Nutrients in PEW Water

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Subject: Nutrient Concentrations in Arcata Wastewater Treatment Plant

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Introduction

Nutrients in water can be an essential part of the growth of living organisms in aquatic ecosystems; however, an excess of nutrients is a form of water pollution that can have detrimental effects on water sources. Nutrients such as Ammonia (NH3), Nitrate (NO3) and Phosphate (PO4) are main contributors to water quality degradation when they appear in excess. They can cause eutrophication in streams and rivers that leads to algal blooms as well as cause harm to humans if excessively present in the water supply. This lab analyzes water samples from the Arcata Wastewater Treatment Plant (AWWTP) to determine the concentration of nutrients at each treatment site. The objective of this lab is to measure the concentrations of NH3, NO3 and PO4 from the Post Enhancement Wetlands (PEW) to determine if the concentration of nutrients meets EPA effluent guideline and to assess the effectiveness of the AWWTP water treatment train.

Methodology

Two Samples of (PEW) wastewater from the AWWTP were analyzed in the laboratory on March 6, 2019. The experiment followed procedures from *Standard Methods* 4500-No 3, 4500-P and 4500-NH3 (APHA 2005). Calibration curve measurements were assigned to separate teams in order to manage lab time.

Results

The concentration of nutrients in the PEW sample was determined by using the calibration curves made for each of the three nutrients. With the calibration curve and resulting trend equation, the unknown concentration were determined and are illustrated in Table 1 below.

Table 1: Concentrations NH4, NO3 and PO4 in PEW water form AWWTP

Sample #	**Ammonia Concentration mg/L**	**Nitrate Concentration mg/L**	**Phosphate Concentration mg/L**

PEW 1	0.897	3.03	0.463
PEW 2	0.902	3.03	0.863

Discussion

The average daily flow rate of the AWWTP during the wet season is 5 million gallons per day (Noren & John 2012).. To better illustrate the concentration of nutrients in the PEW sample, the concentration in mg/L must be multiplied by this flow in order to get lbs/day, the mass load of the effluent. The resulting concentration are as follows. PEW 1: 37.4 lbs/day, 126 lbs/day and 19.31 lbs/day for NH3, NO3, and PO4, respectively. For PEW 2 the values for NH3, NO3 and PO4 are 37.61lbs/day, 126 lbs/day and 35.9 lbs/day, respectively. According to the California Water Board, the max daily load for Nitrate, Ammonia and Phosphate are 2.7 mg/L, 18 mg/L and and 2 mg/L, respectfully (Noren & John 2012; Water Treatment 2019). By these standards, the concentration of nutrients in the PEW water meets EPA standards for effluent release into the bay.

The PEW water from this trial, compared to the rest of class, had overall lower concentrations, which is expected considering it precedes the two other treatments in the treatment train. Errors that may have occurred in the experiment were instrumental errors in calibrating nutrient curves, improper dilutions and other errors caused by human fault.

Conclusion

The PEW water from AWWTP had a concentrations of 0.897 mg/ L and .902 mg/ L for Ammonia, 3.03 mg/L for Nitrate and 0.463 mg/L and 0.863 mg/L for Phosphate. By concentration alone, these concentrations meet EPA effluent standards and by the total daily max load, these concentration also meet standards. The concentrations of nutrients in the PEW water followed the expected decrease in concentration, as it is the final treatment in the AWWTP treatment train. Errors in this experiment could have been a result of improper diluting of the sample, and miscalculating the calibration curve.

References

American Public health Association (APHA), AMerican Water Works Association (AWWA), Water Environment Federation (WEF). (2005). *Standard methods for the examination of water and wastewater,* 21st Ed., American Public Health Association, Washington DC, USA.

Noren, D., & John, M. (2012, May 7). Waste Discharge Requirements for the City of Arcata Municipal Wastewater Treatment Facility. Retrieved from https://www.waterboards.ca.gov/northcoast/board_decisions/adopted_orders/pdf/2012/12_0031_NPDES_ArcataWTF.pdf

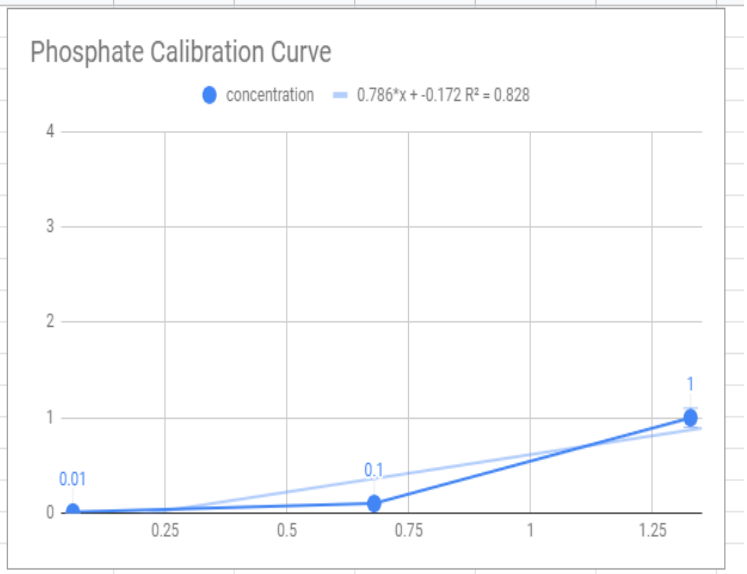
"Water Treatment Solutions." (2019). *Lenntech Water treatment & purification*, <https://www.lenntech.com/phosphorous-removal.htm> (Mar. 15, 2019).

Appendix

Calibration Curves and Raw Data

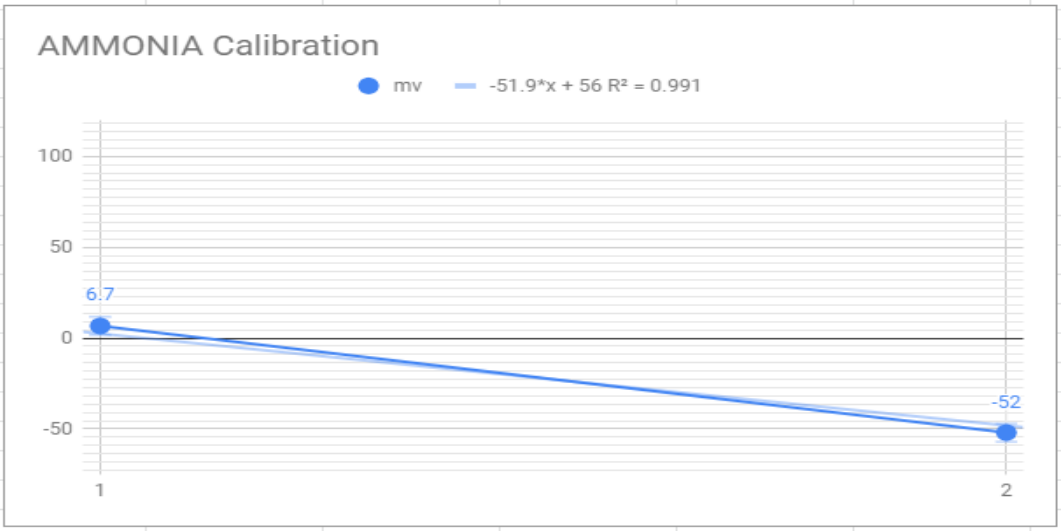
Phosphate

	A	B	C
1	concentration	absorbance1	absorbance 2
2	0.01	0.014	0.038
3	0.1	0.061	0.103
4	1	0.679	0.695
5	4	1.328	1.033
6			
7	For PEW		
8	absorbance	Concentration	
9	0.808	0.463088	
10	1.317	0.863162	



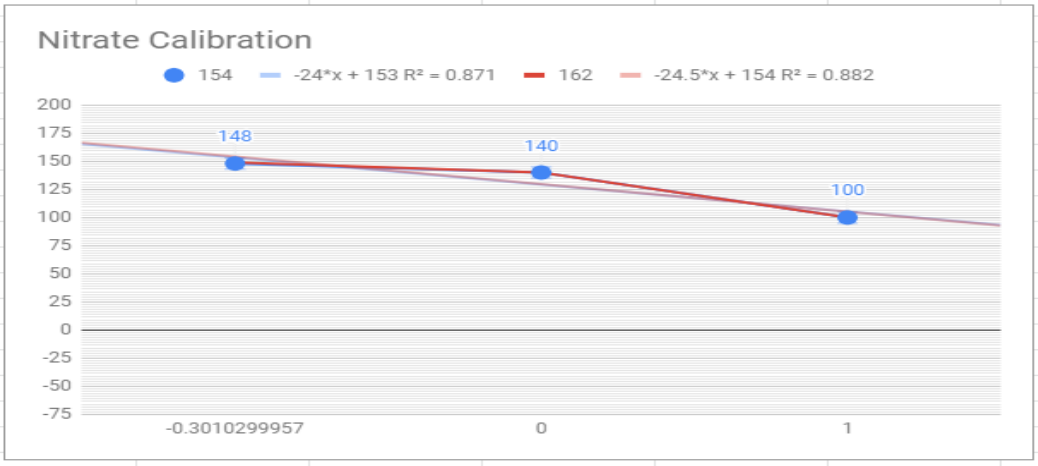
Ammonia

Concentration	mv		Unknown Conc	MV
-1	101.8		0.8978805395	9.4
0	63.8		0.901734104	9.2
1	6.7			
2	-52			



Nitrate

Concentration	mv	mv2	Unknown Conc	MV
-1	154	162	3.02504817	-101
-0.3010299957	148	149	3.02504817	-101
0	140	140		
1	100	100		



Sample Calculations

Dilutions

Equation: C1V1=C2V2 (Ammonia)

C1=100ml

C2=.1

V1=100 ml

V2=?

V2=$\frac{C1V1}{C2}$=1 mL

Max Daily Load

Equation: Concentration(mg/L) * Flow rate=MDL (lbs/day)

For Ammonia:

MDL= 0.807 mg/L * 5 MGD* (8.35 lbs/ 1 Gallon)=37.4 lbs/day