OUR PERSPECTIVE

MANAGING SLUGS

- Slugs must be detected and controlled to minimize damage downstream.
- Slugs can be minimized by installing a control mechanism or by changing the pipeline design.
- Engineers can determine the dynamic loading imposed by slugs on bends and restrictions in pipeline and riser systems.
- New technology such as a piggable drip, known as *Innopipe*, catches liquids around the entire pipeline diameter and can take all liquids with very little interference.

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OILFIELD SLUGS – NOT AS EASY AS A DASH OF SALT

Slugs in your garden can help get rid of organic waste matter, but occasionally they can become a pest when they attack your newly planted rose bush.

Slugs in oilfield pipelines are just as unavoidable; they bring a large amount of valuable hydrocarbon to the plant, but if slugs happen without some kind of control system, the damage can be expensive in both human and dollar cost.

Slugs are formations of liquids, in the lower parts of transmission lines. The liquids can be anything from produced hydrocarbon, lubrication oils, produced water, and chemicals used in production, treatment, compression or dehydration of the gas. Slugs need to be detected and controlled in order to minimize damage to downstream process plants, pipelines and valves. Slugs can be managed with pipeline drips, slug stabilizers and through stimulation.

Simulation

Controlling slugs involves careful measurement of pipeline inclination, size (length) and velocity of the slug itself held up in the pipe, pigging cycles, and dynamic loads on bends and restrictions such as valves.

If the size of the slug can be minimized, either by installing a control mechanism, or by changing the design of the pipeline itself, the result means smaller equipment is required to handle the slug, resulting in significant cost savings.

Some challenges are the use of existing sensors and signal processors to “pinch” inflow but not overwhelm the facility. These designs are achieved using advanced computer modeling with systems such as PIPESYS, developed by Neotechnology Consultants Ltd. (Neotec) in co-operation with Hyprotech Ltd. These systems integrate powerful capabilities for single and multiphase pipeline flow modeling into HYSYS.

Once armed with a good pipeline flow model, an engineer can predict the dynamic loading imposed by slugs on bends and restrictions in pipeline and riser systems. This in turn can be used for mechanical design of pipe work and support structures.

Drips and slug stabilizers

Drips are a vessel, usually buried, and designed to catch the liquids that form in the bottom of the dip of a pipeline. The theory is that gravity forces the liquid into the lowest point of the pipeline, in this case the pipeline drip. Usually these drips are not much more than a vessel with a nozzle pointing upward towards the pipeline from where receives the excess liquid in the pipe.

In practice, only a small of the liquid makes its way into the drip. The reason for this is that the liquid tends to spread itself along the entire diameter of the pipeline, known as annular flow. Discovered by Dutch scientist, L. Oranje, annular flow is explained in, "Condensate Behavior in Pipelines is Predictable", Oil and Gas Journal July 2, 1973. While Mr. Oranje explained this phenomenon almost thirty years ago, only recently has someone determined how to deal with it using an efficient mechanical device.

If the liquid is also at the top of the pipeline, it becomes clear that a traditional drip can only catch those liquids traveling along the bottom of the pipe. Regular inspection of pipelines is done using 'pigs' - Pipeline Inspection Gauges. Pigs ranging from a hard rubber ball to an elaborately designed, self-propelled electronic measuring device designed to inspect welds and pipeline wall thickness.

New technology catches liquids around the entire pipeline diameter, taking in all liquids with little interference.

If the pig has to make it through the line, then you can't just put in a baffle and catch the liquids in a conventional separator. The objective is to allow normal transmission to occur and to allow pigs to pass through. Thus the ancient method of the drip pot at the bottom.

New technology such as a piggable drip, known as Innopipe, was developed by Miles E. Haukeness in conjunction with Union Gas, and uses a series of slots on the pipe wall. This wall is contained within a larger diameter pipe. The whole drip becomes part of the pipeline. By catching liquids around the entire diameter such a drip can take all liquids, yet only interfere with only 5 to 10 per cent of the primary flow.

If there is no interference with the entire flow, pipeline velocity is not reduced. Maintaining velocity means that less mist is formed, so fewer uncontrolled liquids are formed downstream of the separator. This technology means a system can be designed that forms slugs in areas where they can be controlled, such as a stabilizer.

The stabilizer can be anything from a vessel to another loop in the pipeline and is sometimes used for the re-introduction of the liquids downstream of the problem area. Re-introducing liquids at a controlled rate lets valuable hydrocarbons make it the plant without the added expense of trucking from tanks. Conversely, if the system produces water slugs, they can be caught and sent back into the ground at an injection site.

The end result of all these simulations and controls systems is that smaller, high-pressure vessels are required at plant sites, and smaller control systems are required at the inlet to the plant. Instead of sizing for spot rates of large volumes of liquids, the condensate volume is steadied out to an even rate, and can be dealt with in smaller, less expensive equipment.