

0840 Slw Rachel — DMA. OK to use 1L amber for fish bioassay.

0945 Slw Mark Losi. Said that we should go ahead & restart forward flow, even for reactor 2, which appears ~~to~~ have ~~is dead~~ gone septic (DT). He said that regarding the theoretical acetate reqt, only 0.5 mg/L is required for ClO_4^-, the remainder is for ~~[illegible]~~ O_2 & NO_3. For 5 x [ClO_4^-] we would only increase [NaAc] by 5 x 0.5 − 0.5 = 2.0 mg/L. Therefore, we need to confirm the conc. of NO_3^- reported —

If it is as NO_3 or as N

1010 Begin collecting sample from Baker Tank for HW characterization.

1015 Confirmed w/ Dennis Reyes, MWH Labs that the NO_3^- results are reported as Nitrate.

1040 Finished collecting samples from Baker Tank.

1055 Slw Losi. He said we are OK w/r/t the NaAc final feed concentration for now, until we get more data on D.O., ClO_4^-, Ac. Ordered 12.5 kg NaAc. Already has ~ 50 kg. will bring this to site by week's end.

1145 Forward flow resume. Restart NaAc & nutrient feed to previous settings.

1145 De1 Mar Analytical takes custody of samples collected this AM for HW characterization.

1155 Balance Flows – 2.5 gpm through each reactor system.

1330 Check water quality parameters of system.

R1 INF

pH – 7.42 (DT)
cond – .589 (DT)
turb – 0
DO – –
T – 22.2 °C
Sal – 0.02

R2 INF

pH – 7.53
cond – .556
turb – 1-2
DO – -0.78 (DT)
T – 22.2 °C
Sal – 0.02

R1 INT

pH – 7.53
Cond – .55
Turb – 3
DO – -0.78
T – 22.7°C
Sal – 0.02%

R2 INT

pH – 7.75
cond – .554
turb – 10-11
DO – -0.72
T – 22.9°C
Sal – 0.02%

R1 EFF

pH – 7.51
Cond – .55
turb – 5-6
DO – -0.75
T – 23.4°C
Sal – 0.02%

R2 EFF

pH – 8.05
Cond .565
Turb – 20
DO – -0.70
T – 23.6°C
Sal – 0.02%

1430 P. Tinnes offsite Going to Harrow to check D.O. combination, Pu more sodium sulfite powder

1500 Remembered to set nutrient feed speed/stroke settings @ 5 – were .7 ml since turning on this AM.

1515 Slw Dennis Reyes – MWH Labs He said that ① NO_3 samples must be unpreserved ② reported the NaAc results from the first sampling event.

153 Dennis called back to report the results of Friday's sampling He is also checking on whether

we can add NaOH to acetate samples.

1350 Spoke Mark Lust & conveyed analytical results to him. He also said I shouldn't add any more NaOH to the samples, based on the results we have.

1615 Left message for R. Zimmski regd disposal / reuse of Nancy-owned equipment.

1630 Check Flow Meter Settings:

R1	10,743.7	242 gpm
R2	13,360.4	245 53 gpm

EQ Tank #1 – 10,896.4

NUTRIENT FEED TANKS

VOL – 38 + 36 = 74 GAL

~10 GAL MAY NOT BE USABLE

SUBSTRATE FEED TANKS

#1 – 47 + ~71 gal = 118 gal

#2 – 45 + ~47 gal = 92 gal

Add ~50 gal water & 1.1 kg NaOH to each substrate feed tank

Turn down pump speed to .6 speed/stroke for substrate metering pumps (to ensure feed is use through night). Feed conc is still ~150 mg/L.

1700 Offsite.

P. Tas

WED. SEPT. 4

0735 Onsite.

System Check:

$Q_{R1} = 1.94$ gpm

$Q_{Treated} = 12701.5$ gal

$\Delta R1 = 12701.5 - 10743.7 = 1957.8$ gal

$Q_{R2} = 2.78$ gpm $= 2.17$ gpm

$Q_{Treated} = 15800.9$ gal

$\Delta R2 = 15800.9 - 13360.4 = 2440.5$ gal $= 2.72$ gpm

$Q_{EQ\ Tank\ 1} = 14016.9$ gal

Δ EQ Tank $= 14016.9 - 10896.4 = 3120.5$ gal $= 3.47$ gpm

Check Vol remaining in nutrient tanks — About 15+17 = 32 gal

$\Delta = 74 - 32 = 42$ gal $\Rightarrow$ 2.8 gph ✓

Check Vol remaining in substrate feed tanks

For R1 — 27 + ~ 7/12 x π 4 ≅ 82

For R2 — 27 + ~ 3/12 x π 4 ≅ 50.5

$R_1 \Delta$ = 36 gal

$R_2 \Delta$ = 41.5 gal

Re-check Δ vol

$\Delta R1 = 97 - 27 + 5.5''/12 \times \pi \times 4$ — Drawdown since last one

$= 63$ gal $\Rightarrow$ 4.2 gph

$\Delta R2 = 45 - 27 + 4.5''/12 \times \pi \times 4 = 53 \Rightarrow 3.5$ gph — Drawdown

0800 Check Parameters:

R1 INF —
pH — 7.46
cond — .537
Turb — Ø
D.O. — 9.75
Temp. — 20.3
Sal. — 0.02%

R2 INF
pH — 7.47
cond — .537
Turb — 0
D.O. — 9.82
Temp. — 20.2
Sal. — 0.02

R1 INT —
pH — 8.16
cond — .564
Turb — 5
D.O. — 9.75
Temp. — 20.9
Sal. — 0.02%

R2 INT
pH — 7.78
cond — .519
Turb — 7
D.O. — 9.78
Temp. — 20.3
Sal. — 0.02%

R1 EFF —
pH — ~~8.39~~ 8.34 (DT)
cond — .549
Turb — ~~8~~ 7 (DT)
D.O. — 9.73
Temp. — 20.9
Sal. — 0.02

R2 EFF
pH — ~~8.05~~ 8.13
cond — .514
turb — 10
D.O. — 9.74
temp. — 20.4
Sal. — 0.02%

~~830~~ 825 Prepare to collect samples

INF - 826
R1 INF - 830
R2 INF - 831
R1 INT - 832
R2 INT - 834
R1 EFF - 836
R2 EFF - 838

Samples collected

846 Balance Flows through R1/R2 by further throttling back flow into R2. Needed to increase motor speed slightly (from about 50 to 56 %)

Increase speed/stroke settings on substrate metering pumps - to 75 %, 75 % each.

Substrate Feed Tank 1 -
Vol to Add - 150 - 27 + 475 - 51
= 547 gal

Substrate Feed Tank 2
Vol to Add - 150 - 27 + 475 - 35
= 563 gal

Nutrient Feed Tanks
Vol to Add = 300 - 32 = 268 gal

Mass $NaAc \cdot 3H_2O$ To Add To Each Tank To Make ~~Solid~~ 100 mg/L [Ac⁻] In Final Flow:

Tank #1 - 12.4 (12.8 to 150 gal tank, 9.6 to 475 gal tank)
Tank #2 - 12.8 kg (12.8 to 150 gal tank, 10 kg to 475 gal tank)

Nutrient Feed - Mass $(NH_4)_2PO_4$ to Make Up Each Tank For Final NH_4-N conc. of .5 mg/L
PO_4-P conc. of 1 mg/L:

$\frac{268}{300} \times 511.1\ g = 456\ g$

Patrick to Add When He Returns From Dropping off Samples.

Compute Acetate in Final Feed: Feed Tank #1

$C_1 V_1 + C_2 V_2 = C_3 V_3$

(130 mg/L)(78 gal) + (100 mg/L)(547 gal)
= C_3 (78 + 547 gal)
C_3 = 106.2 mg/L

For Feed Tank #2 C_3 = 105 mg/L

9930 D. Tietje offsite.

1030 After checking amount of Sodium Acetate on Hand the amount added to Tank #1 (150 gal) was 1.95 Kg so only 8.5 gals of water were added

Tank #2 (150 gal)

2.34 Kg were added so 105 gals of water were added

Pmh

1530 8-4-02

R1 INF		R2 INF	
pH	7.46	pH	7.46
Cond	.568	Cond	.583
Turb	1	Turb	2
DO	8.76	DO	8.89
T	22.7°C	T	22.4°C
Sal	.02%	Sal	.02%

R1 INT		R2 INT	
pH	8.07	pH	7.73
Cond	.591	Cond	.565
Turb	5	Turb	6
DO	~~8.72~~ 8.65	DO	8.86
T	22.8 °C	T	22.5 °C
Sal	.02	Sal	0.02 %

R1 EFF		R2 EFF	
pH	8.31	pH	8.08
Cond	.594	Cond	.555
Turb	6	Turb	10
DO	8.57	DO	8.73
T	23.2 °C	T	22.8°C
Sal	0.02 %	Sal	0.02 %

1610 Check system parameters

P. Times offsite. Picking up another DO Instrument from Equipco on route to site tomorrow.

$Q_{R1} = 2.33$; $Q_{TOT} = 17052$
$Q_{R2} = 2.34$ $Q_{TOT} = 13934$

Increase motor speed by 4%, from 56 to 60%.

$Q_{R1} =$ ~~2.44~~ 2.52 ± 0.05
$Q_{R2} =$ ~~2.54~~ 2.51 ± 0.05

NUTRIENT TANK VOL: ~303 gal

SUBSTRATE TANK #1 VOL – ①
#2 VOL – ②

① 150 gal Tank Full ~ 180 gal
475 gal Tank – Mark for draw-down (47" fr. ground to ▽)

② 150 gal Tank Full ~ 180 gal
475 gal Tank – 46" from ground to ▽

TO DO'S FOR THURSDAY –

1) Flow into 2nd Holding Tank @ COB tomorrow. Estimate we will have pumped 19,000 gal by then.
2) P.O. for Equipco – if Needed
3) P.O. for CEM → Vitthal
4) Set up sampling for MW, Del Mar for Friday
5) Acetate from Losi

1650 Noticed flow through R2 not recording – flow is throttled back too much through this line.
Open up & re-balance flows.
$Q_{R1} \cong 2.3$ gpm
$Q_{R2} \cong 3.0$ gpm

1700 Offsite.

Dal T

THURSDAY SEPT. 5

0830 D. Tietje onsite.

Equipment / system check

$Q_{R1} = 1.52$ gpm

$Q_{TOT} = 15810.1$ $\Delta = 1292$ gal $\rightarrow 1.3$ gpm (16 h)

$Q_{R2} = 3.19$ gpm

$Q_{TOT} = 20020.3$ $\Delta = 2969$ gal $\rightarrow 3.1$ gpm (16 h)

Check drawdown in Nutrient Feed Tanks

Vol Tot = 130 + 132 = 262 gal

$\Delta = 303 - 262 = 41$ gal $\cong$ ~~2.45~~ gph 2.6 (DT)

Check drawdown in substrate tanks (10)

R1: 150-gal − 140-gal

WL in large tank: 37.5"

$\Delta = 9.5" \Rightarrow 9.5/12 \times \pi \times 4 \times 7.48 + 10 = 84.4$ gal (8) or 5.28 gph

R2: 150-gal − 145-gal

WL in large tank: 38"

$\Delta = 8" \Rightarrow 8/12 \times \pi \times 4 \times 7.48 + 5 = 67.7$ gal or 4.2 gph

0845 D. Tinnes onsite. Brought a ~~Bring~~ new D.O. meter to use today.

Change Pump Settings:

Substrate Feed #1 − .8 speed, .75 stroke

#2 − .85 speed, .8 stroke

Rebalance Flow through R1 / R2

Throttle back flow into R1, increase pump motor speed from 60 to 70 %. 68 (DT)

Flows are now balanced better.

$Q_{R1} \cong 2.5$, $Q_{R2} \cong 2.6$ gpm.

0910 Check Parameters

R1 INF		R2 INF	
pH	7.26	pH	7.28
cond	.576	cond	.593
turb	1	turb	0
DO*	5.7 mg/L	DO*	5.6 mg/L
T	21.0 °C	T	20.8 °C
Sal	0.02 %	Sal	0.02 %
DO	9.46 mg/L	DO	9.62 mg/L

* YSI MODEL 51B

R1 INT		R2 INT	
pH	7.[illegible]8 (DT)	pH	7.54
cond	.607	cond	.575
Turb	2	Turb	5
DO *	1.6 mg/L	DO *	3.7 mg/L
T	21.0 °C	T	21.1 °C
Sal	0.02 %	Sal	0.02 %
DO	9.52 mg/L	DO	9.50 mg/L

R1 EFF		R2 EFF	
pH	8.0[illegible] (DT)	pH	7.83
cond	.609	cond	.561
Turb	3	Turb	8
DO *	0.8 mg/L	DO *	1.85 mg/L
T	21.3 °C	T	21.2 °C
Sal	0.02 %	Sal	0.02 %
DO	9.44 mg/L	DO	9.47 mg/L

1000 Noticed water overflowing from First Rain For Rent Tank. Switching Over To Second Tank.

Estimate we got close to 21K gallons into the first RFR Tank based on totalizer readings from Thur. AM last week & this morning. Also visually inspected

- Tank 1 water level - is close to top.

Slw Vitthal - He said we should consider the following upgrades to the system -

1. Putting in a second influent feed pump so we have 1 per reactor
2. Adding about 10 lbs of Celite to each of Reactor 2 tanks, to increase surface area for bacterial growth - to increase biomass buildup.

Also, we should think about options for maintaining system ~~[illegible]~~ when holding tanks become full, e.g. recirculating "treated" water, which can dilute incoming groundwater.

1130 Left message for Dennis of MWH Labs re: tomorrow's sampling, and to check on prelim. results from yesterday.

Left message for Rachel / Del Mar to set up courier PK for tomorrow > 10 AM; the courier will be bringing 2 more sets of bottles.

Left message w/ Leticia - JDL reg'd the Del Mar courier.

1215 Noticed R1 inf flow meter was not recording flow.
Opened up ball valve on R2 inf line, reduced motor speed & rebalanced flows to ~ 2.2 gpm into R1, 2.9 gpm into R2.

1400 P. Times offsite.

1430 System Check

Q_{R1} = 1771 gpm
Q_T = 16577 gal

Q_{R2} = 3.18 gpm
Q_T = 21009 gal

ΔP GAC = 11 psi

Check Nutrient Tank Feed Vol -
123 + 126 = 249 gal

Check Substrate Tanks -
#1 - 120 gal + 39" from ground to water level
#2 - 133 gal + 39.5" from ground to water level

☆ Pumpdown rate since this AM ~ 6.5 gph - ok

TO DO'S FOR FRIDAY

(1) Check on preliminary results from Wednesday's sampling.
(2) Check w/ Tom - World Minerals - on ordering 15-20 lbs of Calite.
(3) Pick Ice en route to site

1500 - offsite.

P. Tod

FRIDAY SEPT. 6

800 ONSITE

CHECK SYSTEM —

R1 Q = 1.26 gpm
R2 Q = 3.19 gpm
R1 Q_{TOT} = 18,054 gal - Δ = 1477 gal ⇒ ~1.57 gpm
R2 Q_{TOT} = 24485 gal - Δ = 3476 gal ⇒ 3.21 gpm

EQ Tank #1:
Q_{TOT} = 23,049 gal

NUTRIENT TANKS:
TOTAL WATER = 202 gal
Δ = 49 gal / 18h = 2.6 gph - ok

CHECK WATER LEVEL IN SUBSTRATE FEED TANKS —

#1 – ~94 + 24.5" from ground to WL

Δ = 108.4 gal / 18 h = 6.02 gph ✓

#2 – ~100 + + 25" from ground to WL

Δ = (33 + 74.4)/18h = 5.96 gph ✓

* Will need to reduce Naac feed rate for R1 today due to lower Q; also increase feed rate for R2 due to higher Q.

0825 Check parameters:

R1 INF		R2 INF	
pH	7.27	pH	7.48
cond	.686	cond	.538
Turb	0	Turb	0
DO*	5.9	DO*	5.2
T	20.9°C	T	20.6°C
Sal	0.02	Sal	0.02%

w/ YSI 51B

R1 INT		R2 INT	
pH	8.18 ↑	pH	7.66
Cond	.662	Cond	.542
Turb	4	Turb	2
DO*	1.1	DO*	3.6
T	21.0°C	T	20.6°C
Sal	0.02%	Sal	0.02%

R1 EFF		R2 EFF	
pH	~~8.3~~ 8.26	pH	7.92
Cond	~~.66~~ .656	Cond	.535
Turb	~~5~~ 4	Turb	4
DO*	0.7	DO*	2.1
T	21.3°C	T	21.0°C
Sal	0.02%	Sal	0.02%

930 Collect samples for HW Characterization from second Holding Tank (Southwest Rain For Rent Tank).

Collect samples from PBR system —

INF	0955	R1 EFF	1004
R1 INF	0956	R2 EFF	1006
R2 INF	0957		
R1 INT	0959		
R2 INT	1001		

1010 Patrick Tinnes takes PBR samples to MWH Labs.

1045 Change [redacted] metering pump settings based on Q_{R1} = 1.25 gpm, Q_{R2} = 3.25 gpm. Set pump Q 55 ~~60~~ % speed, stroke for former, 100 % speed stroke for latter.

Q_{TOT} = 4.5 gpm ⇒ nutrient feed rate of ~ 2.6 gph ok.

[redacted]

1110 Del Mar Analytical picks up samples.

1245 Determine how much water & feed chemicals to add:

Nutrients : 94+96 = 190 gal

ADD 110 gal & 182 g $(NH_4)_2PO_4$ to both tanks

Substrate #1 – 89 + 22.5 " = 265 gal

Substrate #2 – 98 + 22 " = 270 gal

To ST #1 – Add : (1) $\frac{150-89}{625} \times 14.86$ kg ⇒ 1.45 kg

(2) $\frac{475-170}{625} \times 14.86$ kg ⇒ 7.13 kg

To ST #2 Add :

Add $\frac{150-98}{625} \times 14.86$ ⇒ 1.24 kg

Add $\frac{475-172}{625} \times 14.86$ ⇒ 7.2 kg

1300 Begin adding water to substrate/nutrient feed tanks.

1915 Finish making down substrate / nutrient feed tanks.

1915 Dennis – MWH Labs calls to report results from Wednesday's sampling.

Adjust speed on influent feed pump, to increase flow slightly. Increased speed from about 0.6 to 0.65 %.

1430 Begin filling Tank #4 (RFR Tank #3)

Check Volumes of Feed Tanks —

Nutrient — ~300 gal

Substrate #1 — 150 + $\frac{41\frac{1}{2}''}{12} \times \pi \times 4 \times 7.48$

= 475 gal

Substrate #2 — 155 + $\frac{41\frac{1}{2}''}{12} \times \pi \times 4 \times 7.48$

= 480 gal

∴ Added a little too much acetate — about 30% excess.

Should have added $\frac{375 - 176}{375 + 150} \times 12.5$ kg

to large ST #1 &

$\frac{375 - 172}{375 + 150} \times 12.5$ kg

to ST #2

4.7 kg & 4.83 kg respectively

1450 Check Parameters —

R1 INF

pH	7.48
Cond	.561
Turb	2
DO*	6.5
T	22.1°C
Sal	0.02%

R2 INF

pH	7.50
Cond	.671
Turb	1
DO*	6.0
T	21.9°C
Sal	0.02%

R1 INT

pH	8.20
Cond	0.567
Turb	6
DO*	1.4
T	22.6°C
Sal	0.02%

R2 INT

pH	7.64
Cond	.668
Turb	2
DO*	4.2
T	21.9°C
Sal	0.02%

R1 EFF

pH	8.30
Cond	.564
Turb	5
DO*	1.2
T	23.1°C
Sal	0.02%

R2 EFF

pH	7.91
Cond	.661
Turb	4
DO*	2.02
T	22.3°C
Sal	0.02%

1535 Final system check.

Q_{R1} — 1.36 gpm
Q_{R1} treated — 18623.2 gal

Q_{R2} — 3.47 gpm
Q_{R2} treated — 25908.6 gal

P_{R1} inlet — 12 psi
P_{R1} int — 6 psi
P_{R1} eff — 0 psi

P_{R2} inlet — 20 psi
P_{R2} int — 7 psi
P_{R2} eff — 0 psi

$Q_{EQ\ TANK\ 1,\ TOT}$ — 24,254.5

$P_{GAC\ IN}$ — 29 psi
$P_{GAC\ OUT}$ — 11 psi } $\Delta = 18$ psi

1545 Left message for Vishal re: results from Weil's sampling.

Offerte

MONDAY SEPTEMBER 9

0800 Arrive onsite.
System check.
- Influent Feed Pump is off due to high WL in EQ Tank #1. EQ Tank Pump is running, but Q is very low (not reading on flow meter, which has min. flow of ~25 gpm). ΔP through GAC vessel is 19-9 = 5 psi

- Check Flow Rates & Flow Totalizers
R1 INF — Q (Influent feed pump off)
Q_T = 21,895.9 gal
R2 INF — Q (Influent feed pump off)
Q_T = 33,305.1 gal

ΔR1 = 21,895.9 − 18623.2 = 3272.7 — 0669
=
ΔR2 = 33305.1 − 25908.6 = 7396.5

Over 65 hours, this averages out to be ~0.9 gpm for R1, 1.89 gpm for R2 OR 2.8 gpm combined

Substrate Feed Tanks

Feed Tank #2 is EMPTY.
Shut down pump.

Feed Tank #2":
~85 gal + 21½ (ground to WL)
= 253 gal tot (Avg. 4.18 gph)

Shut off Metering Pumps

Based on 3.25 gpm for R2,
1.25 for R1, the system operated
for about 38 to 42 hours
b/f shutdown.

En route to site, s/w Vitthal,
who said we should increase
Ac⁻ feed concentrations into both
reactors & prepare system to
recirculate flow from Baker Tank
w/ water still containing Cl_2 - (bypass
GAC, IX) by first transferring water from
Baker Tank into RFR Tanks.

Nutrient Feed Tanks Here
~35 + 37 gal = 72 gal ⇒ 3.5 gph ✓

0900 Begin pumping down Eq Tank #1.

The discharge line from the pump
that drains down Eq Tank
#1 was choked off w/
algae from Eq Tank #1.
S/w Vitthal, and he said it
would be OK to add
bleach to this tank to try
to stem the growth.
(Added 3 qts bleach w/ 6 %
sodium hypochlorite sol'n)

0930 Decided we will recirculate
flow around influent Eq
Tank while we pump out
Baker Tank #1 during next
few days.

1000 Compute chemicals req'd to
make up substrate tanks.

#1 - 525 - 253 = 272 gal to add
$\frac{272}{525} \times 12.48$ kg = 6.5 kg

10:15 Empty out Eq Tank 1 — may still contain some bleach.

10:30 Put system in recirculation mode w/ Influent Eq Tank, reactors and Eq Tank 1. Maintain same feed rate of NaAc, nutrients.

Begin pumping contents of Baker Tank into ~~[illegible]~~ Third Rain For Rent Tank (capacity ~ 10K gal) @ 5 gpm. Flow totalizer reads 29,700 gal.

10:45 Show Vithal — said we should turn down flow through reactors — it does not need to be 5 gpm. Turned Influent Feed Pump Speed Down to 40 %. Q is 1.0 gpm through R1, 2.3 gpm through R2.

Readjust substrate & nutrient feed settings:

For SF #1, Q = 1 gpm, Q_{feed} = 2.3 gph. Reset pump Q to 80 % speed/stroke.

For SF #2, Q = 2.25 gpm, Q_{feed} = 5.1 gph ⇒ Pump set Q 80 % speed/stroke.

For nutrient feed, Q_T = 3.25 gpm, ~~[illegible]~~ Q_{feed} = 2.0 gph ⇒ Pump set Q 45 % speed/stroke.

~~Recalculate mass of chemicals needed — Increase mass of NaAc added to tanks by 75 % over amt. reqd to make 100 mg/L Acid [etc.]~~

~~Add to ST #1 — 6.5 × 1.75 =~~

~~ST #2 — 12.48 × 1.75 =~~

Show Lois —

1. Add O_2 into Influent tank in pre-sleep mode
2. Do Not Add NaAc in Excess
3. Consider Sampling a few times during final sleep mode for NaAc, CO_2, NO_3
4. Will have NaAc by weekend

NEED TO ADD NAAC —

12.48 kg to ST #2 (both)

6.5 kg to ST #1 (both

#1 — 1.85 to 150 gal ✓

= 4.65 to 375 gal

#2 — 3.56 to 150 gal ✓

8.91 to 375 gal ✓

1150 Check vol water for add to nutrient tanks —

300 − (32 + 34) = 234 gal

Mass reqd = 511.1 g × 234/300

= 398.7 g (Add to each about equally)

1400 → 1600

BUILD RECIRCULATION PIPING FOR UPCOMING 'SLEEP' MODE

1600 Check system parameters w/ Horiba UW & YSI Model SLB (*)

R1 INF

pH 7.0

Cond .795

Turb −10

DO * 3.9 mg/L

T 24.0°C

Sal 0.03 %

R1 INT

pH 8.41 II

Cond .770

Turb −10

DO * 1.4 mg/L

T 25.1°C

Sal 0.03 %

R1 EFF

pH 8.48 III

Cond .719

Turb −10

DO * 0.8 mg/L

T 25.0°C

Sal 0.03 %

R2 INF

pH 8.67 I

Cond .868

Turb −10

DO * 3.9 mg/L

Sal 0.03 %

T 23.9°C

R2 INT

pH 8.45 IV

Cond .878

Turb −10

DO * 1.9 mg/L

T 24.3°C

Sal 0.03 %

R2 EFF

pH 8.54 V

Cond .871

Turb −10

DO * 1.0 mg/L

T 24.6°C

Sal 0.03 %

I Checked w/ YSI 3500 — 7.85

II " " — 7.92

III " " — 7.95

IV " " — 8.03

V " " — 8.10