ANC Control Fall 2009 Research

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ANC CONTROL

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INTRODUCTION

The former ANC group experimented on different designs for a lime feeder, including a column model, a conical vessel, a funnel-column and an inverted traffic cone model. These results can be found on pages 10 through 17 of ANC control with lime.docx and in Table 1 below. The descriptions and diagrams pertaining to the experimental set-ups are explained in pages 4 through 8 of the above report.

The column succeeded in keeping the lime suspended for a few hours but the water began to flow in a preferential path after the lime settled on the bottom. For the conical column, the mixing at the bottom of the vessel proved to be insufficient in keeping all the lime in a suspended state. On the other hand, the funnel-column apparatus worked well for 20 hours but only because it was unclogged periodically, which would not possible in a real-time set up.

As a result, the inverted cone model that supplied saturated limewater at a pH between 11 and 12 for about 18 hours without having to be unclogged and without the above difficulties was selected as the best alternative among them. However, the main problem was that inverted cones are extremely difficult and expensive to construct, install and maintain. So the task of the ANC team was to search for a simpler solution for the lime feeder design. Since the upflow velocities were also highly variable (as seen in Table 1), another goal was to find the optimal upflow velocity for the limefeeder.

Unknown macro: {float} *Table 1. Results of 2006 Experiments. M_init is the initial mass of lime; Q is the flow rate; T_obs is the time the effluent had a pH of 12; T is the theoretical duration; Vb is the upflow velocity; and Vbottom is the velocity at the bottom of the vessel.

Reactor	M_init (g)	Q (L/min)	Res.Time (min)	T_obs (hr)	T(hr)	Vb (cm/min)	Vbottom (cm/min)
HalfCone	400	0.6	12.48	9	12.56		84.9
Funnel	200	0.1	46.10	20	37.67	0.71	12.4
Funnel	200	0.1	46.10	25	37.67	0.71	12.4
Funnel	100	0.1	46.10	7.75	18.84		12.4
Cone	300	0.4	31.95	6	10.69	1.5	19.6
Cone	300	1	12.78	1.25	4.28		49.0
Cone	500	0.88	14.52	4.75	8.10	2.35	43.1
Cone	1800	0.55	23.24	18	46.65		26.9
Cone	1000	0.52/0.84	22.02	11			
Cone	1000	0.67	20.00	12		1.65	32.8

ALKALINITY IN HONDURAN WATER

The table below shows the actual measurements of pH and alkalinity in AguaClara treatment plants in Honduras. To more accurately research ANC, the conditions of Honduran raw water were simulated in the laboratory. The results in the table demonstrate a decrease of pH during the treatment process. It is strongly visible on Cuatro Comunidades and Tamara plants. Therefore, one goal was to increase the alkalinity of the water, creating a buffer system against acidity.

Unknown macro: {float} *Table 2: Water Quality in Honduras

Source: Honduras water reports, 2009

OJOJONA	**RAW WATER**	**TREATED WATER**
pH (UN)	6.51 - 6.8	6.26 - 6.56
Alkalinity (mg/L CaCO3)	34.7 - 36.3	17.3 - 19.4
MARCALA	**RAW WATER**	**TREATED WATER**
pH (UN)	6.44 - 7.28	6.07 - 6.45
Alkalinity (mg/L CaCO3)	15.3	Before chlorination 8.7 After chlorination 11.12
CUATRO COMUNIDADES	**RAW WATER**	**TREATED WATER**
pH (UN)	6.34 - 7.00	6.80 - 6.85
Alkalinity (mg/L CaCO3)	7.65	Before chlorination 4.59 After chlorination 10.71
TAMARA	**RAW WATER**	**TREATED WATER**
pH (UN)	La Chorrera: 6.44 El Manzanal: 5.97	6.56 - 6.66
Alkalinity (mg/L CaCO3	La Chorrera: 7.14 El Manzanal: 22.4	4.08

PROPERTIES OF LIME

The pH of calcium hydroxide(lime) solution decreases with an increase in temperature. (see Figure 3 below) The temperature at the Honduran plants is generally in the range of 19-21 degrees C but during summers it can increase to 27 degrees C. This temperature differential can change the pH of limewater and thereby affect the working of the lime feeder and needs to be taken into consideration while designing the lime feeder.

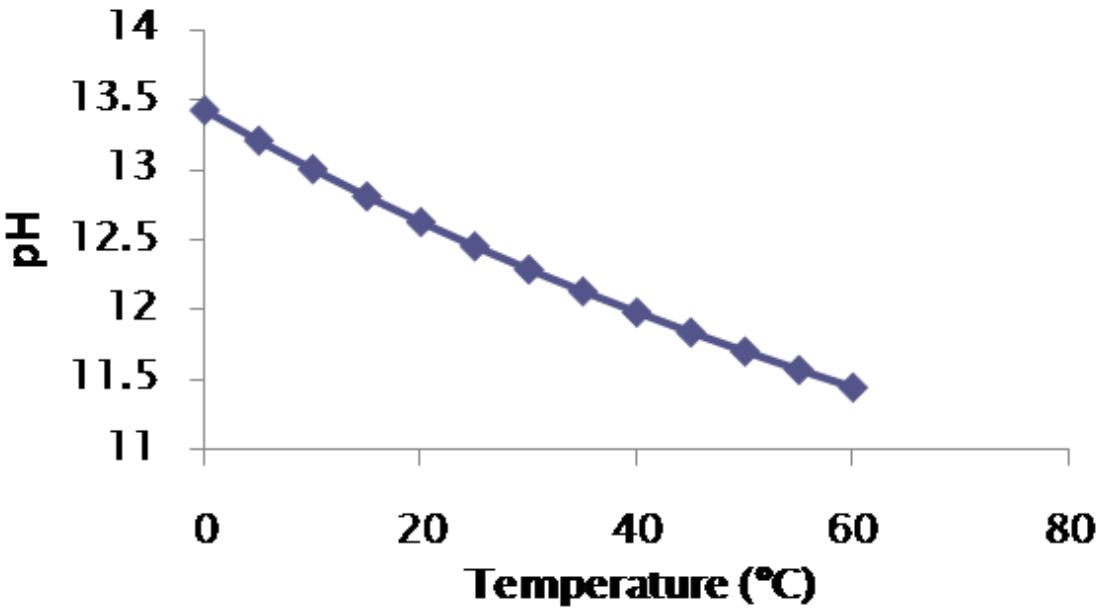

Figure 3. Changes in pH of lime with respect to Temperature changes

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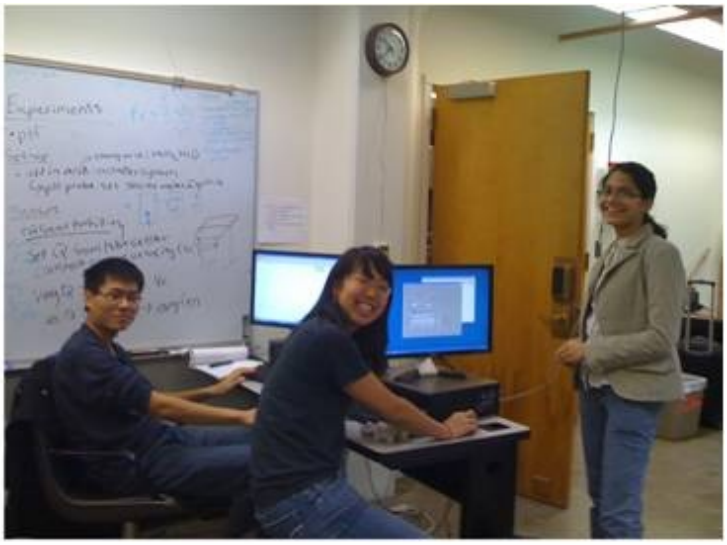
PROCEDURES AND RESULTS

One of the first tasks was to measure the relationship between the changes in pH and ANC with changing flow rates in the lime feeder. The analysis of lime feeder flow requirements was made with the help of MathCAD software.

The next tasks were a series of experiments carried on the column-based model of a lime feeder.
Experiment 1: Feasibility of using a Glass column as a fluidized Lime feeder

Experiment 2: Testing the lime feeder performance using a pH probe

Experiment 3: Addition of sloping glass column above the lime feeder and Tube-length Calculations



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1 Comment

Matthew William Hurst

Please put table headings above, not below. Please format tables on the wiki and do not insert them as images.