Sampling Groundwater using Model 407/408 Pumps

Introduction

Retrieving a groundwater sample using a Bladder or Double Valve Pump, requires answers to two questions - how much pressure and how much volume of drive gas do I need? The drive gas is usually air or nitrogen delivered through portable gas cylinders or an air compressor. Portability to the site and the pressure requirement for the application, are the main deciding factors. The selection of either compressed nitrogen or air, to use as the drive gas, is made based on the availability, as well as the potential for affecting groundwater sample quality.

Pumping Pressure

Determining the amount of applied pressure (in psi) to retrieve a sample, is simple. 1 psi of pressure can raise a 2.3 ft column of water, which is about half of the column height of water in feet, expressed as psi.

e.g. If the Bladder Pump's intake is at 100 ft below ground surface, you will require approximately 50 psi of pressure to bring a sample to ground surface. If you are sampling with a Double Valve Pump, then this calculation is made from ground level to static water level (as a minimum, but can be made from total pump depth to maximize purging rates). Therefore, if a Double Valve Pump is 100 ft below ground surface, and static water level is at 50 ft, you can select a pressure of between 25 and 50 psi. With both Bladder Pumps and Double Valve Pumps, add an extra 10 psi to allow for "line loss".

Tip: What do you do when your pnuematic pump is properly connected, yet there is no sample discharge? A simple 'trick', is to submerge the sample discharge line into a clear container of water. During the drive cycle, you should see bubbles. An aggressive blast of air bubbles can mean that there is no water available, while a steady mild bubbling indicates that the pump is operating and the sample water is on the way up!

Drive Gas Volume

Gas volume is usually expressed as CFM (Cubic Feet per Minute). As a 'rule of thumb', it takes about 1 CFM of gas (air or nitrogen) to deliver 1 USGPM (US Gallon per Minute) of water, at 0 psi. If you opt to sample with an air compressor, you should also consider using a 50% duty cycle or, 'factor of safety', for the compressor. This 50% duty cycle ensures that the air compressor won't be running all the time.

e.g. To collect a sample from a depth to water of 100 ft (30 m), using a Double Valve Pump at a rate of 0.05 USGPM (200 mL/min), the calculation is:

> 0.05 USGPM (200 mL/min) x 1.5 (includes a 50% duty cycle) = a drive gas requirement of 0.075 CFM, or about 0.1 CFM.

Now the user needs to select an air compressor that will supply a minimum of 0.1 CFM at 50 psi pressure. This is done by checking the manufacturer's data sheet to see that the CFM needed will meet the output delivery for the required pressure. Considering a 50% duty cycle, the Solinst 12 Volt Air Compressor (pt.#106009) will deliver 0.1 CFM at 50 psi, which is equivalent to a 100 ft (30 m) pumping depth. A larger compressor should be used for deeper applications.

Pump Controller

When selecting a pump controller, look for easy to follow preset pumping options. This helps take the guesswork out of determining suitable drive and vent times. For example, if you anticipate that the monitoring well has good recharge and 'makes water', then select a 'fast' cycle rate (~6 sec/cycle of drive & vent times); in poorly producing, or 'slow to recharge' wells, a longer cycle rate of ~115 sec may be more suitable.

To help protect the pump controller from damage due to moisture, always position the pump controller physically higher than the sample discharge and wellhead. This helps prevents a syphoning effect, where the gravity back-flow of sample water can enter into the pump controller.

Note that there will be a time delay from when the pump controller is turned 'ON', to when an actual water sample is discharged at ground surface. This time delay could be as much as several minutes.

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For further information contact: Solinst Canada Ltd.
Fax: +1 (905) 873-1992; (800) 516-9081 Tel: +1 (905) 873-2255; (800) 661-2023
35 Todd Road, Georgetown, Ontario, Canada L7G 4R8
Web Site: www.solinst.com E-mail: instruments@solinst.com

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Memorandum

GROUNDWATER SCIENCES CORPORATION

To: file

From: Ryan Ulrich

Date: September 17, 2013

Re: Groundwater Sampling Protocols for Waterloo Samplers

To determine the appropriate sampling technique for each sampling interval, adjust the pressure knob on the control unit so that the purge rate is at least 0.1 L per minute, which is the minimum flow rate for flow-through cells. If a purge rate of 0.1 L per minute cannot be attained, purge at the highest rate possible and use low yield Waterloo sampling, described below.

When a purge rate of 0.1 L per minute is attained, check the vibrating wire transducer for drawdown. If drawdown is occurring use low yield Waterloo sampling. If the sampling interval can be purged at 0.1 L per minute without drawdown use the well yield matched purge sampling technique as described in the Work Plan.

Low yield Waterloo sampling is a modification of low yield well sampling described in the Work Plan. For low yielding sampling intervals, purge the sampling interval until cavitation. Prior to cavitation, use a spring clamp or other means to affix the discharge tubing to the side of the purge bucket to prevent the tube from whipping around.

Allow time for the sampling interval to recharge. Purge the sampling interval until the volume of water is sufficient to record water quality field parameters. If the purge rate remains relatively steady, collect a sample. If the purge rate increases dramatically and air bubbles appear in the discharge line, which occurs just prior to cavitation, do not collect a sample. Instead, allow the sampling interval to cavitate a second time. Collect a sample as soon as a sufficient volume of water is present.