CE 432-Design of Water and Wastewater Systems II
Homework Assignment

WWTP Mass Balance Analysis

Due: September 3, 2010

Introduction
The Moscow WWTP began experiencing high effluent phosphorus (P) concentrations on or around July 29th, 2009. Effluent total P measurements were recorded by the city above 5 mg/L (permit limit=0.136 mg P/L). To help identify the possible cause(s) of the apparent EPBR process upset, we collected samples on 5 different days beginning July 29th. Samples were tested for volatile fatty acids (VFAs), soluble chemical oxygen demand (sCOD), soluble P, total P, sulfate, ammonia, nitrate, dissolved oxygen (DO), and pH.

Influent and Effluent Phosphorus Data
The sampling dates and corresponding are attached.

Problem Statement
Given the following information on the Moscow WWTP:
- RAS ratio=1
- MLR ratio=1
- Influent Q=1.0 mgd
- Each anaerobic basin=205,000 gallons
- Each anoxic basin=360,000 gallons
- Aerobic basin=1,800,000 gallons

Conduct a mass balance analysis around each basin in the system and identify potential causes of the failure of their biological phosphorus removal process. Make appropriate assumptions for reactions occurring in each respective basin.

Summarize your findings in a brief memorandum. Your submittal should also include all your calculations. Make sure your calculations are prepared in a manner that I can easily follow your logic. I will be grading both your technical analyses and your writing.

Moscow WWTP 7-29-09

Sample	Concentrations (mg/L)								pH
	VFAs	sCOD	Sol. P	Total P	Sulfate	NH$_3$	NO$_3$-N	DO	
Influent	63.0	172.9	3.6	7.5	31.6	13.3	-	-	7.41
AN1	10.1	141.3	3.8	6.9	43.0	11.2	-	0.26	7.14
AX1	13.2	130.3	2.5	6.3	37.9	8.9	-	0.44	7.13
AN2	76.8	140.9	3.5	6.0	35.8	8.6	-	0.3	6.63
AN3	34.5	72	19.5	24.5	32.6	6.1	0.6	0.36	6.83
AX2	40.4	40.4	12.6	11.4	35.9	2.5	4.0	0.34	6.99
AE	0.0	29.4	3.0	5.2	36.2	0.3	10.3	1.53	6.86
2°	22.7	19.2	3.1	5.0	36.8	0.3	11.2	-	-

Moscow WWTP 7-30-09

Sample	Concentrations (mg/L)								pH
	VFAs	sCOD	Sol. P	Total P	Sulfate	NH$_3$	NO$_3$-N	DO	
Influent	-	215.7	3.9	6.3	14.7	14.7	-	0.54	7.3
AN1	-	196.6	3.8	-	35.6	13.0	-	0.35	7.37
AN2	-	154.6	4.1	-	36.7	11.9	-	0.22	7.14
AN3	-	91.1	21.9	-	29.6	8.7	0.6	0.2	6.89
AX	-	153.4	12.2	-	34.1	9.9	3.2	0.34	6.76
AE	-	34.5	3.6	-	-	0.5	9.8	-	6.94
2°	-	38.3	3.1	4.7	-	0.3	10.1	-	7.17

Moscow WWTP 7-31-09

Sample	Concentrations (mg/L)								pH
	VFAs	sCOD	Sol. P	Total P	Sulfate	NH$_3$	NO$_3$-N	DO	
Influent	-	168.0	2.9	-	9.4	10.2	-	0.65	7.64
AN1	-	168.6	3.6	-	28.1	12.7	-	0.41	7.62
AN2	-	152.1	3.9	-	35.6	12.9	-	0.2	7.61
AN3	-	98.1	14.4	-	33.7	10.9	0.7	0.15	7.47
AX	-	49.7	15.3	-	37.7	5.2	2.5	0.16	7.38
AE	-	44.0	3.2	-	36.8	0.3	9.8	1.1	7.4
2°	-	40.2	2.9	-	36.7	0.2	9.8	3.06	7.41

Moscow WWTP 8-3-09

Sample	Concentrations (mg/L)								pH
	VFAs	sCOD	Sol. P	Total P	Sulfate	NH$_3$	NO$_3$-N	DO	
Influent	-	145.1	2.9	-	72.5	9.5	-	0.72	7.51
AN1	-	157.8	3.6	-	35.8	12.9	-	0.22	7.48
AN2	-	147.0	3.8	-	51.5	11.9	-	0.31	7.57
AN3	-	86.0	16.3	-	36.8	8.9	-	0.28	7.63
AX	-	40.8	10.0	-	38.0	2.4	5.1	0.33	7.37
AE	-	44.0	5.4	-	35.4	0.2	10.2	0.92	7.36
2°	-	44.7	5.1	-	37.5	0.2	10.0	3.06	7.35

Moscow WWTP 8-5-09

Sample	Concentrations (mg/L)								pH
	VFAs	sCOD	Sol. P	Total P	Sulfate	NH_3	NO_3-N	DO	
Influent	-	178.2	3.2	-	13.9	19.4	-	-	-
AN1	-	166.7	3.7	-	30.9	26.9	-	-	-
AN2	-	155.3	4.1	-	32.9	26.0	-	-	-
AN3	-	86.6	18.3	-	37.6	19.0	0.6	-	-
AX	-	43.4	11.7	-	32.8	6.4	5.1	0.29	-
AE	-	42.1	5.9	-	31.4	1.3	11.7	1.37	-
2°	-	27.5	6.1	-	38.3	0.5	12.5	-	-
RAS	-	40.2	6.7	-	29.5	0.9	9.7	-	-