30 Gallon Flextank Argon Gas Headspace Purging Experiments – Phase II

As noted previously (see Phase I experiments), I have been conducting tests to determine how much argon gas is required to purge the headspace of my "small" Flextanks when they are only partially filled with wine. In Phase II of my experiments, described below, I designed a rig that allows me to continuously monitor the oxygen level in the headspace under computer control. When the control computer senses the presence of trace levels of oxygen, it automatically opens an electronic solenoid valve connected to an argon gas cylinder and purges the headspace. In theory, this level of automation should permit me to use the 30 gallon Flextank as a variable capacity maturation vessel without the fear of undesired oxidation of its precious wine contents. Note, however, that this theory has yet to be verified in practice (but this is coming in the near future).

The custom hardware fitted to the opening of the Flextank is depicted in Figure 1. Three holes were drilled through a schedule 40 PVC plug that easily screws into the threaded port on the Flextank lid. These holes were fitted with "air tight" PVC fittings which held the oxygen sensor probe, argon gas inlet with computer controlled solenoid valve, and a one-way exhaust valve needed to vent the headspace during the inert gas purging events.

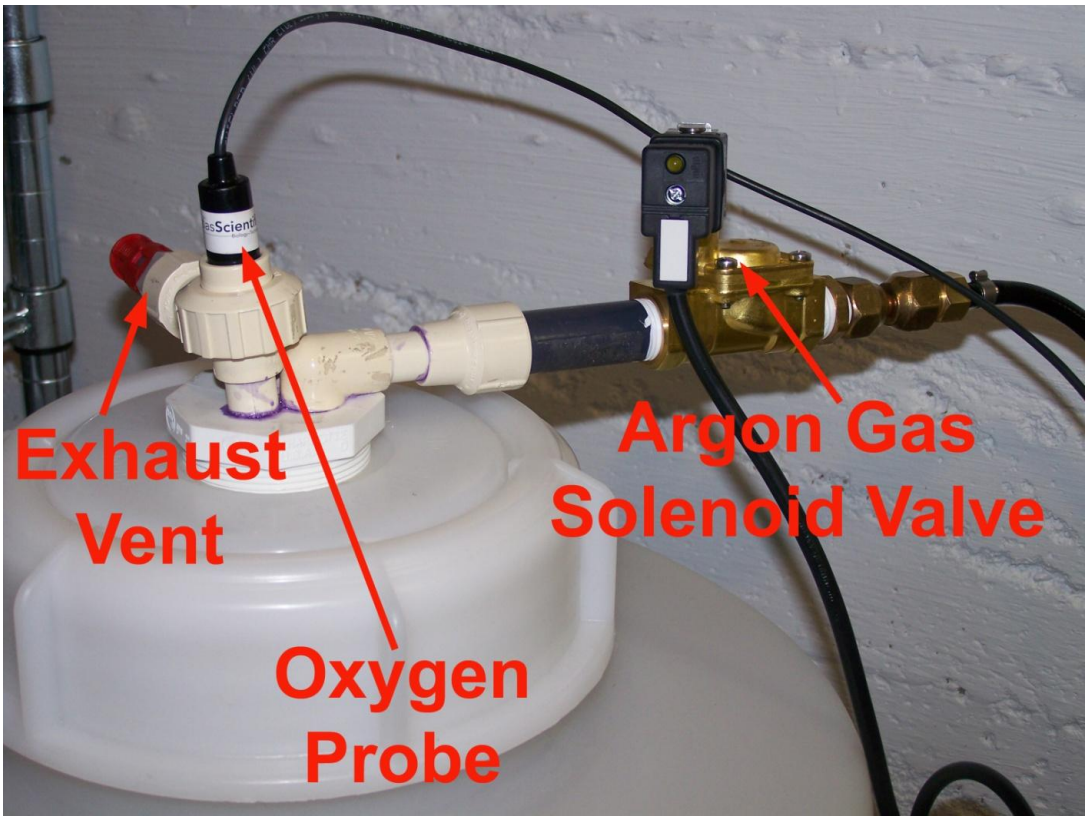

Figure 1. Custom fitting for inert gas purging of 30 gallon Flextank.

Headspace oxygen was monitored using an Atlas Scientific dissolved oxygen probe interfaced to an Atlas Scientific Dissolved Oxygen Circuit. This circuit is slightly larger than a postage stamp and has a microcontroller that can be accessed by an external computer to calibrate the oxygen probe as well as collect oxygen measurements upon demand. It connects to any control computer via a standard serial interface running at 38,400 baud. Figure 2 shows the dissolved oxygen circuit temporarily mounted on a solderless breadboard used during project development.

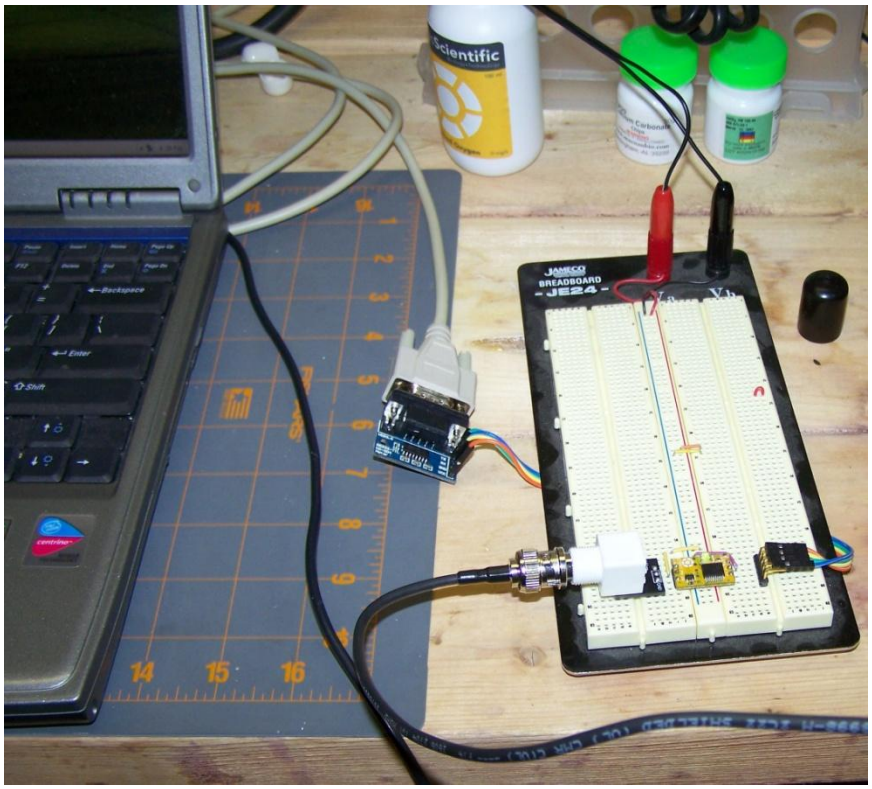

Figure 2. Atlas Scientific Dissolved Oxygen Circuit mounted on solderless breadboard. Note the BNC connector input from the oxygen probe and RS232 level-converter used to interface the circuit to the COM (serial) port of the laptop computer controller.

In addition to the electronics needed to collect headspace oxygen readings, an additional circuit was needed to allow the control computer to open and close the solenoid valve used to implement the argon gas purging process. The electronic valve used here was an ASCO Series 8238 2-way normally-closed solenoid valve with half-inch pipe ports and requiring 12 volts (DC) to operate. The DC operating voltage was computer controlled via a solid state relay module controlled via a connection to the computer's legacy parallel printer (LPT:) port. A hand-drawn schematic circuit describing the interface is depicted in Figure 3 while a photograph showing the whole tank-electronic interface-computer setup is presented in Figure 4 (below):

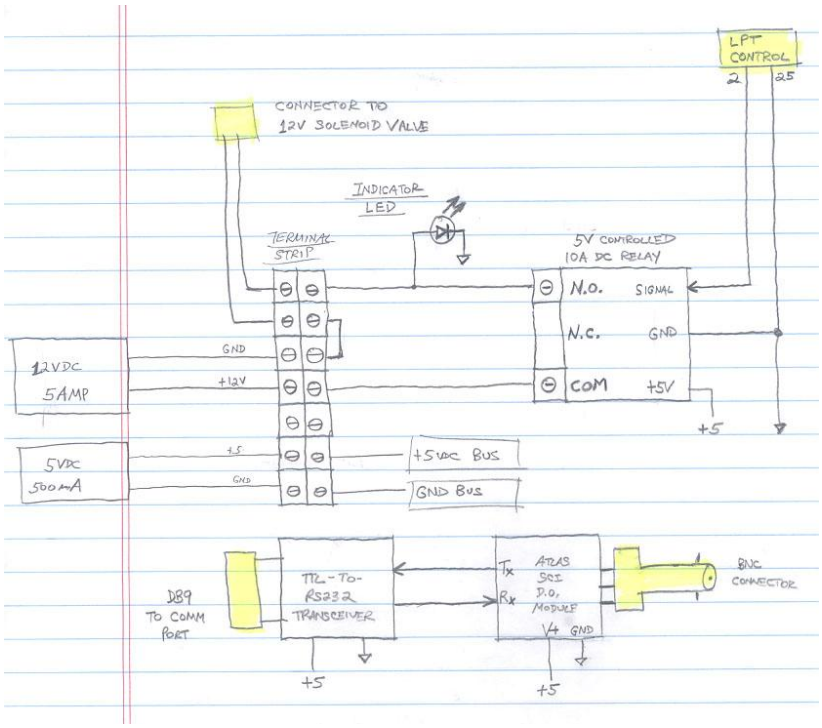

Figure 3. Computer interface functional diagram.

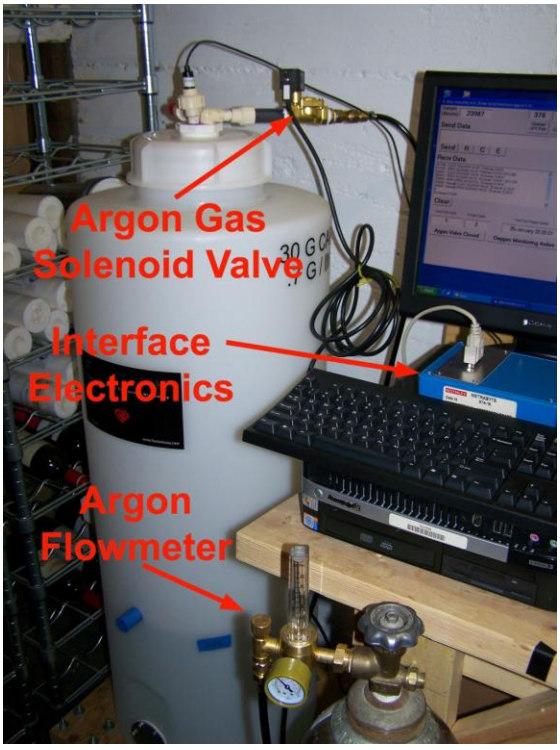

Figure 4. Experimental Flextank automated inert gas purging setup (Note computer screen showing VisualBasic-based user interface).

Automated Argon Gas Experiment

The 30 gallon Flextank was filled with 10 gallons of water and then sealed using the custom cap (fitted with the oxygen sensor, solenoid valve connected to the argon gas tank and exhaust port). Next, the 20 gallon empty headspace was completely purged of oxygen using argon gas. After purging was complete, the flowmeter on the argon gas tank was set to 30 cubic feet/hour and the solenoid valve was closed using the custom control software. This control program was then configured to continuously sample the oxygen level of the headspace and to execute a 5 minute argon gas purging cycle any time trace levels of oxygen were detected.

Experimental Results

Oxygen levels and automatic argon gas purging activity were logged to a computer disk file. The first trace oxygen detection event occurred after 174 hours (7.25 days). The second trace oxygen/argon gas purging event occurred after another 181 hours (7.5 days) had elapsed. The experiment was allowed to continue until a third oxygen detection event occurred after yet another 172 hours of elapsed time (7.16 days). At this point the experiment was terminated.

The results collected here indicate that a 30 gallon Flextank filled to less than half its capacity needed to be purged with argon gas at an interval of approximately 7 days (mean = 7.3 ±0.1).

The high consistency of the elapsed time required between trace oxygen detection events indicates that automated purging of the partially filled 30 gallon Flextank could be accomplished with a simple timer set to automatically open the solenoid valve (for a period of 5 minutes) every 7 days. This would significantly reduce the cost of the equipment required since the relatively expensive oxygen probe, interface circuitry and control computer could be eliminated from the design.

Future Experiments

So far, no wine has been used in any of my experiments into the dynamics of the argon gas purging requirements for partially filled, small-format Flextanks. This will soon change. Soon I will be blending and bottling the contents of one of my 30 gallon Flextanks. When that happy day arrives, I plan to leave 5 gallons of this finished wine behind and subject this sample (complete with 25 gallons of empty headspace) to my automated argon gas purging protocol (as described above). After 90 days, I will terminate the experiment and compare the experimental wine to control samples bottled prior to the start of the 90 day auto-purge experiment. The before/after samples will be evaluated for signs of oxidation and other organoleptic qualities as well as free SO_2 levels. The test wine will also be protected by a floating "skin" manufactured by Flextank USA. The results of this experiment should be available by September 2013 (or sooner). Stay tuned.

References

Atlas Scientific http://www.atlas-scientific.com/product_pages/sensors/do-sensor.html

ASCO Series 8238 Valves http://www.ascovalve.com/Common/PDFFiles/Product/8238_R5.pdf