Originally published in the November 2008 issue of ESI eNews

Ask An Engineer

Many of our customers have similar questions. Each month we will try to pick the most common question and answer it in the PUMP-FLO Update eNewsletter. If you have a question about piping systems, send your question to natalie@eng-software.com with "Ask an Engineer" in the subject line.

Q. I've noticed that some of my pipelines have positive differential pressures being calculated. How can a pipeline have a positive dP?

A. The simplest answer is that in order for there to be a positive dP calculated in a pipeline, there must be an increase in elevation *head* between the inlet and the outlet. This means that the actual elevation must drop from the inlet to the outlet. More specifically, the Bernoulli equation states that the total energy at any two points in a fluid piping system must be equal.

Bernoulli Equation: $$\frac{P_1}{\rho} + \frac{v_1^2}{2g} + Z_1 = \frac{P_2}{\rho} + \frac{v_2^2}{2g} + Z_2 + HL$$

Where: P = fluid pressure
ρ = fluid density
v = fluid velocity
g = gravitational constant
Z = elevation
HL = friction head losses through pipe/valves/fittings

If the two points are the inlet and outlet of a pipeline, then we can make some assumptions. The flow rate will be the same at the inlet and outlet as well as the inside diameter, so the fluid velocity will be the same. These terms drop out of the equation. Then:

$$dP = P_2 - P_1 = (Z_1 - Z_2 - HL)\,\rho$$

Now, if the endpoints of the pipeline are the same ($Z_1 = Z_2$), or if the inlet is lower in elevation than the outlet ($Z_1 < Z_2$), then the dP will definitely be negative. But, if the inlet is higher in elevation than the outlet ($Z_1 > Z_2$), then there is the possibility that the dP could be positive. If the drop in elevation is greater than the friction losses ($\{Z_1 - Z_2\} > HL$), then the pipeline dP will be positive.

Return to PUMP-FLO UPDATE April 2009 Issue