Pump ED 101

Wastewater Pump Draw Down Calculator

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Based on several of my previous Pumps & Systems articles, you probably know that I have major concerns about the off BEP operation of wastewater pumps. Last month we revisited suction recirculation and its potential effects on wastewater pumps due to the rather large eye diameter to impeller diameter ratio. In 2010 we discussed unbalanced radial thrust and how the wide vane impellers used in wastewater pumps are extremely vulnerable to the damage it can cause. In February of this year, I wrote and article on my Field Test calculator. Although it accommodates several different pump designs, wastewater pumps were a major focus.

Flow meters are becoming more popular in many wastewater applications but it is often difficult to justify their cost in smaller lift stations and those that are not connected to a SCADA network. Up here in the Northwest, the vast majority of these stations use "Draw Down" as the standard pump test technique. This testing method can be very reliable as long as the data collected is accurate and the test is repeated several times to insure reliability. Often, a draw down test is used to measure pump flow rate and then flow rate is used to determine where the pump is running on the H/Q curve. But, flow rate alone may not provide all of the needed information. Pressure must also be measured if we are to assess the true performance of the station.

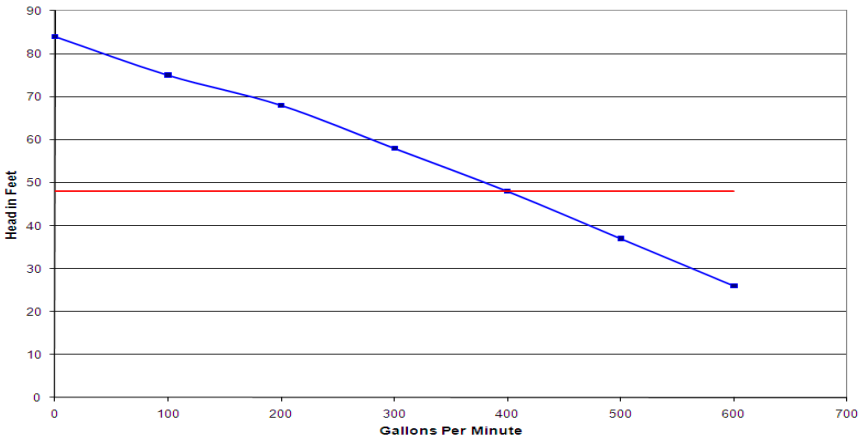


Figure 1 shows the pump curve for a duplex lift station that was designed to pump 400 GPM into a gravity main against a static head of 48 feet. The red, horizontal line is the system head at pump start level in the wet well. In this example we will ignore any friction in the discharge piping. In a standard draw down test we would calculate the wet well volume per foot and record the time required to lower the water level one foot. Dividing the volume by the

time in minutes gives us the flow rate in GPM. When possible, we like to use one foot because there is very little change in flow for most pumps over such a small elevation change. Now, suppose we perform several draw down tests and compute an average flow of 350 GPM. Based on the performance curve, the pump is operating at 55' instead of the design point of 48'. Is this reduced flow and increased head due to blockage in the discharge pipe or was the original design point incorrect?

It turns out that neither was the culprit. When the pressure was measured at the valve box and corrected for the elevation difference between the water level and the gauge, the operating head was nearly 48'. It turns out that the reduced flow measurement was due to a leaking check valve that allowed part of the flow to return to the wet well through the other pump. This example is an actual case that I witnessed in the field and illustrates the importance of measuring both flow and pressure.

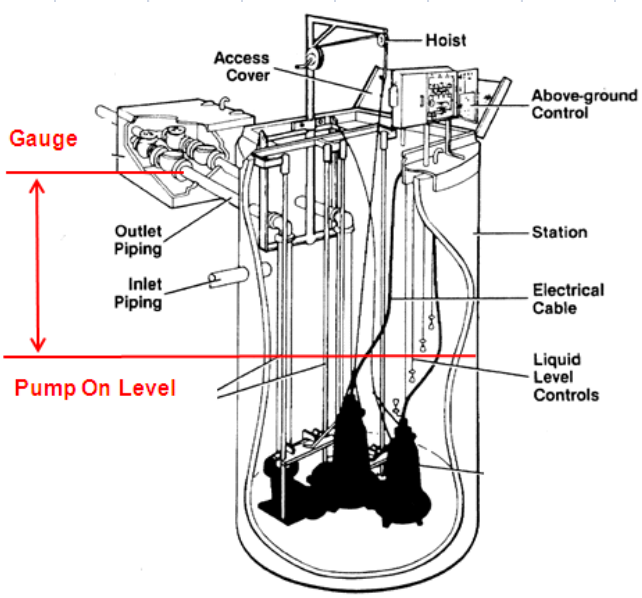
WASTEWATER PUMP DRAW DOWN CALCULATOR

INPUT DATA

Wet Well Diameter (inches)	96.0
Pump Down Distance (inches)	12.0
Pump Down Time (seconds)	40
Discharge Gauge Pressure (PSI)	25.0
Gauge Location to Water Level (inches)	108.0
Pump Suction Diameter (inches)	5.0
Discharge Pipe ID @ Gauge (inches)	4.0
Wet Well Discharge Pipe OD (inches)	12.0
Number of Wet Well Discharge Pipes	2

CALCULATED RESULTS

Wet Well Volume / Foot (Gal)	364
Draw Down Volume (Gal)	364
Flow Rate (GPM)	546
Discharge Velocity @ Gauge (ft/sec)	13.9
Discharge Velocity Head (ft)	3.0
Suction Velocity (ft/sec)	8.9
Suction Velocity Head (ft)	1.2
TDH (ft)	68.5
TDH (PSI)	29.7



Notes

Enter vertical distance from the Pump On Water Level to discharge gauge location in cell C9.
Calculations ignore discharge pipe friction since pipe length is usually short. Calculate manually and subtract if necessary.
Calculations also work for above ground & dry pit pumps.
For above ground pumps enter the suction piping data in cells c12 & c13
For dry pit installations enter 0 in cells c12 & c13
Use a calibrated gauge that reads the measured pressure near the mid point of the gauge range.

Figure 2 is a screen shot of my Draw Down Calculator which is available as and Excel spread sheet on the "Pump Sizing, Selection & Testing Tools" page at PumpEd101.com. It

provides a standard procedure for testing wastewater pumps when a flow meter is not available. The calculations take into account the elevation difference between the "pump start" water level and the gauge position. It also includes the suction and discharge velocity heads in the TDH calculation. If the wet well contains submersible or above ground pumps, the wet well volume per foot can be corrected for empty discharge or suction piping in the wet well. This can increase drawdown accuracy in smaller wet wells. Testing wastewater pumps at least twice a year will reveal changes in operating conditions due to changes in system conditions and pump wear. It will also alert you potentially damaging off BEP operation.

Joe Evans is responsible for customer and employee education at PumpTech Inc, a pumps & packaged systems manufacturer & distributor with branches throughout the Pacific Northwest. He can be reached via his website www.pumped101.com. If there are topics that you would like to see discussed in future columns, drop him an email.