Great Lakes Environmental Center
September 8, 2006

Oxygen Uptake Test
Palo Alto Treatment Plant Aeration Basin

Summary Report

Introduction

The Specific Oxygen Uptake Rate (SOUR) test is used to determine the oxygen consumption rate of a sample of activated sludge. The test was derived from Standard Methods (SM 2710 B). The test involves utilizing activated sludge and an oxygen probe or manometric devise to accurately measure the reduction in oxygen over a standard period of time. The resulting rate of oxygen usage is a reflection of the biological activity of the sludge, and any impacts of target chemicals can be evaluated by comparisons to the controls.

Methods

A specific oxygen uptake test was completed on product from the aeration basins at the Palo Alto, CA wastewater treatment plant. The oxygen uptake test was conducted according to Standard Method SM2710B, using YSI Model 5905 BOD oxygen probes.

The aeration basin product was collected by the Palo Alto wastewater treatment plant, and shipped on ice overnight to Great Lakes Environmental Center (GLEC). The product was continuously aerated for two hours to remove any volatile acids that have been trapped and accumulated in the solids. This aeration process also allowed the product to come to test temperature (approximately 23.3 °C) prior to the initiation of the tests.
The test material was Vaporooter liquid (30% by weight metam-sodium).

Five concentrations of the test material (metam-sodium, 30% active ingredient, Vaporooter, Inc.) were tested. All concentrations (2, 4, 8, 16 and 32 ppm) were calculated on complete Vaporooter product, not based on the 30% active ingredient. The test concentrations were chosen by calculating the highest amount of metam-sodium likely to enter the Palo Alto wastewater collection system from standard applications, and incorporating the average daily flow of the Palo Alto wastewater stream. These calculations resulted in an anticipated concentration of approximately 4 ppm vaporooter product at the wastewater plant. Concentrations were then chosen below and significantly above these levels for the experiments. Each test concentration was run simultaneously with an individual control, to reduce variability due to external factors. Approximately 1000 mL of aeration basin product was removed from initial aeration. A 500 mL aliquot was measured, and an appropriate amount of Vaporooter test material was added from a prepared stock solution to reach the desired target test concentration (e.g., 2 ppm). Prior to the initiation of the tests, the dissolved oxygen probes were calibrated according to standard procedures.

To initiate a test, a 300 mL aliquot of the target concentration solution was measured into a standard glass BOD bottle for analysis of oxygen consumption. A 300 mL aliquot of the Palo Alto aeration basin product without metam-sodium (Vaporooter product) was placed into a separate BOD bottle as the companion control. Each bottle (control and test concentration) had a Teflon stir bar placed in the bottom and were placed on a stir plate. Dissolved oxygen probes, with integrated stir bars, were placed in the bottles. Stirring was initiated with both stir bars and the probe stirrers, and the BOD bottles were allowed to equilibrate for 60 seconds. The test temperature was recorded, and dissolved oxygen measurements were taken every minute for 15 minutes. Test temperatures were consistently between 23.2 and 23.3 °C for all tests. At the conclusion of the tests, the oxygen probes were triple rinsed in distilled water, and placed in distilled water until the next test.

The observed dissolved oxygen readings (mg/L) for each test concentration and companion control was plotted using Axum 6.0 (Mathsoft Corp.) as a best fit linear regression. The slope of the line was calculated by the linear regression line and the slope represented the oxygen consumption rate in mg/L per minute. Data were expressed as uptake per hour (mg/L/hr) and were corrected for total solids, reported to be 2300 mg/L (2.3 g/L). Data were analyzed by a paired t-test for correlated samples and found not to be significant ($p=0.16$) at the 5% confidence level.

Results and Discussion

Table 1 shows the data as calculated from the slopes of the regressions, and corrected for total solids. It appears that the five concentrations of metam-sodium tested do not have a consistent impact on oxygen consumption by the organisms present in the Palo Alto aeration basin liquid. Variability in the oxygen consumption rate was observed between control and test concentrations. In some cases, oxygen consumption was greater in the test concentrations. It is anticipated that detrimental impacts on biological activity could reduce oxygen consumption, as the biological capacity of the organisms may be reduced due to the impact of the test material. However, consistent impacts were not observed. Figures 1 through 5 exhibit the linear regressions of the individual oxygen consumption tests.

Based on these preliminary data, it does not appear that metam-sodium from the Vaporooter product has a demonstrated impact on oxygen consumption at the chosen levels. Detrimental effects may be seen at higher concentrations, not tested here. However, the levels used in these tests exceeded the maximum concentrations likely to be observed in the wastewater stream.

Table 1. Data from the oxygen consumption test for Palo Alto.

Palo Alto Vaporooter Data Summay

Test Run	O2 uptake/Min (mg/L/min)	Uptake/hr (mg/L/hour)	Total Solids correction (mg/g/hr total solids)
Control A	0.1645	9.87	**3.80**
2 mg/L Vaporooter	0.2175	13.05	**5.02**
Control B	0.1767	10.60	**4.08**
4 mg/L Vaporooter	0.1591	9.55	**3.67**
Control C	0.1681	10.09	**3.88**
8 mg/L Vaporooter	0.1711	10.27	**3.95**
Control D	0.2123	12.74	**4.90**
16 mg/L Vaporooter	0.209	12.54	**4.82**
Control E	0.1623	9.74	**3.75**
32 mg/L Vaporooter	0.2024	12.14	**4.67**

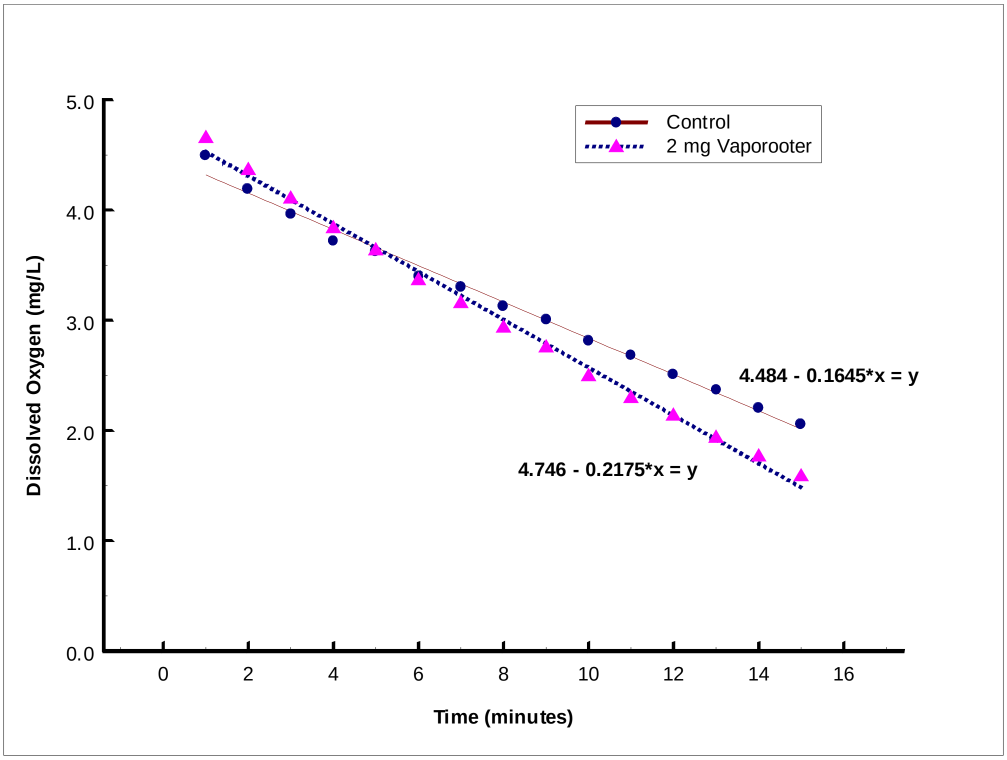

Figure 1. Oxygen Consumption Rate for Palo Alto Aeration Basin Product with 2 mg/L (2 ppm) Vaporooter vs. control (no Vaporooter).

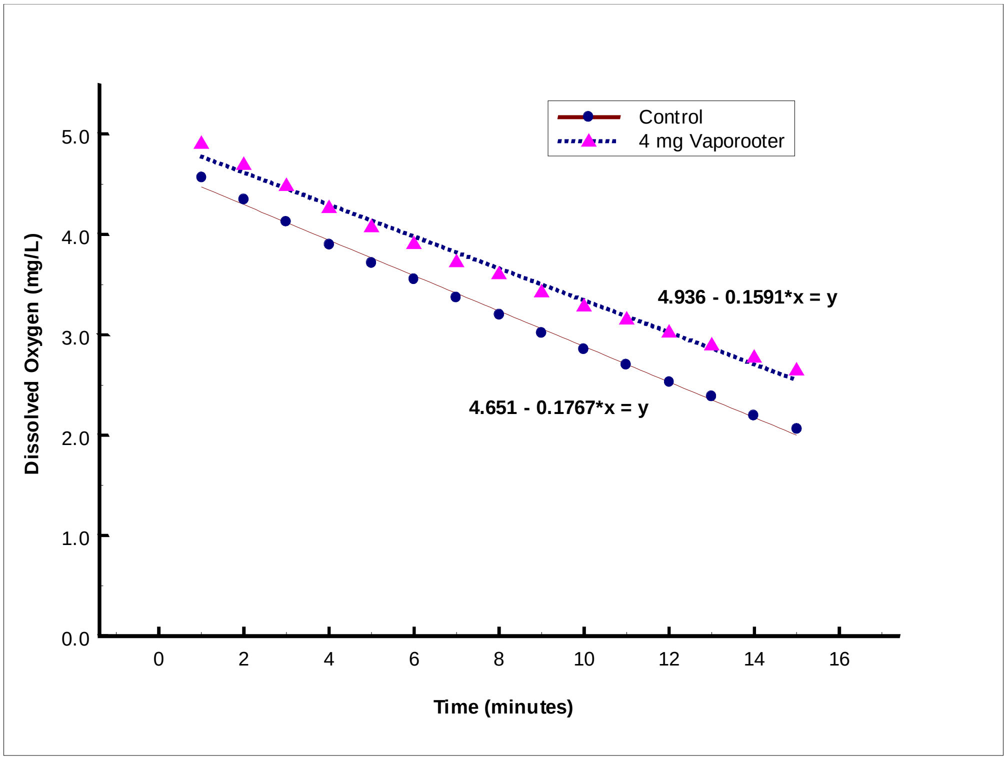

Figure 2. Oxygen Consumption Rate for Palo Alto Aeration Basin Product with 4 mg/L (4 ppm) Vaporooter vs. control (no Vaporooter).

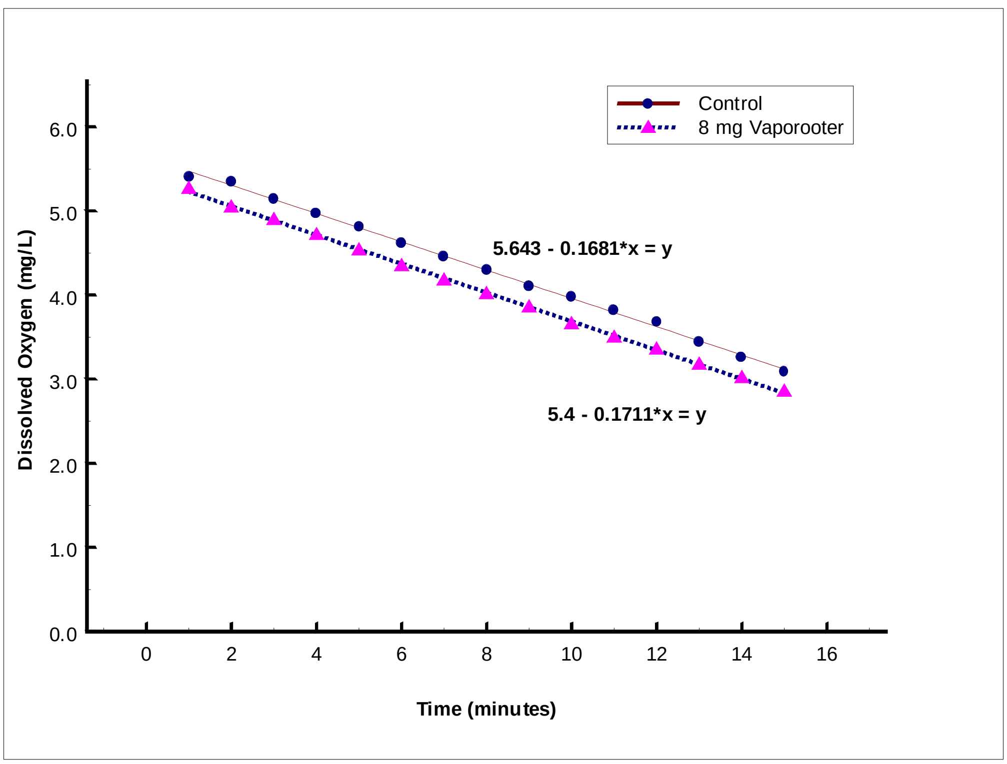

Figure 3. Oxygen Consumption Rate for Palo Alto Aeration Basin Product with 8 mg/L (8 ppm) Vaporooter vs. control (no Vaporooter).

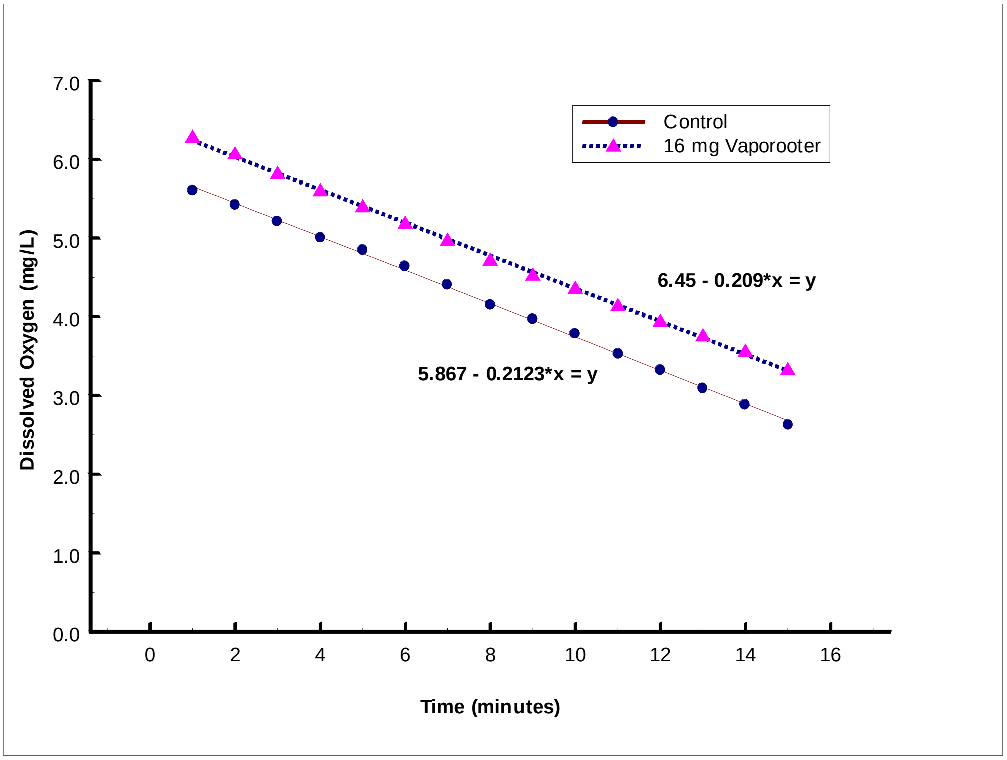

Figure 4. Oxygen Consumption Rate for Palo Alto Aeration Basin Product with 16 mg/L (16 ppm) Vaporooter vs. control (no Vaporooter).

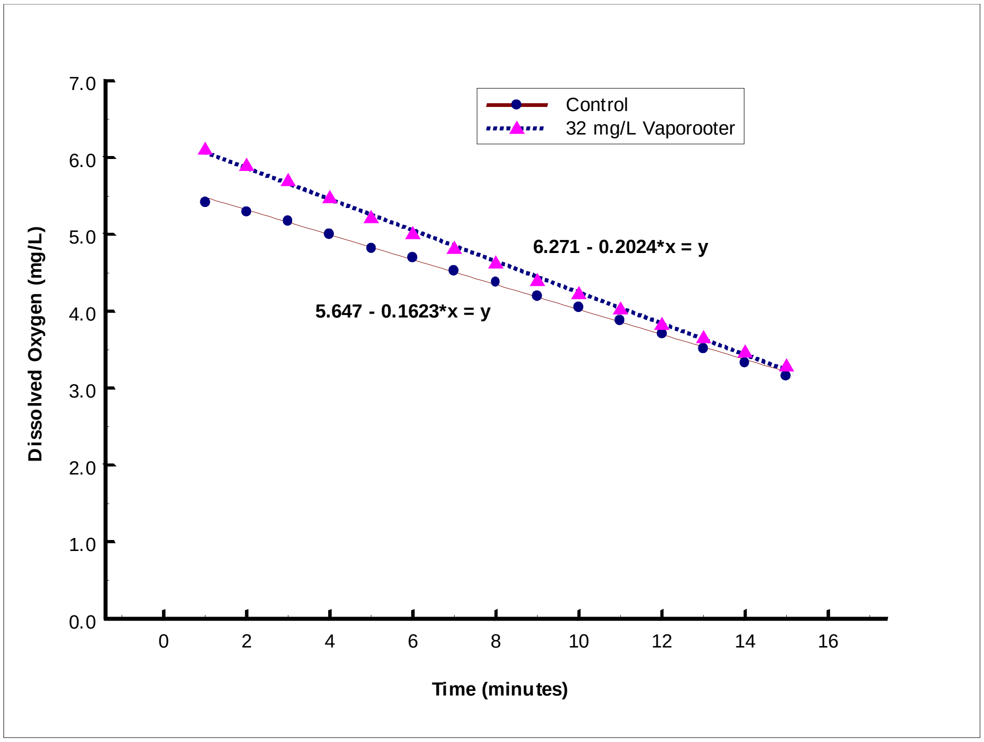

Figure 5. Oxygen Consumption Rate for Palo Alto Aeration Basin Product with 32 mg/L (32 ppm) Vaporooter vs. control (no Vaporooter).