Top 8 Questions About Pipe Flow Hydraulic Analysis

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1. What is available in Aspen HYSYS® for pipe flow hydraulic analysis?

In Aspen HYSYS, there are two recommended approaches for modeling pipeline hydraulics — but many other tools which can also be used.

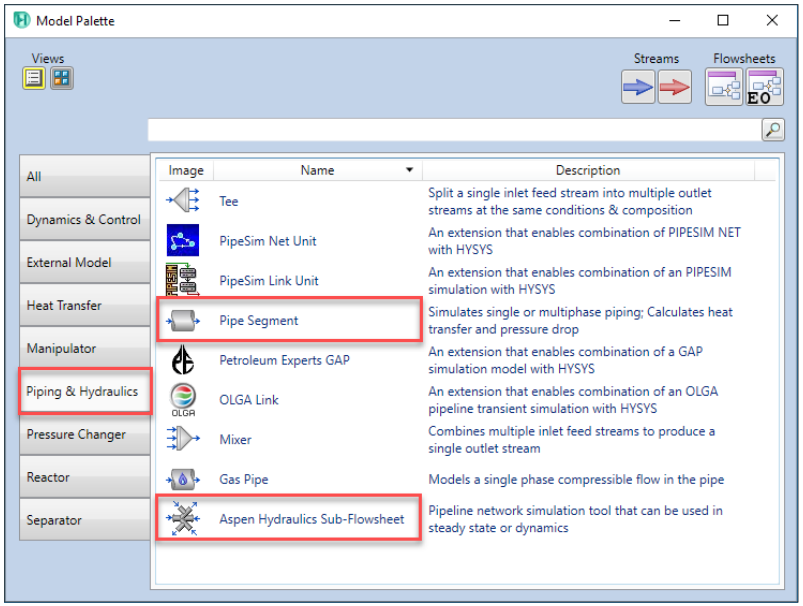

Figure 1: Pipe Segment and Aspen HYSYS Hydraulics Sub-Flowsheet are both accessible from the Aspen HYSYS Model Palette.

- **Pipe Segment in Aspen HYSYS.** This unit operation is recommended for low-velocity flow within a process (for example, between equipment). We do not recommend it for high-velocity flow because it ignores the acceleration term in the pressure drop equation. It also has some limitations for transient analysis, including the inability to recognize pressure buildup (i.e., line packing) inside the segment as well as backwards flow when the pipe is on an incline.

  Additionally, liquid in the pipe will flow at the same velocity as the vapor (i.e., no-slip assumption) regardless of whether the correlation specified includes a holdup model. Pipe Segment is available as a unit operation in the Aspen HYSYS flowsheet.

- **Aspen HYSYS Hydraulics.** This tool is recommended for gathering networks, outside of the facility. It can, of course, be used for in-plant piping, but often the calculation rigor available in Aspen HYSYS Hydraulics (and the extra token cost) is not required for pressure drop analysis of in-plant process piping.

  This tool is recommended for high-velocity flow, multiple sources and destinations, and dynamic studies. The tool is not recommended for single-component hydraulic analysis unless the fluid is subcooled liquid or superheated vapor for the entire network analysis. Aspen HYSYS Hydraulics is available as a sub-flowsheet in Aspen HYSYS.

Additional Hydraulic Tools:

- **Aspen Flare System Analyzer.** This AspenTech product handles flare system piping hydraulic analysis. It does not support transient analysis, but can be used to model very complex gas, liquid and two-phase pipe networks.
- **Compressible Gas Pipe in Aspen HYSYS.** This unit operation is also available within Aspen HYSYS, but it is generally not recommended for use. This model was originally intended for dynamic analysis, but it should only be used if no liquid is present. The model also does not support rigorous thermodynamics, only simplified models for gas flow. But it does include the acceleration and kinetic energy terms in the pressure-flow equations.

2. What correlations would AspenTech recommend?

Through validation with available data, AspenTech currently recommends the Tulsa Unified Model for two-phase and three-phase flow. The Tulsa Unified Model should not be confused with the Tulsa 99 model. The Tulsa Unified Model performs consistently well for horizontal, inclined and vertical pipes when compared to Beggs & Brill, Aziz et. Al, Duns & Ros and HTFS.

As an example, Figure 1 compares the pressure gradient in a horizontal pipe measured in the experiments with those calculated from the Tulsa Unified Model using Pipe Segment in Aspen HYSYS.

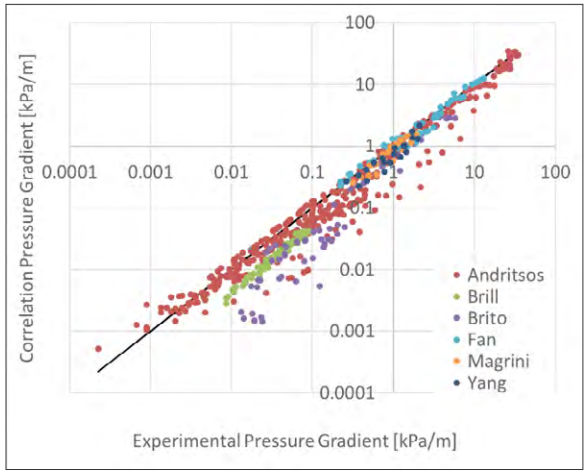

Figure 2: Comparison of the pressure gradient between calculated (Tulsa Unified Model) and experimental results in a horizontal geometry

3. Previously in Aspen HYSYS, methanol modeling wasn't very accurate. What is AspenTech doing to address this gap?

In Aspen HYSYS v8.8, the cubic-plus-association (CPA) equation of state was introduced to better model how polar compounds (like methanol) partition between the vapor, liquid hydrocarbon, and water phase. In addition to developing this new equation of state, we also regressed new binary interaction parameters for methanol. (Note: new parameters were also regressed for MEG, DEG and TEG in Aspen HYSYS v10.) We've published some **of the data** used to validate the partitioning of methanol between the different hydrocarbon phases.

Also, there is a Hydrate Inhibition Utility which uses the new methanol (also MEG, DEG and TEG) binary interaction parameters to calculate how much inhibitor is needed to suppress hydrates. This tool is useful for predicting the formation of the three different types of hydrates (Type I, Type II or Type I and II). The tool results are also linked to a flowsheet coloring scheme to easily identify if hydrate will form or not.

In general, Aspen HYSYS is a great tool for screening the design before refining the analysis with specialist tools — and we are continually improving component properties to provide more value to customers.

Note: In the rare case of high CO2 concentration, the CPA package in Aspen HYSYS (V8.8-V10.1) doesn't benchmark well. This is being addressed for future versions of Aspen HYSYS.

Our friends over at Process Ecology continuously write informative articles **on this topic of hydrate inhibition**, among many others. We recommend you give those articles a read.

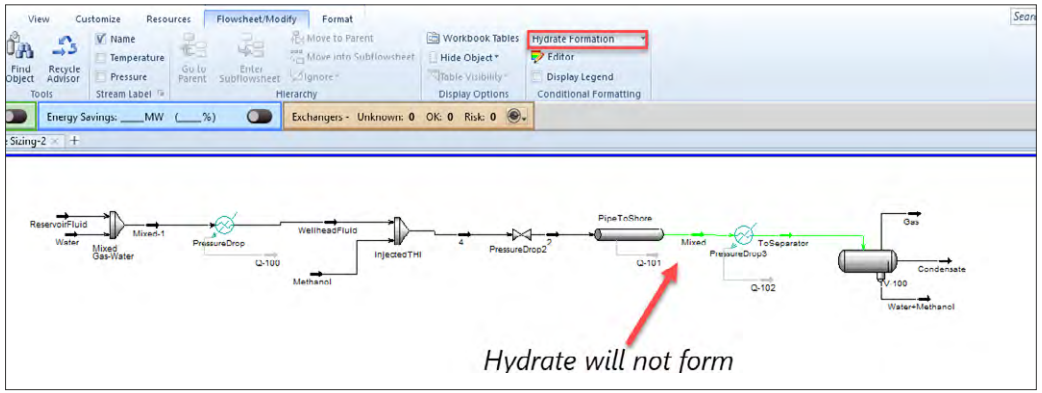

Figure 3: The Hydrate Inhibition Utility is available as a stream analysis tool (hydrate formation).

4. Can I use Aspen HYSYS to analyze mercury removal modeling?

Yes. In Aspen HYSYS V9, we improved the binary interaction parameters (BIPs) for mercury when using the cubic-plus-association (CPA) equation of state. (BIPs were similarly improved for Peng-Robinson and SRK property packages.) Similar to the Hydrate Formation Utility, we also added a Free Mercury Utility — and the utility results also link to a flowsheet coloring scheme to easily identify if free mercury (a fourth phase) will form.

This work greatly improved property prediction for mercury removal enables better predictions of free mercury phase formation and mercury dissolution behavior. To learn more about mercury partitioning, **view this comparison of results with experimental data**.

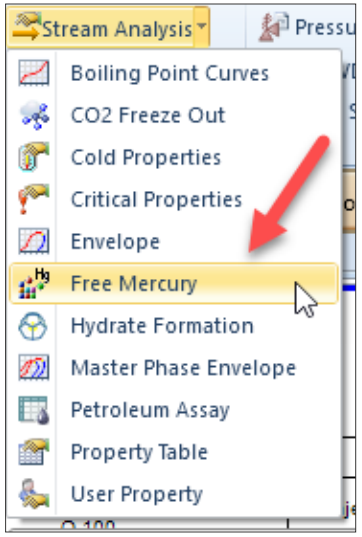

Figure 4: The Free Mercury Utility is available as a stream analysis tool (Free Mercury).

5. Can I simulate slugging in Aspen HYSYS? What types of slugging?

Yes, you can simulate terrain-induced, pigging-induced and hydrodynamic slugging for accurate prediction of slug volumes and frequency. Terrain-induced slugs are caused by accumulation and periodic pushing of liquid along the length pipeline as it traverses over varying elevations. This type of slug is common at the local minima of the pipeline network. Aspen Hydraulics provides dynamic simulation of the slugging phenomena and accurate prediction of the liquid level, pressure and fluid velocities along the pipe.

To learn more about how Aspen HYSYS Hydraulics addresses terrain-induced slugging, **download this paper**.

6. Can I connect my pipe flow models to other equipment models in Aspen HYSYS for a full view?

Yes, Aspen HYSYS Hydraulics is added to the HYSYS simulation environment as a sub-flowsheet enabling you to connect other models of equipment to the pipeline models.

By connecting gas gathering networks to detailed processing facilities in Aspen HYSYS, Xodus Group helped Origin Energy in Australia build an integrated production model (IPM) to assist in planning, testing operability with dynamic models and using an online real-time compressor monitoring system to identify underperforming equipment. Through this work, Xodus projects savings up to $3M per year.[1]

7. Can I compare real-time data to pipeline models in Aspen HYSYS?

Yes, you can use Aspen HYSYS in conjunction with Aspen OnLine® to improve operational decisions with calibrated predictive models. **View this tutorial video to learn more**.

8. How do I get started with Aspen HYSYS for pipe flow hydraulic analysis?

Many resources are available on the **AspenTech Support Site**, including how-to videos, tutorials and computer-based training modules.

If you have additional questions, connect with **Anum Qassam** and **Jennifer Dyment** on LinkedIn.

Reference

[1] Jones, Andy (General Manager, Xodus Group Perth). April 2017. OPTIMIZE *2017*, Houston, TX USA.

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