Fleet Dispenser Technology Keeps “Up” With Requirements

Sometimes a design problem is hard to solve only because the final answer seems too simple. Gasboy’s Kent Robinson brings up a case in point.

Staying on top of aboveground storage tank needs

This is the fourth article in PE&T’s continuing coverage of new and state-of-the-art dispenser technology. The February issue featured Dresser Wayne’s new technology for dispenser hydraulics; the April issue featured Universel Epsco’s use of fiber optics technology in dispensers; and the June issue featured Bennett Pump Company’s dedicated electronics technology for dispensers. In this article, Gasboy International’s Kent Robinson discusses the dispenser technology involved in meeting the changing demands for fleets’ aboveground storage tank facilities.

In 1859, Charles Darwin published his famous book on biological evolution, On the Origin of Species by Means of Natural Selection. Darwin observed that, although offspring inherit a resemblance to their parents, they are not identical, and that the offspring with the qualities most adapted to their environment will survive through natural selection. Roll the clock forward 140 years, switch the topic from organisms to products, and Darwin might be the latest hot author on today’s business best-seller list with a book titled, On the Origin of Products by Means of Market Selection.

New products often bear resemblance to their predecessors, and the changes in form and function most suited to the environment lead to product success through market selection. The modern Darwin case study could have been the evolution of fuel dispensers for use with aboveground storage tanks (ASTs).

Photo 1: Compact transfer pumps are popular on smaller tanks for light-duty fueling operations. Courtesy of Gasboy.

Origin of the species

Historically, ASTs used for refueling were relatively small. They were commonly found on farms, at small fleet fuel sites and even at consumer residences. Compact transfer pumps typically were mounted on top of the tanks for dispensing the fuel. These pumps were ideal to meet the fueling requirements of these light-duty fueling operations and remain popular today for similar applications (see Photo 1).

Typically, compact transfer pumps have the following components:

• Consumer Grade Pump—A vane-type pumping unit directly driven by a 115 VAC or 230 VAC motor.
• Non-Positive Displacement Meter—A nutating, disc-style meter in which the fuel passing through causes a disc on a ball-and-socket hub to rotate, and a pin in the ball hub to drive the register gear train. As the fuel is not required to positively displace all of the space within the meter for measurement, these meters do not provide the same level of accuracy across the operating range of flow rates as a positive displacement meter.

Compact transfer pumps have no air elimination system. There is no allowance for separating air from the fuel to make sure air is not being measured.

A changing environment

Over the last decade, federal and state regulations on underground storage tanks (USTs) have made ASTs increasingly popular, and they started showing up at a variety of private fleet operations. Typically, these more demanding fueling operations require the heavy-duty fleet fuel dispensers used at traditional fleet UST sites. The need for consumption reporting and inventory control for these larger fleets necessitates a higher level of measuring accuracy from the dispenser. (See Photo 2.)

Heavy-duty fleet dispensers typically include the following:
• Commercial Grade Pump—A heavy duty, gear-type pumping unit that is belt driven by a 115 VAC or 230 VAC motor. These pumps are the same as those used in retail service station suction pump dispensers.
• Positive Displacement Meter—A piston-type, positive displacement meter. Fuel entering and exiting the piston cylinders drives the pistons, which are linked to the register gear train. As the cylinders must be completely filled, or positively displaced, these meters provide a higher level of accuracy across the various operating flow rates than the disc meters. These meters are also the same as used in retail service station dispensers.
• Air Elimination System—An integral air elimination system in the pump that separates the air from the fuel so air is not measured.

Photo 2: Commercial-grade dispensers serving two ASTs. Courtesy of Gasboy.

Special valves required

Using a traditional suction pump dispenser with an AST creates special piping considerations. When the product level in the tank is above the dispenser inlet, it develops positive head pressure on the dispenser, creating a pressurized system. Valves need to be installed in the piping to prevent leakage, which can occur either when the dispenser is idle or when it is in use.

• When dispenser is idle—If there is a failure in the piping from the tank to the dispenser, the siphon effect can drain the tank through the failed area. The National Fire Protection Association's NFPA 30A, Automotive and Marine Service Station Code, Section 2-4.6.3 states that: "Where a tank is at an elevation that produces a gravity head on the dispensing device, the tank outlet shall be equipped with a device (such as a normally closed solenoid valve) that will prevent gravity flow from the tank to the dispenser. This device shall be located adjacent to and downstream of the outlet valve specified

by 2-3.8.1 of NFPA 30 Flamable and Combustible Liquids Code. The device shall be installed and adjusted so that liquid cannot flow by gravity from the tank to the dispenser in the event of failure of the piping or hose when the dispenser is not in use."

• When dispenser is in use—Although the need for the solenoid valve near the tank outlet is well understood, the need and purpose for an additional valve directly under a suction pump-type dispenser is often missed. When the dispenser is in use and the nozzle is closed, the pump runs in bypass mode and recirculates the fuel within the pump, as it has nowhere to move the fuel. In a suction system with an underground tank, this is fine, but the positive head pressure in an AST configuration creates another element. With the positive head pressure of fuel in the suction chamber, the suction chamber does not create a vacuum to pull fuel through the air elimination system while in bypass mode. Fuel can build up in the air elimination system until it is forced out the air elimination vent into the environment. Also, if the dispenser is knocked over while in use, fuel could flow out of the inlet pipe at the point of breakage.

Section 2-4.6.5 of NFPA 30A requires that, if a suction-type dispensing device is used, a vacuum-actuated valve, or equivalent type valve, must be installed beneath the dispenser to prevent fuel from leaking through the air elimination system. A shear section is specified so that, if the dispenser gets knocked over, a valve below the shear point closes, preventing fuel from flowing from the tank. (See Photo 3.)

Photo 3: Tokheim Model 52 Pressure Regulator Valve, a vacuum-actuated valve with shear section for use with a pressurized suction system. Courtesy of Gasboy.

The Tokheim Model 52 pressure regulator valve meets the NFPA requirement. Operation of this valve is purely hydraulic. A pilot valve controls the pressure on both sides of a piston poppet assembly, which controls the main valve. When the nozzle is opened, the vacuum opens the pilot valve, which "unbalances" the pressure on the top side of the piston poppet assembly. This, in turn, opens the main valve and allows the fuel to flow through the valve.

With the nozzle closed, the pilot valve closes, and the pressure on both sides of the piston poppet assembly equalizes, which allows the main valve to close, stopping the flow of product. Therefore, when the nozzle is closed, the pressure regulator valve is closed, relieving the head pressure against the suction pump so it can work in normal bypass.

Using a solenoid valve at the tank outlet and having the pressure regulator valve beneath the dispenser meet the NFPA requirements for a safe installation. However, compared to a system with compact transfer pumps installed on top of the tank, a pressurized suction system: (1) may cost more because the special valves add to the installation cost; and (2) is more prone to a line leak than a true suction system (fuel can be pushed through the leak into the environment).

In a true suction system (non-pressurized), a leak in the line will instead pull air into the system. When this happens, the pump will not operate properly (low flow, excessive air out the air elimination

vent). If the leak is severe, the pump will lose prime, and the fuel in the lines will flow back to the tank. So, the technological challenge has been how to get the benefits of a true suction system using heavy-duty fleet dispensers.

Photo 4: Compact fleet pumps, mounted on top of the tank, offer commercial grade features in a non-pressurized configuration. Accessibility of user controls limits the tank size. Courtesy of Gasboy.

Elevating the dispenser

The answer, of course, has been to get the dispenser back on top of the AST. In 1992, Gasboy International introduced a compact version of its mechanical registration 9100 Series fleet dispensers. These dispensers contained the same heavy-duty components of the traditional fleet dispensers, but were different in one major respect: they were mounted in compact cabinets which could be installed directly on top of ASTs.

Now that the dispenser was once again above the product level in the tank, the system was no longer pressurized by the fluid head pressure, and the need for the costly valves was eliminated. The heavy-duty components could handle the most demanding fleet requirements. (See Photo 4.)

With smaller tanks, the compact fleet pump became a great solution. However, as ASTs continued to grow in popularity, they began showing up in larger and larger fleet operations. The tank sizes grew to the point that it was impractical to put the compact fleet pumps on top of the tank. Compact fleet pumps started showing up on shelves on the sides of the large tanks so that their nozzles and on/off levers were in convenient reach of the users. Once again, with the dispensers below the product level, a pressurized system was created, and the special valves were required. (See Photo 5.)

Thus, the challenge became how to maintain the benefits of a true suction dispenser system (unpressurized) on large ASTs while providing easy user access to the nozzle, on/off lever and register.

Photo 5: Compact fleet pumps, mounted on shelves to make them user-accessible, require the same special valves as traditional fleet pumps with ASTs. Courtesy of Gasboy.

Divide and conquer

Sometimes the best solutions are the simplest. If you break the challenge down into its simplest components, you have the answer. The dispenser hydraulics need to be above the product level in the tank to eliminate the pressurized system; and the nozzle, on/off lever and register must be in a convenient location for the user. So, why not separate the dispenser into two components?

In 1995, Gasboy International did just that, introducing its Aboveground Storage Tank Remote Access (ASTRA) dispenser. The ASTRA divides the traditional fleet dispenser into two components: the meter and pumping unit box, and the remote register and nozzle boot.

The meter and pumping unit box mounts on top of any size tank and eliminates pressure in the lines. Being electronic rather than mechanical, the register is located remotely from the meter hydraulics. The remote register and nozzle boot mounts on a free-standing pedestal, or on the side of the tank, so that it is convenient to the user, regardless of the tank size. Draping the hose overhead from the discharge on the pumping unit cabinet creates a convenient hose-handling arrangement, just like multi-product retail dispensers. (See Photos 6 and 7.)

Photo 6:
The meter and pumping unit boxes for ASTRA dispensers sit atop two ASTs, while the remote register and nozzle boots are convenient to users. Courtesy of Gasboy.

Photo 7: This two-compartment tank is equipped with two separate ASTRA dispenser systems. Courtesy of Gasboy.

What's in the box?

The dispenser hydraulics are contained in the meter and pumping unit box, which is 25 inches wide, 23.5 inches high and 20.25 inches deep. The cabinet is mounted to the top of the tank by five "L"-shaped, stainless steel feet (two on each side and one in the back). The tank manufacturer provides mounting bolts attached to the tank or a mounting plate, so the installer does not interfere with the integrity of the tank. The two feet on the sides to the front of the cabinet are adjustable to allow the box to cantilever over the edge of the tank, so the hose will clear the tank edge. This prevents premature wear on the hose. A hole is provided under the base for the power conduit. The hydraulics inside the box include:

- A rotary gear-type, belt-driven pumping unit with integral air eliminator. A hole in the back of the cabinet is provided for returning the air elimination vent tube directly to the tank for a completely closed system.

- Underwriters Laboratories listed explosion-proof motors with thermal overload protection. Two models are available: a .5 HP intermittent-duty motor for standard speed applications (typically gasoline, up to 15 GPM) and a .75 HP continuous-duty motor for high flow applications (typically diesel or applications requiring extended fueling times, up to 21 GPM). The standard motor is 115/230 VAC, 60 Hz (50 Hz is optional).

- A three-piston, positive displacement meter that meets Weights and Measures accuracy requirements.

- A dual phase 1000:1 pulser (liters 250:1) with error detection. The dispenser is automatically shut down if multiple pulses are received in succession from the same channel (in cases where one channel fails). If no pulses are received in a 255-second period, which indicates an abandoned transaction or dual channel failure, the dispenser is automatically turned off.

- An optional internal vapor splitter and vapor return line for vapor recovery applications. The vapor

return line exits out of the rear of the cabinet for returning vapor back to the tank. A coaxial-to-standard hose adapter is available for users who wish to start with a non-vapor-recovery configuration and have the unit ready for future vapor recovery use.

Other options include: various lengths of hose to meet specific installation requirements; internal filter (standard or high-flow) or external high-flow filter; two-stage solenoid valves for applications requiring preset shut-offs; mechanical non-resettable totalizer; and a post-mounted retractor with enclosed spring return reel.

Remote register and nozzle boot

The remote register and nozzle boot is mounted on either an optional free-standing pedestal, or directly to the side of the tank. For mounting directly to the side of the tank, the tank manufacturer must provide mounting bolts, so the integrity of the tank is maintained.

A nozzle boot/hood assembly doubles as the pump control handle, thereby making it impossible to hang up the nozzle without first turning the pump off. The assembly is constructed of a cast-aluminum lever covered with a metal-reinforced PVC hood. The PVC hood creates the top of the nozzle boot, and the lever serves as the bottom. A sliding lock mechanism assures positive nozzle lockdown when it is not being used (requires customer padlock).

Darwinian theory transformed?

Not unlike Darwin’s observations of living organisms from over a century before, when environmental conditions change, products must adapt to meet the market. The AST remote access dispenser is an excellent example of a product that inherited the best traits of its predecessors in a manner to make it more fit for the current market.

There is no doubt that regulations and technology will continue to change the environment, and that the ASTRA and its successors will also have to continue to evolve in form and function.

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