30 Gallon Flextank Argon Gas Headspace Purging Experiments – Phase I

Recently, I acquired my first two Flextanks. They are both 30 gallon tanks designed for maturation of wine and deliver the same micro-oxygenation dose as a typical oak barrel. One tank currently is filled with Western Iowa St. Croix wine from the 2012 vintage. However, in the future, I would like to use the tanks to age quantities of wine ranging between 10-25 gallons (That is, less than their full capacity). This means that I will need to purge the excess headspace with inert gas and devise a means to assure that oxygen levels are maintained at near-zero levels for the duration of the maturation process.

In order to accomplish these goals I have designed a custom rig that screws into the 2-inch threaded schedule-40 port on the top of the tank (see Figure 1 below). This custom screw-on cap is fitted with (1) an air-tight fitting that holds an Atlas Scientific oxygen sensor, (2) an electric solenoid valve that controls the entry of pressurized argon gas into the tank and (3) a one-way exhaust valve that vents the pressure build-up accompanying the addition of the argon gas.

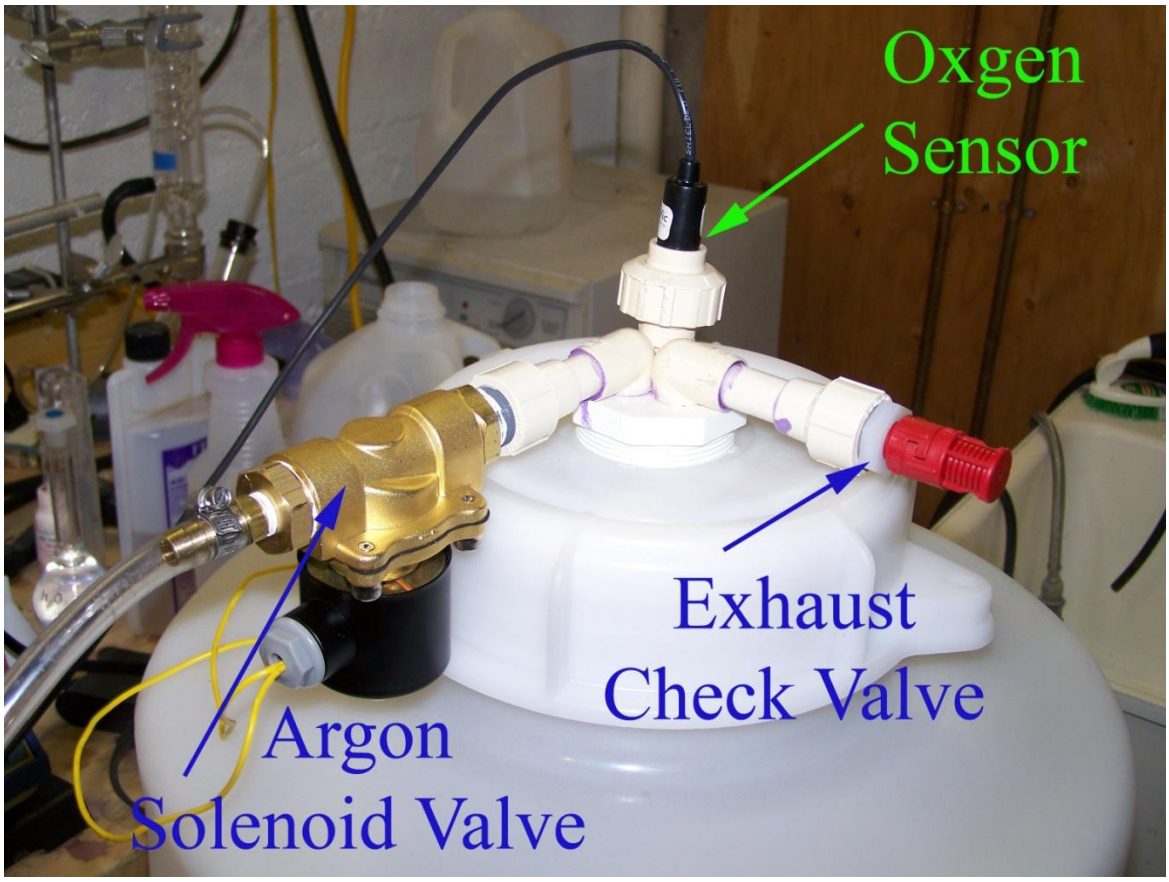

Figure 1. Custom fitting for purging Flextank headspace with inert gas and measuring its O^2 content.

Eventually, I plan to develop a microcontroller circuit that continuously monitors the oxygen level of the headspace by reading the output of the O^2 sensor. Whenever any trace levels of O^2 are detected the controller will open the electric solenoid and purge the headspace with pressurized argon gas until the O^2 level returns to zero. Before designing that circuit, however, I plan to perform a few preliminary

experiments to determine how much argon gas is needed to purge varying volumes of headspace in the 30 gallon tank.

So far, I have run three small-scale experiments to determine the time required to purge the tanks for three different amounts of headspace: 5, 10 and 20 gallons, respectively. For all of the experiments, the argon gas was delivered at a rate of 30 ft^3/hour via a tube that terminated in the center of the headspace (halfway between the surface of the liquid and the top of the tank). The results of these headspace purging experiments are depicted in Figures 2-4.

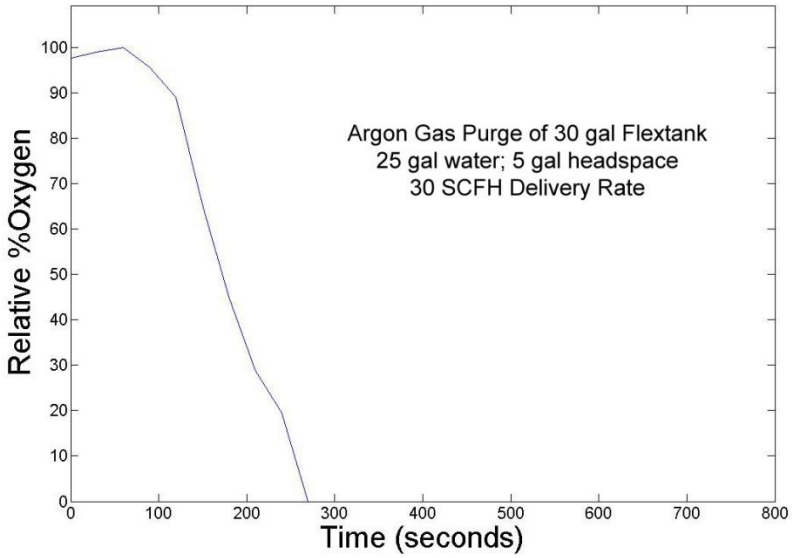

Figure 2. O^2 level in 5 gallon headspace as a function of time since the start of argon gas purge.

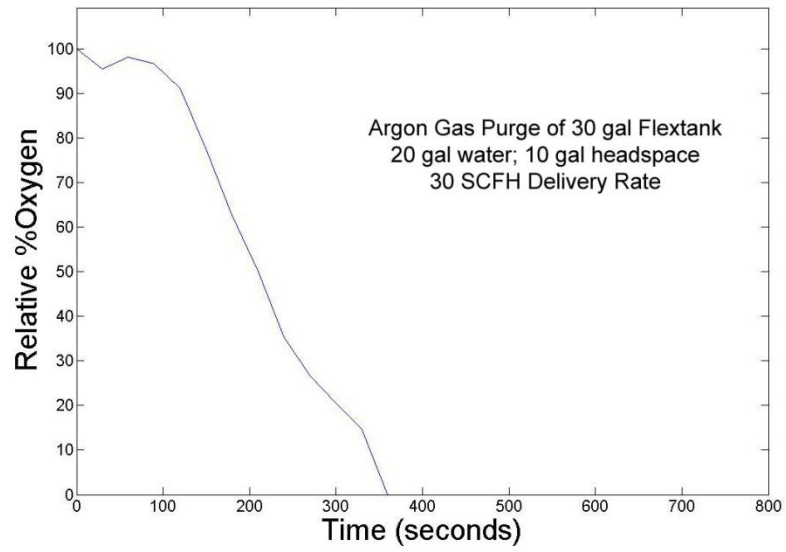

Figure 3. O^2 level in 10 gallon headspace as a function of time since the start of argon gas purge.

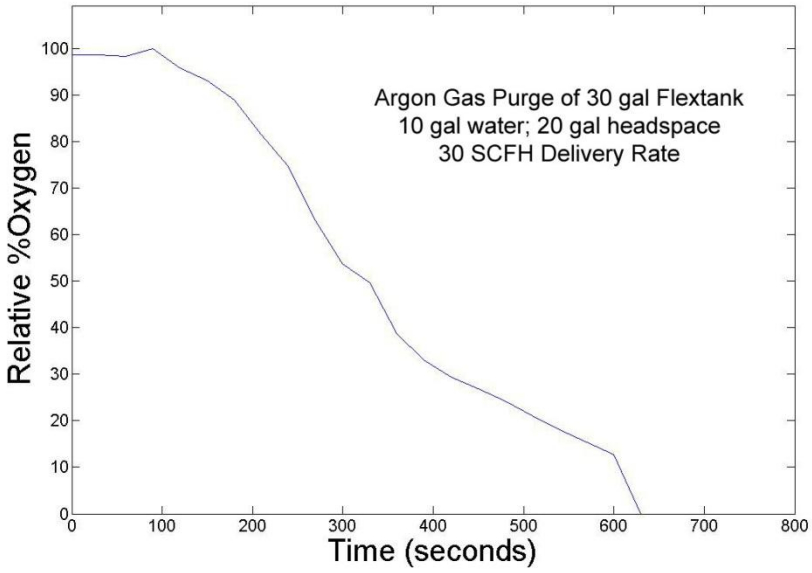

Figure 4. O^2 level in 20 gallon headspace as a function of time since the start of argon gas purge.

Given an argon gas delivery rate of 30 ft^3/hour, it took 270, 360 and 630 seconds to purge headspaces of 5, 10 and 20 gallons, respectively. Analysis revealed that a simple linear equation generated a very accurate description (R^2 = 0.996) of the relationship between the volume of the headspace and the time necessary to completely purge it of oxygen. This relationship is described in Equation 1:

Purge Time (sec) = 24.42 (headspace in gallons) + 135

Equation 1. Time needed to purge headspace of 30 gallon Flextank at 30 ft^3/hr argon gas delivery rate.

Phase II of my experiments will measure the time required for trace amounts of O^2 to re-infiltrate the headspace following the argon gas purging process. Since I anticipate this process to be slow, it will take many weeks (perhaps months) to adequately characterize this process using a computer automated O^2 monitoring and logging process. Once this process is better understood, it should be possible (in principle) to design a device to automatically purge the headspace with argon gas according to a pre-specified schedule. This would eliminate the need for the relatively expensive O^2 sensor and interface ($200) and significantly reduce the cost of the hardware needed to protect the wine in less-than-full Flextanks. I shall post the results of these experiments at www.moundtop.com when they are completed (Spring-Summer 2013).