Properly Handling Ethanol Throughout the Supply Chain

As consumption continues to grow, equipment manufacturers are doing their part to ensure ethanol is being distributed safely and efficiently

By Gary Schriever

No one knows whether or not ethanol &#151 despite the renewable fuels thresholds set forth in the Energy Policy Act of 2005 &#151 will ever become the first choice among motor fuels consumers. But there is no arguing that ethanol, in some form, will continue to be a major player in the powering of the nation's on-road vehicles. Whether viewed only as an oxygenate used in 10 percent doses in regular gasoline, or as a potential panacea for the country's dependence on foreign oil in its highly concentrated E85 form, the production and consumption of ethanol for fueling purposes continues to rise on an annual basis, as the following 2006 numbers attest:
&#149 114 ethanol plants in operation with a total annual capacity of 5.48 billion gallons
&#149 70 ethanol plants under construction
&#149 Actual production of 4.9 billion gallons, up from 3.4 billion gallons in 2004
&#149 Blended into 46 percent of America's gasoline, mostly as E10
&#149 Comprised 3.5 percent of total U.S. gasoline consumption
&#149 1,120 gasoline stations (out of 164,476) offering E85
&#149 6 million flex-fuel vehicles (out of 230 million) on the road
Even the Indy Racing League, home of the venerable Indianapolis 500, has gone green in 2007 with all of its cars using 100 percent ethanol as the official racing fuel, replacing a 10-percent-ethanol-90-percent-methanol blend. And that's just the tip of the iceberg, with ethyl alcohol also commonly used in everyday personal care products from mouthwash, perfume and hairspray to household cleaning products, clothing, food, beverages, and pharmaceuticals.

The Questions

However, with this increase in production and demand comes a corresponding rise in the questions and concerns surrounding ethanol and its use, namely:
&#149 Is the country capable of producing enough corn (the current feedstock of choice) to keep up with ethanol production demands?
&#149 When will technology allow alternate forms of feedstock to be economically and commercially viable for the production of ethanol, and by doing so, reduce the demand on corn crops?
&#149 Is the infrastructure and equipment in place to handle the production, loading, unloading, shipping, transporting, storing, and ultimately, delivery of ethanol and its derivative products &#151 with all of their unique properties and compatibility issues &#151 to the consumer's gasoline tank or store shelf?
It's this final question that this article addresses. The one area where ethanol

material compatibility has garnered some headlines recently is at the business end of the supply chain. Last October, Underwriters Laboratories (UL) distributed a communication saying that it had suspended its authorization of E85 dispenser components and that it would be updating its requirements, citing as a primary concern the potentially corrosive effects E85 could have on dispenser components used at the fueling site.

In March 2007, Sen. John Thune, R-South Dakota, and 13 other farm-state senators, said that UL's decision to suspend its authorization of E85 dispenser components was having a chilling effect on the installation of E85 fuel pumps at service-station locations and that the lack of new pumps could hamper the development of ethanol. Less than a week after Thune's announcement, UL revealed that it had established a timeline for completion of its internal testing and validation of E85 equipment and will begin accepting equipment for the purpose of evaluation and certification by the end of 2007.

The Issues

OPW-FC's research shows that unprotected soft metal products in contact with ethanol may form chalky corrosion that could be passed on through the nozzle. Products made of nickel-plated or stainless steel components and ethanol-friendly elastomers avoid this problem.

Caught in the middle of this are companies that produce the hanging hardware and nozzles for fueling operations, companies such as Cincinnati-based OPW Fueling Components (OPW-FC) that offer a wide array of ethanol-compatible products. "The UL suspension of all E85 listed products really caught us by surprise especially since we were the first to the market with a UL-approved solution; then to have the approval pulled was definitely unexpected," said Les Rogers, product specialist of dispensing products for OPW-FC. "We spent the time and had the research to support our product approvals. We're convinced our products are designed to meet the demands of E85 service right now."

OPW-FC's research indicated that unprotected products made of exposed soft metals may show degradation when in contact with ethanol, resulting in a white, chalky corrosion that could be passed on through the nozzle. However, by developing products that are made of either nickel-plated or stainless steel components and that feature ethanol-friendly elastomers, OPW-FC believes its E85 dispensing equipment complies with all ethanol-handling recommendations. "OPW has the most complete hanging hardware solution for dispensing E85," said Rogers.

Farther upstream, there have not been any headline-grabbing pronouncements or material compatibility issues, just solid research and subsequent equipment developments that have helped ethanol products enter the mainstream. Because of its unique properties, ethanol-blended fuels generally cannot be shipped by petroleum product pipeline due to operational issues, mainly ethanol's affinity for

water, which is a by-product found at some level in all of the world's major petroleum pipeline systems. The ability to ship by pipeline is also limited because there currently are no pipeline networks near the majority of ethanol production facilities. Hence, a separate distribution system is needed for ethanol up to the point where it is blended into petroleum-based fuel as it is loaded into tank trucks or railcars for delivery to retail and fleet operators. The costs of building a new pipeline in the U.S. are also extremely prohibitive with estimates as high as $1.1 million to $1.3 million per mile.

As is the case with all liquid fuels, it is vitally important that proper fuel-handling techniques be practiced to prevent fuel contamination. Certain materials commonly used with gasoline may be incompatible with high-level ethanol blends, causing them to degrade and contaminate the fuel. Metals that have been shown to degrade over time in the presence of high-level alcohol blends include brass, lead, zinc, and lead-based solder. Non-metallic materials that degrade when in contact with ethanol include natural rubber, polyurethane, cork gasket material, leather, polyvinyl chloride (PVC) polyamides, and certain thermoplastic or thermoset polymers. On the other hand, unplated steel, nickel-plated steel, stainless steel, black iron, and bronze have shown resistance to ethanol corrosion, with non-metallic materials such as reinforced fiberglass, Buna-N, neoprene rubber, polypropylene, nitrile rubber, Viton, and Teflon meeting acceptable usage standards with E85.

The inability to ship ethanol by pipeline creates opportunities for tank truck and railcar manufacturers as well as the companies that manufacture the valves, seals, gaskets, gauges, and transfer equipment, such as loading and unloading equipment, for use in these applications, knowing that the ultimate responsibility for the safe shipment of ethanol falls on the shipper.

The Answers

To combat potential compatibility issues with ethanol, Midland is using Teflon-encapsulated O-rings on plug valves. Elastomer O-rings in pressure relief and vacuum relief valves are made from Buna or Viton G compounds.

"The primary compatibility concern is that while alcohol is easy to handle, when it is denatured with gasoline you can have problems with the compatibility in the seals," said Kevin Cook, vice president of sales and marketing for Skokie, IL-based Midland Manufacturing, which produces pressure relief valves, angle valves, rupture disc devices, actuator systems, measurement gauges, and other equipment for the railcar industry. "The selection of seals for rail tank car equipment is the responsibility of the shipper and since they understand what they're shipping better than everybody else, they have the responsibility to identify the correct seals to use," explains Cook. "In general, the seals have been very effective. Ten or 15 years ago, there were issues with EPDM rubber seals being attacked by the denaturant,

but we've learned from those experiences and moved on."
To effectively combat potential compatibility issues with ethanol, Teflon-encapsulated O-rings are being used on plug valves, which can be constructed of carbon steel with some stainless steel trim, while elastomer O-rings in pressure relief valves and vacuum relief valves are being made from ethanol-resistant Buna or Viton G compounds. And the rail tank cars, themselves, are made with carbon steel.
Remarking on the railcar or tank truck loading and unloading processes, Dave Morrow, product manager of loading systems for OPW Engineered Systems (OPW-ES) in Lebanon, OH, said that when it comes to ethanol material compatibility, "we really haven't had any problems." He explained: "Most bulk plants have specified the use of carbon steel or stainless steel materials of construction with aluminum sub-components. We have seen some concern over the use of aluminum, but most users do not seem concerned with this material being used as a sub-component on a loading arm."
As for seal selection, Morrow and OPW-ES are following the producer's recommendations but have had great success with Viton GFLT (high grade FKM) in ethanol service. With more and more ethanol being shipped, the one area where Morrow has seen a significant change is in the flow rates being used to load and unload the fuel. "Many people are wanting to load railcars at very high rates like 600 to 800 gallons a minute," he explained. "That gets you up into six-inch loading arms, which can introduce ergonomic, safety, and storage concerns. To safely and efficiently handle arms of that size, we're doing a lot of pneumatic cylinders to assist with maneuvering and counterbalancing the arms." Another issue with the higher loading rates is the potential for static generation. "We stress the importance of a properly grounded loading system and recommend utilizing a ground verification package to ensure that the system is properly grounded prior to loading," stressed Morrow.
An issue that many shippers are facing is vapor recovery. Most of the ethanol being loaded into tank trucks and railcars is being top-loaded through an open hatch. To address vapor recovery concerns, most loading arms are being equipped with a vapor recovery attachment such as an inflatable hatch seal.

Blackmer uses a higher grade of FKM in seals, allowing pumps to be used with all grades and blends of ethanol.

One company that reported seeing some ethanol compatibility problems with the seals on its pumps was Blackmer, Grand Rapids, MI. About a year ago, the FKM-style fluorinated elastomer seals that Blackmer was using on its various lines of sliding vane pumps began experiencing some leakage. "Our customers were calling and saying, 'Hey, what's going on?'" explained Scott Jackson, product manager for Blackmer. "They were beginning to have leakage that was not acceptable." After

researching the problem and getting together with its O-ring vendors, Blackmer decided to use a higher grade of FKM in the seals that would give them a broader range of compatibility and allow the pumps to be used with all grades and blends of ethanol. Jackson equated it with upgrading from regular unleaded gasoline, which works just fine in your automobile, to super premium for a boost in performance.
"Now we have almost a full year of experience with these higher grade components and have had no further problems," Jackson said. "Since this upgraded FKM has proven very successful, we have standardized to this upgraded material across the board. From now on, any of our pumps that have FKM O-rings will have this new upgraded material."
Blackmer manufactures its pumps in stainless steel and ductile and cast iron materials. However, Jackson noted that the large majority of its customers are using ductile and cast iron models that are showing no signs of corrosion after several years of use.

Civacon hasn't seen much impact from ethanol on its tank truck components. Its biggest hurdle has been calming the concerns of customers leery of using older components in newer ethanol-handling operations.

Elsewhere, components appear to be holding up just fine to various ethanol-handling demands. "On components that we manufacture, we have not seen a great amount of impact," said Chris Gooding, director of sales and marketing for Civacon and Knappco, based in Kansas City, MO. Civacon manufactures overfill equipment, API heads, vents, and valves used in the transfer and transport of ethanol and petroleum products. Knappco manufactures industrial access ports, manholes, hatches, weld rings, and fill covers in dry bulk applications; its fill covers, access doors, and pressure/vacuum relief vents are used on storage tanks in many ethanol processing plant applications. "With dedicated ethanol hauling or ethanol-gasoline blends, we haven't really seen any effect. The products are holding up very well in the ethanol market."
The biggest hurdle for Civacon, according to Gooding, has been assuaging the concerns of its customers, who are leery of using older components in newer ethanol-handling operations. "Mainly, we haven't seen any challenges as far as the performance of our products, but we've had to educate our customers who are wondering if the components will hold up," he said. "Our stance is that what you have now will be suitable for an ethanol application; it's just a growing market."
The market has also had to adjust to the different requests going into truck trailer manufacturers. In the past, a typical gasoline trailer constructed of aluminum would have four different compartments for hauling up to four different formulations of gasoline. Now, some trailers are being built of stainless steel for the dedicated hauling of ethanol.

Engineered specifically for the biofuels market, Sure Seal's high-performance butterfly valves come standard with 316 stainless steel trim, polyester polyurethane body coatings, and three seating configurations.

Commenting on the area of ethanol processing, Jay Thompson, vice president of the chemical/industrial marketing unit for the OPW Fluid Transfer Group and its Sure Seal division, said he has heard of no issues. Sure Seal, Mineral Point, MO, specializes in components for most applications requiring the processing, movement, and storage of dry bulk or liquid materials including butterfly valves, lined ball valves, actuators, aeration systems, relief valves, hopper tees, couplers, and sanitary valves. "Mostly what we're seeing in the processing area is that 65 percent of the components are made of 316 stainless steel, and 35 percent are made with carbon-steel bodies, and all have 316 stainless trim," said Thompson. "We're also seeing a lot of PTFE sealing components for the seats in the valves, and those are highly compatible with ethanol." Sure Seal has also introduced a line of triple offset seated valves that rely on metal-to-metal construction, which eliminates the need for any type of PTFE-encapsulated seats in the valve.
Gary Schriever is the market manager of biofuels for U.S.-based OPW Fluid Transfer Group. The company is comprised of six operating companies: OPW Engineered Systems, Midland Manufacturing, Civacon, Knappco, Sure Seal, and OPW Fluid Transfer Group&#151Europe. They design, manufacture, and distribute solutions that assist in the safe handling and transporting of hazardous bulk products. More information on properly handling ethanol throughout the production, distribution, and supply chain is available by contacting Schriever at 513-696-1550 or gschriever@opwftg.com. More information on products manufactured by OPW Fueling Components and Blackmer is available by visiting www.opw-fc.com and www.blackmer.com.