

## Accuracy of PIPE-FLO and Flow of Fluids Models



### Q: How Accurate is My PIPE-FLO and/or Flow of Fluids Model?

PIPE-FLO (and/or Flow of Fluids) uses proven engineering concepts, equations, and methods to calculate results based on the data that is input by the user, but there are several things that may contribute to discrepancies between the calculated results and the flow rates, pressures, or other measured variables in the actual piping system.

When modeling a system, first and foremost for accuracy is attention to detail. The more detail the model has, the more accurate the results will be. It is crucial to input accurate data for major components such as pump curves, component pressure drop vs. flow rate performance, and control valve  $C_v$  data.

Elevations are also important for accurate results. Bottom elevations for tanks, pump suction and discharge elevations, and components elevations all affect the calculated pressures in the system. Elevations need to be measured from a reference datum plane, whether from sea level, facility grade, the keel of a ship, or setting the

lowest point in the system at zero and making all vertical measurements from that point. As long as you are consistent, no errors will be introduced due to elevation. If modeling a system with water, a 10 foot error in elevation results in 4.3 psi inaccuracy in calculated pressure.

Of course it is also important to model the system as it is actually constructed, including the location of all equipment tie-ins and junctions. If the various items in the model are not connected the same way as the physical piping system then there is no way the model can accurately represent the physical system.

It is also important to have accurate fluid property data. Fluid density, viscosity, and vapor pressure have an impact on the calculations for pressure, head loss, NPSH, and flow rate. Also, PIPE-FLO assumes single phase Newtonian flow, so if two phase flow is occurring in the actual system, inaccuracies will be introduced in the calculated results. There are also limitations with using the Darcy method for calculating pressure drop for compressible gas and vapor flow, so results that are outside of these limits introduce inaccuracy in the calculations.

Pipe line data is also crucial, with the correct inside pipe diameter having the greatest impact on the accuracy of the results and pipe length being important but not having as much of an effect. For water flow in a 4 inch schedule 40 pipe line, a 10% error in the pipe length results in 0.85 feet error in calculated head loss. For most piping systems, the number and type of valves and fittings is usually a minor contribution to the system head loss, but if these losses are actually a major source of head loss in the system compared to the piping head loss, the inaccuracy may increase if these losses are neglected.

But even the most detailed model can have discrepancies with measurements taken on an operating piping system. Cavitation, cavitation damage to the pump impeller, and worn wear rings will cause the hydraulic performance of the pump to fall off the pump curve. Corrosion and sedimentation build-up in pipelines will cause higher head loss in the actual system compared to the calculated results. This is where the usefulness of the PIPE-FLO model comes into play as a troubleshooting tool to resolve discrepancies between what you see in the actual system and the model.

For more information on what type of information is needed to accurately model a fluid piping system, read the related white paper listed below.