Why STPs have an Edge Over Suction Pumps Today: The Role of Line Leak Detection

Curt Trondson explains the advantages of submersible turbine pumps in retail applications where overcoming inherent limitations of suction systems, including long piping runs between tanks and dispensers, large diameter tanks, high flow rate requirements.

Technically Speaking
Since the 1970s, submersible turbine pumps (STPs) have become the primary means of pumping motor fuels at retail service stations in the United States. Before that time, most U.S. stations used suction sumps, the other pump option available. Today, in many other countries, the use of suction sumps remains high. The purpose of this article is to discuss the primary differences of these two pumping systems and to describe the market factors that favor the use of STPs.

How STPs work
STPs, as most readers are aware, are installed directly into the underground storage tank (UST). The pump intake is set a few inches off the tank bottom. The pump itself is a centrifugal type that pressurizes the fuel through the pump motor, up through the riser and the STP control head. The pump motor pushes the fuel under pressure through the piping system to the dispensers. Generally, one STP is used per product grade.

Blending systems are those in which two product grades are blended into a variety of grades at the dispenser. These blending systems have reduced the number of STPs required per station to only two—one for regular and one for premium product grade. Blend systems are becoming more and more popular since they require fewer STPs, tanks and nozzles, and less underground piping. Entire stations offering multiple gasoline grades can now be operated with as few as two STPs.

How suction pumps work
By contrast, suction pumps are generally rotary vane-type positive displacement pumps that are located inside each dispenser cabinet. They operate on the principle of reducing atmospheric pressure at the pump inlet. This allows atmospheric pressure to push the product from the underground tank into the pump where it is then pushed through the air eliminator, meter, hose and nozzle.
One suction pump is needed per hose, except in the case of six-hose multiple product pumps (MPPs), which are equipped with three suction systems—one per product. For example, a station with four MPPs has 12 suction pumps, each with a motor, air eliminator, pumping unit and pressure relief valve.

A modern U.S. retail station typically employs STP pressure systems to provide multiple fueling lanes with high volume dispensers.

### Pumping up fuel

With STPs, there is a lot less pumping equipment to purchase, install and maintain over the life of the station. However, long before multiple product dispensers (MPDs) and MPPs were available, STPs were taking over as the pumping system of choice in the United States. This is mainly because of the physical properties of the fuel being pumped and the size of the stations.

Gasoline can vaporize when pulled from the underground tank by a suction pump. Gasoline boils (that is, converts from liquid to vapor) when its absolute vapor pressure approaches absolute atmospheric pressure. In a suction system, this can result in vapor-lock, causing the pump to either stop pumping or slow severely.

This occurs when the suction force required to lift the gasoline from the bottom of the UST up to the suction pump exceeds the vapor pressure of the gasoline being pumped. The sidebar on page 53 details factors leading to the vaporizing of gasoline in suction systems.

When STPs are used, the length of piping run and tank diameters are not major factors. USTs can be a considerable distance away from the dispenser islands, where the USTs can be filled without blocking traffic at the dispenser islands.

In addition to vaporization problems, flexibility is restricted for both the station layout and tank diameters when using suction pumps. While the use of remote fills in suction systems can resolve this issue, remote fill locations add to the cost of constructing the site and complicate overfill protection.

### Suction selling points

Traditionally, suction pumping systems have two perceived advantages over STPs:

1. An STP pump failure results in a complete loss of that product grade for sale until the pump is repaired. Since a suction system typically has several pumps for each product grade, a single pump failure simply means one or two nozzles are out of service. STPs, however, have proven to be very reliable pieces of equipment; and it is not unusual for them to operate years without any service interruptions; and

2. In theory, leaks in suction systems will be smaller than those in STP systems because piping to suction pumps operates under negative pressure, and piping to STPs operates under positive pressure. However, environmental laws are in place in the U.S. and many other countries that make it necessary or at least desirable for leaks of any size to be detected and contained. The incidence and
seriousness of leaks from STP systems have been greatly reduced with the help of leak detection and secondary containment technologies.

**Variable speed STPs with telescoping risers allow different tank diameters. Distributors only need to stock a single model.**

**Line leak detection**

Both mechanical and electronic line leak detection are used very effectively with STPs. Mechanical line leak detection has been used with STPs since the early 1960s. These devices are installed directly into the STP, and are designed to detect leaks as small as 3.0 gph at 10 psi in pressurized piping systems. When the symptoms of leaks are detected, the mechanical leak detector temporarily restricts fuel flow to three gallons per minute, alerting the operator to an abnormal condition which should be investigated.

Electronic line leak detection that can detect leaks as small as 0.1 gallon per hour are offered by several manufacturers. Some have the capability of interrupting power to the STP until the problem is corrected. The widespread use of mechanical and electric line leak detection technologies has satisfied marketers and government fire safety and environmental bodies that leaks in STPs can be detected and therefore controlled before they cause a fire or environmental hazard. But detecting leaks is not the same as containing them.

**Secondary containment**

Enter secondary containment. It, of course, involves both the tank and the piping system. When a leak occurs, the fuel escapes from the primary pipe or tank; the fuel is then contained in the secondary system and detected through hydrocarbon sensors mounted in the secondary containment interstice.

Secondary containment piping can be installed for both STP and suction systems; however, suction systems tend to require far more piping than STP systems since a separate suction pipe is required from each pump to the UST. Thus, secondary containment piping tends to cost more for suction systems than for STP systems.

**The larger picture**

Many market-driven factors have led to the popularity of STPs. It all began with high speed freeways, encouraging car manufacturers to build high horsepower engines that require higher octane fuels, which often have higher vapor pressure. More cars have led to larger and larger stations, which also favor STPs because they push the fuel into the dispenser, whereas suction pumps pull the fuel into it. Fuel can be pushed longer distances than it can be pulled, or suctioned, and the need for fuel to be piped longer distances becomes increasingly important at larger stations.

High volume stations require dispensing points that can handle the increased system flow rates needed to keep fueling times at a minimum. Variable speed STPs have now been on the market for the past 15 months (shown on page 53). Depending on its size, a variable speed submersible can provide substantially greater flow rates for high volume stations. These submersibles also provide
features such as the ability to obey the EPA-mandated “10 GPM Spitback Rule”; dry run protection; system diagnostics; and the capacity to operate with either electronic or mechanical line leak detection.

The evidence is in. Based on many factors, STP systems are a better option than suction pump systems for marketers today.

**Causes of Gasoline Vaporization in Suction Systems**

| Fuel Chemistry | Higher octane fuel may have a higher vapor pressure, depending on the method by which the octane is raised. Fuel with a higher vapor pressure vaporizes (boils) more readily than fuel with lower vapor pressure. New oxygenated fuels and unleaded fuels—particularly premium grade unleaded—have higher vapor pressures. Vapor pressures are regulated by U.S. EPA air quality regulations. |
| Burial Depth | Underground piping must be sloped back to the tank to ensure the proper operation of check valves and to facilitate testing. Piping must also be buried deeply enough to prevent it from being damaged by traffic above it. Suction piping runs are generally limited to 60 feet or less to permit sloping without either requiring increased burial depth of the tank or having the piping buried less than 18 inches below the paving surface. Larger diameter underground tanks add to the problem. |
| Temperature | Heating gasoline increases its vapor pressure. Vapor-lock is most prevalent on hot summer days and at sites with a shallow piping burial depth. |
| Station elevation | Atmospheric pressure also affects the point at which gasoline vaporizes. The higher the station elevation, the more easily the gasoline vaporizes. |

Curt Trondson is Vice President of Sales and Marketing for FE Petro, Inc