



ETHANOL:

Shipping it through pipelines

Ethanol is an alcohol product made principally from corn and can be used as an automotive fuel. The U.S. oil and natural gas industry has blended it in gasoline for decades and expects to use increasing amounts in the years ahead to help meet the nation's transportation fuel needs. However, use of ethanol as a transportation fuel presents special challenges. One of the more significant is that ethanol is not easily transportable through the country's pipeline system.

Ethanol background

Ethanol is blended in gasoline to add octane and oxygen and may help reduce certain kinds of emissions. The most common blend with gasoline is sometimes called gasohol, which contains 10-percent ethanol and 90-percent gasoline, and can be used in conventional gasoline-powered vehicles. Other blends, including E85 (85-percent ethanol/15-percent gasoline), which can be used in flexible fuel vehicles, are still relatively limited.

Ethanol distribution

Ethanol is not easily transported via pipelines for several reasons. First, it is water soluble (has a tremendous affinity to absorb or pick up water). Because water accumulation in pipelines is a normal occurrence (in most cases water enters the system through terminal and refinery tank roofs or can be dissolved in fuels during refinery processes), introducing ethanol into a pipeline risks rendering it unusable as a transportation fuel. Also, if gasohol is shipped in a pipeline, the water may strip some of the ethanol out, resulting in sub-octane fuel.

According to a report prepared by the Oak Ridge National Laboratory Ethanol Project in 2000, "Once an ethanol blend phase-separates it is extremely difficult and usually impossible to re-blend. In many cases the ethanol/water bottoms must be disposed of in accordance with hazardous waste regulations."¹

Second, ethanol can dissolve and carry impurities that are present inside multi-product pipeline systems, making it harmful to motor vehicle engines when blended in gasoline. Finally, ethanol is corrosive and may adversely affect pipeline

parts. There is some evidence that ethanol in high concentrations can lead to internal stress corrosion cracking, which is hard to detect and manage. This may be accelerated at weld joints or "hard spots" where the steel metallurgy has been altered. In 2003, the state of California said that because ethanol "has a corrosive effect on the seals and valves of the pipelines," it is blended at the loading racks of distribution centers.² Ethanol corrosion of untreated weld joints is currently the subject of industry research.

Since ethanol is not added to gasoline before shipment through pipelines, it has to be shipped to terminals separately – usually by barge, rail or truck – and then blended with the gasoline at the rack as the truck is loaded for retail delivery. This may affect consumer costs and create environmental impacts associated with the different modes of alternate transportation.

Addressing water and corrosion problems

It may be possible to limit water contamination problems by reducing the water that enters the distribution system. This is more difficult than one might anticipate as water is pervasive in and around most distribution system facilities.

Examples of measures to minimize or eliminate water include the installation of roofs on tanks to keep rainwater out as well as the installation of coalescer vessels to remove the water from other sources such as condensation on internal tank walls.

A third option is the use of "sacrificial buffers" of neat ethanol preceding the "primary" batches

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Shipping ethanol through pipelines

of gasohol or ethanol in the pipeline. The neat ethanol buffer absorbs water in the pipeline ahead of the primary gasohol or ethanol, reducing contamination but leaving the problem of storing and disposing of the buffer. These measures can add to consumer costs and may or may not be sufficiently effective to enable shipment of ethanol or gasohol by pipeline depending on the quality specifications of the product.

Ethanol-related corrosion problems can result from how ethanol behaves in the pipe. It tends to clean the internal surfaces, making them more susceptible to corrosion from water inside. A potential increase in pipeline failure from internal corrosion increases potential risks and liability as well as costs for pipeline operators. Because this is a new issue for the industry, the extent of the problem and ways to address it have not been fully assessed. Tank liners, selective post-weld heat treatment, and the coating of internal critical zones (at pipeline weld points, for example) may help but would increase costs.

A 1981 test completed by Williams regarding the feasibility of ethanol shipments in a refined products pipeline led to the conclusion that, "fuel grade ethanol can be successfully transported in a multi-products pipeline system under controlled conditions. The greater the frequency of batches through any system through any given line segment, the fewer the quality problems that we would expect to experience."³ Some proprietary pipelines can carry ethanol, but these are generally small diameter pipelines with limited product slates and few shippers.

Dedicated pipelines

Because ethanol production centers, most often located in the corn-belt of the Midwest, are far from most consumers, the cost of transporting ethanol by truck or other means is great. To reduce costs and avoid water contamination issues associated with use of existing petroleum pipelines, building dedicated ethanol pipelines has been considered. That could be difficult because of siting problems. Moreover, the dispersed nature and limited production volumes of ethanol facilities may not generate the volume demand needed for new pipeline construction.

At a forum held in 2000 on potential ethanol use in the mid-Atlantic region and the Northeast hosted by the U.S. DOE and various third-party groups, a representative of Buckeye Pipeline said that neat ethanol could be shipped via pipeline provided that a significant market developed.

Buckeye also indicated that it had run tests shipping ethanol blends over long distances via dedicated pipeline, that the fuel remained uncontaminated, and that no long term unsolvable problems were evident.

Terminal modifications for E85

Pipeline terminals may have to be significantly retrofitted with additional equipment to accommodate increased throughput of ethanol. This could include adding new tank capacity (in areas where ethanol is already used as an oxygenate, the existing storage tanks might be adequate), modifying the rack to accommodate E85, and adding hardware to blend the fuel.

In the near term, it is likely that most of the projected increase in shipments in ethanol to terminals will be handled by tanker truck and rail tank car as opposed to pipelines. Except for a few proprietary pipelines, the common carriers generally do not ship ethanol in their systems. The increased risk of corrosion and potential for water contamination associated with ethanol are key factors limiting its transport via pipeline.

The largest concern is for terminals that are configured to receive ethanol via truck. At present, for every 10 trucks leaving such a terminal with gasoline containing ethanol blended at 10 volume percent (E10), there is one truck coming in to the terminal with a load of ethanol. To distribute E85 fuel would entail 8.5 incoming truckloads of ethanol for every 10 trucks leaving the terminal. Demand for high volumes of E85 would require significant modifications to the terminal to handle the additional truck traffic, the building of new areas for unloading the ethanol, and likely require the addition of new tanks. Terminals receiving product via marine barge/ship or railroad may only need to install additional storage tanks.

¹ *The Current Fuel Ethanol Industry Transportation, Marketing, Distribution, and Technical Considerations*, <http://www.ethanolrfa.org/objects/documents/111/4788.pdf>, p.4-2.

² Letter from Division of Measurement Standards, California, to all weights and measures officials, May 16, 2003.



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