The butane blending bubble

Todd M. Eldridge, Pond, USA, outlines three options for companies seeking to take advantage of butane blending to control their costs.

As oil prices and the need to reduce costs at the pump have risen over the last 10 years, many midstream companies have taken advantage of butane blending to control costs and improve profits.

Some midstream companies have off-load butane directly from the truck into their tanks, which is a cost effective method. However, with this method, more butane tends to boil-off in the tank prior to fully blending, resulting in a loss of product and profits. The blend accuracy also has a low tolerance due to the uncertainty of blend quality and completeness, which limits how much butane can be blended at a time.

Other companies opt for a privately-patented system to receive, store and blend butane with finished gasoline directly into the truck, bringing the gasoline up to the various regulated Reid vapour pressure (RVP) limits for the areas they serve. This increases profits, but this type of in-line blending and on-site butane storage is extremely expensive.

As oil prices have fluctuated over the last few years, more midstream companies have shown significant interest in how to reliably decrease costs and increase revenue by blending butane and gasoline in the tank.

One such company, an independent midstream terminal firm located in the south eat US, decided that a recent rail spur upgrade would offer an opportunity to introduce butane blending. The company wanted to take advantage of the capacity it had, but had a strict budget to adhere to for the new butane facilities and did not want to take on the cost of storing the butane on-site. The company turned to Pond, with whom it had worked on several previous projects, to help design the most efficient butane blending process it could obtain while still sticking to the bottom line.

Figure 1. Offload assembly using PD pumps.

Figure 2. Rail offload platforms, undergoing construction.

Blending options

Generally, there are three options for companies that wish to blend butane at the terminal. The first is the turnkey 'into-truck' process, which introduces the butane directly into the pipes in which the gasoline is being pumped into delivery trucks. This is the most efficient process from a vapour-control standpoint, as it allows closer tolerance in blending with an on-demand system. The time that the blend spends in the pipe (rather than sitting in a large tank) also reduces the potential for butane to boil off. While this is the most efficient process, that efficiency comes at a much higher price, either in capital costs or as a tariff on the attached butane delivery contract.

The least expensive blending process involves off-loading butane directly into an established gasoline storage tank. This uses facilities and infrastructure that tank farms already have, so upfront costs are low; however, because the butane is forced from a pressurised tanker truck directly into a non-pressurised tank, a portion of the butane will bubble out and evaporate, resulting in nearly immediate loss of potential revenue.

The third blending option is much less expensive than the 'into-truck' method, but is significantly more efficient than the least expensive option. This is the solution Pond recommended to its midstream client. The client did not have to install LPG bulllet tanks or expensive infrastructure. To minimise the loss of butane, Pond designed a system that combined the butane pumped from the tank car and the gasoline being stored in one of the tanks into a recirculation pipe with blending features. In doing so, this mimicked the 'into-truck' blending method and managed to decrease the amount of boil-off that tends to happen in the cheapest in-tank blending option. This is largely due to the additional dwell time that the butane and gasoline have while under pressure, as well as the turbulent flow, which allows additional chemical bonding time, resulting in less boil-off in the tank.

Special consideration was also given to how to transfer the butane from the tank cars to the gasoline. Compressors are the most efficient method of off-loading, since they can do so at higher flow rates and also result in little residual product left in the tank car. However, since there is no LPG bullet tank with a vapour space to offload to, a compressor is difficult to use. Pond developed an option to use compressors with a pipeline injection using two vapour development flash tanks, which allow the use of higher flow rate compressors without a bullet tank as the target vessel.

Ultimately, the client chose to use a positive displacement (PD) pump to off-load the tank cars. These pumps, unfortunately, have flowrate limitations in LPG service. If the liquid butane is pumped out of the tank car too quickly, it boils off more rapidly in the tank car, therefore decreasing efficiency and profits. The pump can also cause a vacuum in the tank car if an insufficient amount of oxygen is let in, which increases the risk of implosion.

Timing was also a factor when choosing a solution. There was a limit as to how long the client could keep the railcars on its site. The client wanted to hook-up and unload a railcar within a 12 hour shift, so the pump could not perform so slowly that it affected the off-loading time. Pond worked closely with the equipment manufacturers to ensure that the pumps in the client's new system could not only work well with the butane, but also operate safely within the client's time limits.

Safety and operations

Because the client's terminal had only stored liquid up to this point, it was also imperative to address the additional operational challenges and required safety measures that needed to be enforced for handling a LPG product such as butane. Just like high pressure pneumatic testing vs hydrostatic testing, handling compressed gases can be very different than atmospheric liquids due to the stored energy of the gas. Very minor actions can cause potentially catastrophic events.

One of the biggest safety challenges with butane is spotting and dealing with leaks. Vapour leaks cannot be seen as similar to liquid leaks, unless they are large enough to frost. As such, Pond included strategically placed gas detection systems, in addition to visual leak inspections, to help identify potential safety issues. The fire protection methods also needed to be addressed, as fighting a butane fire requires a different response than gasoline fires

(gasoline fires burn in place, whereas butane fires pose a high explosion risk and can result in unexpected flame-ups).

Additional safety reviews were added to the design process, thus several full days were dedicated in the schedule for the client and Pond to thoroughly walkthrough the system design. This was in order to review the process for potential hazardous operational issues and safely address them. These discussions led to slight alterations in the design and system operation that meant increased system safeguards to help prevent hazardous situations.

In addition, process safety management (PSM), a risk management plan (RMP) and additional operator training, as is typically required by agencies for these new systems, were implemented to ensure the safety of the client's employees.

Conclusion

Overall, butane blending is one of the best ways currently available for midstream companies to increase their profit margins. Finding a way to do it efficiently and with low upfront costs, is key to capitalising on the opportunity. Given the options for how it can be carried out, companies of all sizes can find a solution that fits their financial situation and project specific needs. T&T