

Turning Lost Vapors Into Found Money

GAS COMPRESSORS SHOULD BE STANDARD EQUIPMENT IN ANY LPG VAPOR-RECOVERY APPLICATION

By Glenn Webb



An example of a designated vapor-recovery pad to capture all of the vapors from any tank being serviced.

Introduction

Imagine you were creating a refining, transportation, delivery and storage network today for a newly discovered petroleum product. It's characteristics include an ability to be shipped and stored in pressurized containers as both a liquid and gas. Because of these characteristics, however, the delivery network has a few inefficiencies that just can't be overcome, including:

- From its extraction and processing at the refinery, to tank or truck transfers, or to the maintenance on small twenty pound storage cylinders, a small amount of saleable vapor either escapes or is, by necessity, burned off into the atmosphere.
- When receiving delivery of the product from a large tank such as a 33,000-gallon rail car, the end-user may be expecting to receive close to 30,000 gallons, for example. However, because pumps are unable to completely empty 100% of the liquid from the tank or remove vapors, as many as 1,000 gallons of liquid are left behind in the form of un-recovered vapors.

Confronted with these conditions, no right-thinking person would make an investment in this new petroleum product. Of course, this product – liquefied petroleum gas, or LPG – has been a vital fuel around the world for nearly a century, despite the inefficiencies inherent in its storage, transportation, handling and delivery.

But with LPG's price increasing, along with possible increased attention from the United States' Environmental Protection Agency (EPA), these inefficiencies can no longer be tolerated. With so many points in the LPG supply chain, there are still millions of gallons of recoverable, useable and sellable vapors literally going up in smoke every year.

The Challenge

Liquefied petroleum gas is a mixture of hydrocarbon gases that are synthesized by refining petroleum or "wet" natural gas. It was first produced in 1910 and currently provides about 3% of the energy consumed around the world. LPG burns cleanly with no soot and very few sulfur emissions, which means it poses no ground or water-pollution hazards.



One of the largest taxicab fleets in the United States uses a vapor-recovery system to draw down the vapor level in taxis prior to service. This vapor-recovery system features a Blackmer LB161 Series compressor.

At normal temperatures, LPG will evaporate. Because of this, LPG is stored and supplied in pressurized containers. The pressure at which LPG becomes liquid is called its “vapor pressure,” which varies based on its composition and temperature.

The challenges involved in handling LPG begin at its origin — the oil or natural gas field. During the production of these commodities in the field, it’s a fact of life that at both the wellhead and storage-tank batteries, some quantity of recovered product will either escape, be vented or flared off into the atmosphere, resulting in the loss of saleable product and the introduction of hazardous air pollutants (HAPs) into the atmosphere. This is a growing concern, not only because of the potential harm these HAPs can do to the atmosphere, but also because the EPA is taking notes and showing signs of leaning toward increased regulation of this flaring or venting process.

From there, the raw LPG that makes its way into storage vessels before it is transferred to railcars or transport trucks for delivery to the refinery. At every point along this transfer network there is the potential for the recovery of LPG vapors – again, which are sellable and also potentially harmful to the environment – that would otherwise escape into the atmosphere.

At the refinery, the LPG is refined to a user grade and quality. The next potential opportunity for lost vapors comes when that refined LPG is loaded onto transport trucks or railcars for delivery. As the LPG works its way down the supply chain, each transfer point is another area where saleable product may be lost.

When the LPG finally reaches the end-user, pumps are often used to unload the transport vessel into storage tanks. Over the years, it has been assumed that one-half of a percent to as much as 3 percent of the delivered LPG will remain in the heel of the railcar or tanker because the pumps used to transfer the LPG are incapable of completely evacuating the transport vessel without damaging the pump. The liquid heel and vapors remaining in a large tank truck or railcar could total more than 1,000 gallons. If 1,000 gallons are left in the delivery vehicle and LPG is selling for \$1 per gallon, that’s \$1,000 per load. If a busy facility is doing one or two loads a day that can be product worth as much as \$40,000 that the customer may be leaving in the tanks every month. The cost in lost product rises exponentially at larger facilities that are able to offload multiple railcars at one time.

That’s just a look at where LPG product and vapors can be lost during the production, refining and delivery processes. Once in use, there are hundreds of ways that sellable vapors can be irretrievably lost. Among the most common are:

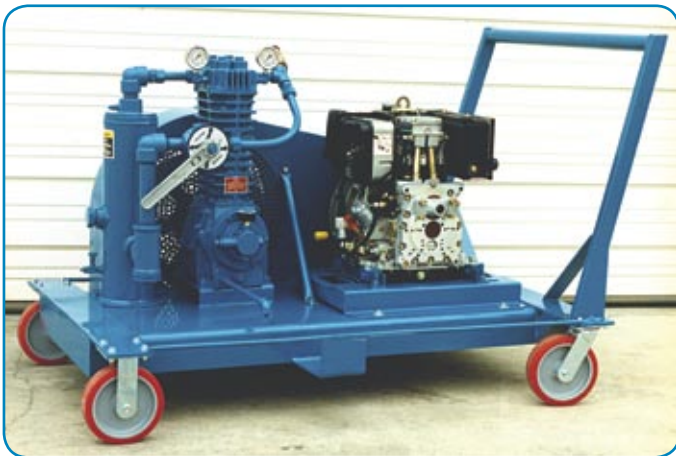
- During any type of maintenance on LPG bobtails or transport trucks
- During LPG bulk transfers from transports or railcars
- During routine maintenance or valve replacements on storage tanks that can range from the 20-pounder used on the backyard barbecue to 1,000-pound residential storage tanks
- During the filling and maintenance of forklift tanks
- After accidents when the trucks or railcars involved need to be evacuated of any residual LPG before the cars can be moved
- During the routine hydrostatic testing of bobtails, transports and railcars that occurs every few years

It is during these common processes that the potentially dangerous practice of venting or flaring the LPG tanks comes into play. Storage tanks that need to be repaired, refurbished or have new valves put on them need to be completely evacuated of any residual LPG before they can be worked on. The most common way to do this is allowing the remaining LPG to just vent to the atmosphere, or by burning it off in a process called “flaring.” This flaring introduces HAPs into the air supply, which has drawn the increased attention of the EPA, which is aggressively beginning to determine just how harmful these HAPs are to the atmosphere and what the consequences might be.

The Solution

As mentioned, pumps do a great job of moving LPG within a closed system, for example, in a refining application where it is moved continuously from one storage tank to another without the need to completely evacuate the tank, pipeline or delivery vessel. However, pumps do not have the ability to completely evacuate the heel of a railcar, transport truck or storage tank. That creates problems for the operator who needs to maximize the value of every drop of LPG as its price continues to rise.

Meanwhile, those LPG retailers who spend the bulk of their time filling, emptying or repairing storage tanks of various sizes, should no longer freely release or flare the vapors into the atmosphere. In many cases, there is a true return on investment potential that can be realized by using an LPG compressor for unloading liquid and performing vapor recovery on railcars and truck tanks. Also, as mentioned, the EPA is becoming ever more vigilant regarding the flaring process.



Mobile evacuation units, such as this one featuring a Blackmer LB Series compressor, are simple to move from application to application within a facility.

Fortunately for the members of the LPG supply chain who would appear to be caught between a rock and a hard place, there is a solution that can perfectly meet the challenges in the storage, delivery and use of LPG. It is the Reciprocating Gas Compressor – specifically the models in the LB Series – from Blackmer®, Grand Rapids, MI, USA.

Blackmer LB Series single-stage, oil-free reciprocating gas compressors are perfect for LPG liquid-transfer and vapor-recovery applications because they create a slight pressure differential between the vessel being unloaded and the receiving tank. The suction stroke of the compressor piston draws in vapor from the receiving tank. The discharge stroke

moves a measured volume of vapor at a slightly higher pressure into the supply tank. Once the tank-pressure differential reaches 25 to 30 psi, liquid begins to flow in a separate liquid line from the vessel being unloaded into the receiving tank.

Generally, the liquid flow rate will be 5 to 6 U.S. gpm for each cubic foot of piston displacement (670-775 liters per cubic meter). At the conclusion of the liquid-transfer phase a significant amount of product (vapor and liquid) is left in the tank car, often 3% or more of the tank's capacity. Based on a 33,000 U.S. water gallon capacity (124,915 liters) tank car, unloaded using a Blackmer LB361 gas compressor with 36 CFM (60.3 m³/h piston displacement) and the tank car pressure gauge reading 150 psi (1,034 kPa gauge), there would be approximately 1,315 U.S. gallons (4,978 liters) of recoverable LP gas in vapor form remaining in the tank car. Of this amount, the Blackmer LB Series can economically recover 845 U.S. gallons (3,199 liters) in less than three hours.

Blackmer LB Series compressors are available with transfer rates of 35 to 700 U.S. gpm (132-2,630 lpm) and are designed to handle the transfer and recovery of not just LPG, but other liquefied gasses like butane and anhydrous ammonia. All models feature ductile iron pressure parts for greater resistance to both thermal and mechanical shock.

Application Examples

Blackmer LB Series compressors – which are available in LB161, LB361, LB601 and LB942B models – have already been used in a number of applications, both big and small, by operators who wish to maximize the return on their LPG purchases while also protecting the environment. For example:

- In 2008, the government of the North African country of Algeria, which is the world's second-largest exporter of LPG, installed Blackmer LB Series gas compressors at the majority of its 20 LPG-production facilities for use in the transfer of LPG from railcars to transport trucks used in home delivery of the fuel. The compressors are also used for vapor recovery at the production terminals, which are in operation 24 hours a day, seven days a week.
- For nearly 30 years, the taxicab fleet of Yellow Cab in Las Vegas, NV, USA, has run on LPG as a way to increase efficiency, decrease fuel costs and protect the environment. Despite all of these positive, there had always been a small blind spot in Yellow Cab's 800-vehicle operation: whenever the cabs needed to be

brought in for maintenance or if an older vehicle was being taken out of service, the LPG tanks would need to be completely evacuated. At the end of this process, some of the vapors escaping into the atmosphere. Knowing that sellable LPG was disappearing into thin air, Yellow Cab recently installed an LPG-evacuation system that features a Blackmer LB Series compressor. Now, all of the vapors that are recovered during the evacuation process are transferred to one of Yellow Cab's on-site 60,000-gallon storage tanks and reused as fuel.

- Mexico currently boasts more than 1,300 LPG production plants and ranks No. 1 in per capita consumption of LPG. VANeGAS is one of the leading distributors of LPG in the country. To meet its distribution requirements, VANeGAS uses LB Series compressors.
- The versatility of Blackmer's LB compressors means that they can be used in a variety of unique applications. One that is becoming more common is on a Mobile LPG Evacuation Unit. These portable compressor units are skid-mounted and designed for easy transportation in a pickup truck or via a small trailer, and can be built to meet any customer's specific LPG unloading requirements. In fact, H&H Gas Corporation, Windsor, NJ, USA, has been using a mobile unit fitted with an LB compressor for more than a decade as it goes on the road to purge storage tanks and transport vehicles of residual LPG vapors. The mobile units can also be used to purge vehicles at accident scenes.

Conclusion

On July 1, 2011, the globally focused National Fire Protection Association's Section 58 pipeline-safety regulation will come into effect. This means that all bulk-storage vessels with an aggregate volume of more than 4,000 gallons water capacity will need to be fitted with either internal valves or an

Emergency Shutoff Valve. That's a lot of LPG storage tanks that will need to be upgraded. With that in mind, many facilities are turning to LB compressors for tank evacuation during the retrofitting process, while some operators may choose this time to make install a permanent gas compressor for use in future liquid-transfer and vapor-recovery operations at their facilities.

On the surface it's silly to even contemplate: no one would voluntarily take their hard-earned cash and set it on fire with the resulting vapors disappearing literally into thin air. But throughout the history of LPG production, storage, transportation, handling and delivery that is exactly what has happened as vapors have either escaped into the atmosphere or were intentionally burned off.

Now, with the advances in reciprocating gas compressor technology that are being spearheaded by Blackmer, those days of allowing a valuable commodity to just float away are over. One common thread of the case studies mentioned above is that the savings realized in the recovery of sellable LPG has rapidly paid for the vapor-recovery system, in some cases in a matter of days. Add in the increased attention from regulatory agencies like the EPA, and there is no reason not to make vapor recovery a crucial component of any LPG operation – with industry-leading equipment provided by Blackmer – no matter where it occurs along the LPG supply chain.

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