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2121 E. Washington Blvd.  
Fort Wayne, Indiana 46803

July 8, 2004

Thrush Company, Inc.  
P.O. Box 228  
340 West 8<sup>th</sup> Street  
Peru, IN 46870

Re: Analysis of Aar-O-Vent Air Eliminator Test Assembly for Dissolved Oxygen [DO] Concentration Reduction.

Dear Thrush Company:

Enclosed are the Dissolved Oxygen Concentration Reduction analytical data reports generated for the scaled version of the Aar-O-Vent Test Fixture. The Aar-O-Vent Air Eliminator Test fixture was constructed by Thrush Company and delivered to Edglo Laboratories. The assembly was modified to accept the flow-thru cell assembly utilized for dissolved oxygen measurements. This was accomplished by removing the existing shut-off valves from the sampling ports and replacing them with smaller fittings to accept standard PVC tubing and fittings for leak tight testing.

► **Project Description:**

Analysis of Dissolved Oxygen [DO] in water circulating through Thrush Company Aar-O-Vent Air Eliminator system. The residual Dissolved Oxygen and hence separated or scavenged Dissolved Oxygen removed Oxygen from a saturated system is to be measured as % DO removal based on initial start-up Dissolved Oxygen concentration. Dissolved Oxygen data collected over time period sufficient to allow for stabilization (minimization) of Dissolved Oxygen readings. Temperature and system pressures measured at initial time zero and final data collection completion.

Desired goal of 99.0 % or greater Dissolved Oxygen concentration removal.

Indiana Certifications: C-02-03, M-02-05

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Web Site: [www.edglo.com](http://www.edglo.com)

➤ **Apparatus Description:**

Aar-O-Vent Air Eliminator assembly constructed by the Thrush Company from 1-inch Schedule 40 PVC with Boss Circulator, Expansion Tank and 1-inch Aar-O-Vent Assembly. Dissolved Oxygen concentration measured using Hydrolab Surveyor 4a and Minisonde 4a with Electrochemical Sensor to measure temperature compensated Dissolved Oxygen response. Temperature was simultaneously measured using Minisonde 4a dedicated

Thermocouple. Hydrolab flow-thru cell utilized to flow test solution across membrane of Electrochemical Sensor.

Water source hooked to  $\frac{1}{2}$  in Water Inlet at the 10F Fastall Valve. This water source has been treated by mixed anionic-cationic deionization resins. Water introduced at delivered temperature and pressure.

The Hydrolab system flow cell was connected between the two (2) sampling ports on the Aar-O-Vent Air Eliminator.

➤ **Analysis Procedure:**

The Aar-O-Vent System was flushed with several volumes of water prior to initiating testing. After final rinse volume, the calibrated Hydrolab system is connected to the sample ports (influent - effluent). All water is drained from the Hydrolab flow cell. The Fastall Valve is turned fully counterclockwise. The AOV is isolated by closing the AOV inlet valve. The water source is turned on as well as the circulator. Sufficient air bubbles should be present in the system. The Dissolved Oxygen concentration will stabilize (maximum). Record initial [DO] at this time. The Inlet Ball valve is then opened and the lower is closed to begin circulating water through the AOV. The Fastall valve is adjusted to set system operating pressure. At this point the initial Temperature  $T_i$ , time and system pressures are recorded. Begin recording of time and Dissolved Oxygen concentrations. Release separated Air from system from AOV vent every 5 minutes. Continue until Dissolved oxygen readings have stabilized. Record final DO, Temperature  $T_f$  and time of completion

➤ **Sample Analysis:**

Dissolved Oxygen Concentration analyzed using DO Sensor in-situ monitoring with flow-thru cell. Calibration performed at ambient temperature and pressure using air saturated water. Calibration performed at the beginning of each procedure.

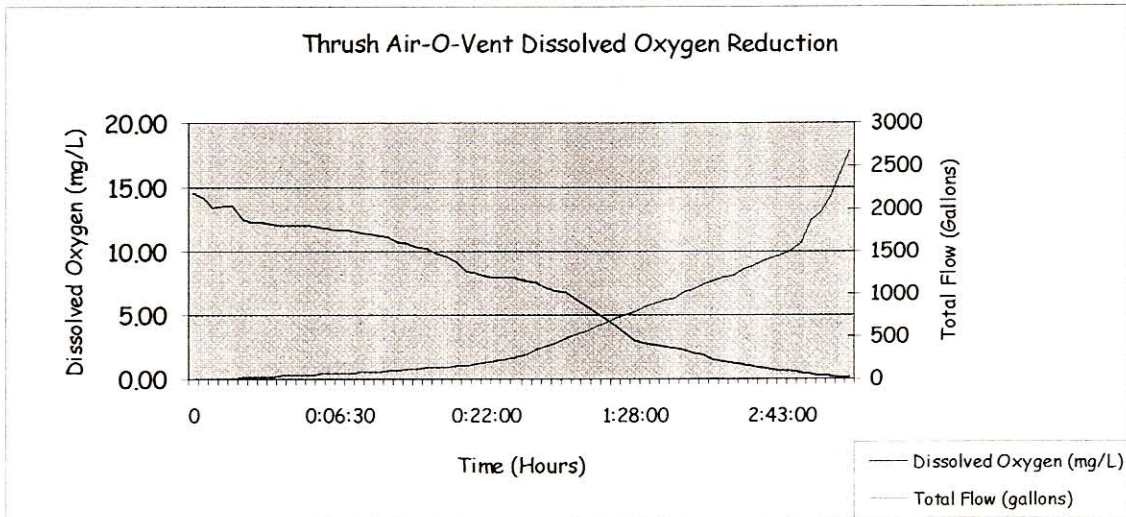
➤ **Sample Results and Discussion:**

The Sample Data can be summarized as follows for the three (3) separate trails of the Aar-O-Vent Air Eliminator.

Trial No	Pressure 1 (psi)	Pressure 2 (psi)	Differential (psi)	Initial Temp (C)	Final Temp (C)	Initial DO (mg/L)	Final DO (mg/L)	DO Removal %
1	25.5	21.0	4.0	19.95	26.98	14.66	0.09	99.39
2	21.5	17.0	4.5	21.04	30.71	11.22	0.03	99.73
3	29.5	25.0	4.5	22.85	33.39	12.84	0.01	99.92

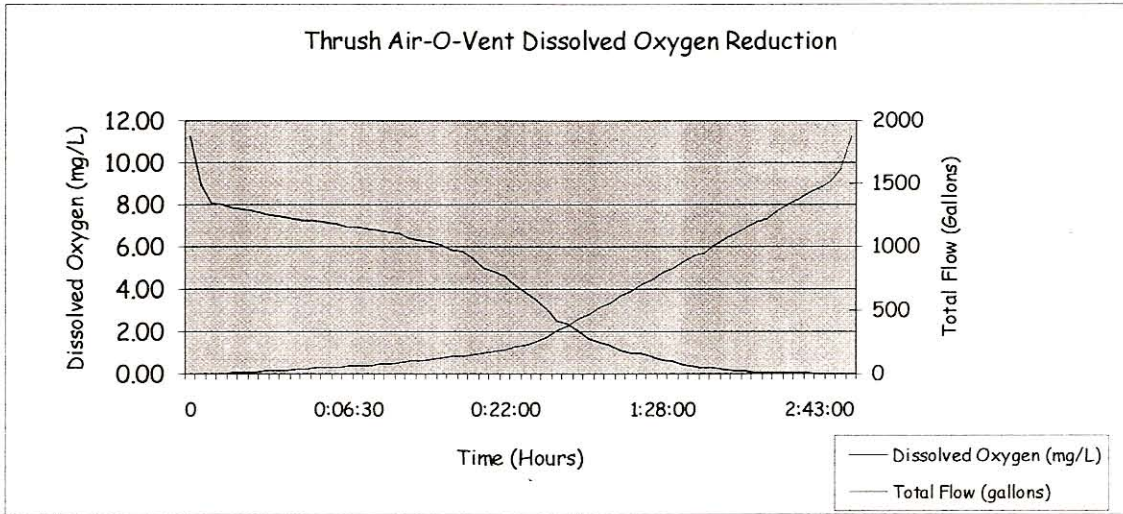
The average % reduction in Dissolved Oxygen Concentration is 99.68 %.  
 The graphical representation of data can be displayed as follows:

Trial 1: June 21, 2004

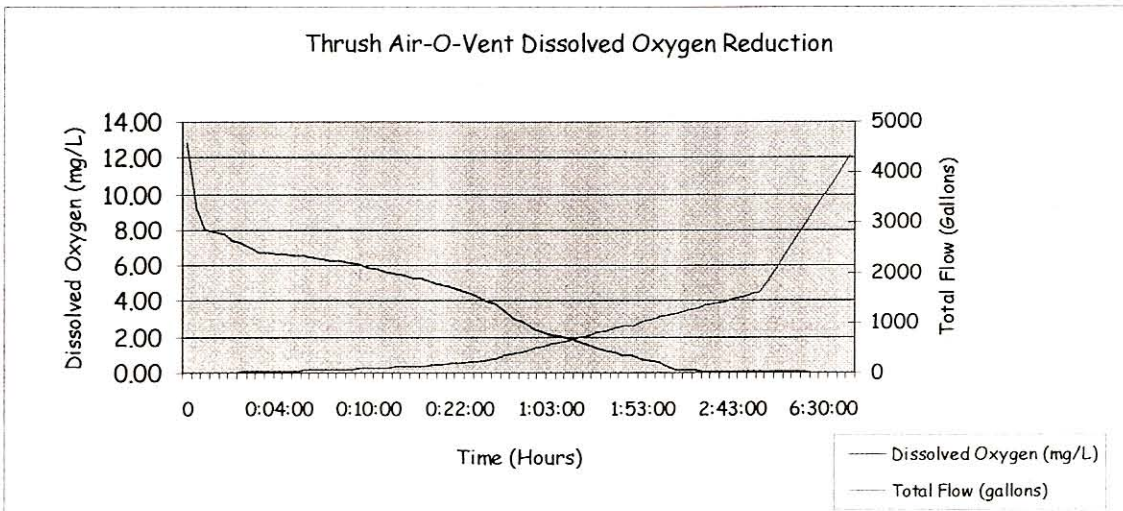




Trial 2: June 28, 2004



Trial 3: July 1, 2004



➤ **Conclusion**

The Aar-O-Vent Air Eliminator System is able to remove consistently greater than 99.7 % of the Dissolved Oxygen from water from a saturated start-up system. Removal percentages approaching 100.0 % will be achieved with sufficient time for stabilization. Dissolved Oxygen analytical precision below approximately 0.5 mg/L is suspect. The Dissolved Oxygen data below approximately this value should only be used for relative comparison purposes. The approximated total flow is based on estimated system flow rate of 9 gpm. Number of system cycles based on flow rate and system volume (all estimated).

➤ **Enclosed Data Reports**

- ✦ Individual Runs Analytical Data and Graphical Representation of Data.

Edglo Laboratories appreciates the opportunity to provide the Thrush Company with environmental analytical services. Should you have any questions or comments concerning this analytical data report, please do not hesitate to contact me at 800-891-8442 or email to [pknott@edglo.com](mailto:pknott@edglo.com) .

Sincerely,  
Edglo Laboratories, Inc.,



Paul Knott  
Laboratory Director

Encl Dissolved Oxygen Data, Aar-O-Vent Air Eliminator