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Follow up to the May/June issue of *G&I*'s print and digital magazine reporting on the response of the electronic specialty gas industry to Dow Chemical's eventual withdrawal from the anhydrous hydrogen chloride (AHCl) merchant market in the US (read more)

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In the May/June issue of *G&I*'s print and digital magazine, we reported on the response of the electronic specialty gas industry to Dow Chemical's eventual withdrawal from the anhydrous hydrogen chloride (AHCl) merchant market in the US (<http://www.gasesmag-digital.com/gasesmag/20100506#pg4>) High-purity and industrial-grade AHCl are also repackaged by suppliers such as Airgas and Alexander Chemical, which cater more to users in non-electronic industries. For example, only 15–20% of AHCl distributed by Alexander is used in electronics. The remaining AHCl is destined for rubber and pharmaceutical production, manufacture of chlorinated compounds (e.g., methyl and ethyl chlorides) and chlorinated metals (e.g., alkyl chlorides), the petrochemical industry, hydrometallurgy and hot galvanizing, gas mixture calibration for environmental emission monitoring, operation of excimer lasers, cotton de-linting, etc.

In 2006, Alexander Chemical upgraded and modernized its AHCl packaging plant in Kingsbury, Indiana. The system includes facilities for railcar unloading, tube trailer filling, and cylinder filling of AHCl for packaging and distribution throughout North America. In addition, the company supplies chlor-alkali products and industrial gases (chlorine, ammonia, sulfur dioxide, and methyl chloride) to major chemical companies, public utilities, industrial users, and municipalities throughout the midwestern US. In February 2010, Carus Holding, LLC, a subsidiary of Illinois-based Carus Corporation purchased all the stock of Alexander. Carus is an environmental company that manufactures permanganates, phosphates, and catalysts for the water, remediation, and air purification markets.

Currently, Alexander receives AHCl delivered by railcars from Dow Chemical and repackages the product in 2- to 600-pound cylinders and 21,000-pound tube trailers for all (except Air Products) major gas companies. Like other suppliers that are anticipating Dow's exit from the merchant market, Alexander is looking for an alternate domestic source of AHCl that has transitioned to delivery by tube trailers, thus bypassing the complicated and costly risk reduction strategies required to prevent catastrophic release of AHCl in the event of railcar transportation failures, or terrorist attacks targeting railcars as chemical weapons, in populated areas.

Owing to hydrogen chloride's reactive and corrosive nature, it must be handled with extreme care, especially when it is also a toxic inhalation hazard (TIH). In the anhydrous state, it is thermally stable, relatively inactive, and corrosive to a few metals. AHCl is extremely attracted to water, however, and when exposed to air, it will react exothermically with atmospheric moisture to form the highly corrosive hydrochloric acid. OSHA lists AHCL as a highly hazardous chemical in quantities above 5,000 pounds (2.27 metric tons). Stored as a liquefied, compressed gas at temperatures not exceeding

125°F (52°C), AHCl can be transported by rail as a refrigerated liquid at -20°F or by truck as a high-pressure liquid under its own vapor pressure.

The gas industry has historically preferred rail systems for long-distance transportation because one tank car could carry several times more gas than a truck. It was also believed to be safer because of the resulting smaller number of shipments moving along a dedicated network. Fatal accidents involving TIH product release in the past decade have proved otherwise. Recent studies by the US Department of Transportation (DOT) and the National Transportation Safety Board (NTSB) on transportation risks by rail of TIH, such as anhydrous ammonia, chlorine gas, and AHCl, are calling for improvements in tank car design standards, changes in traffic control and rail operation, modifications to delivery routes and schedules, more frequent track and railcar inspections, more vigilance in railroad security, and more effective emergency response.

Various regulatory agencies oversee TIH transportation at the federal level. The Federal Railroad Administration (FRA) is part of DOT. Railroads and their TIH cargoes are regulated by the Pipeline and Hazardous Materials Safety Administration (PHMSA) and the Surface Transportation Board (STB), both of which are part of DOT, as well as the Transportation Safety Administration (TSA), which is part of the Department of Homeland Security (DHS). The TSA issued new rail transportation security regulations in 2008 and the FRA issued new regulations in 2009 on tank car design, routing, and operational practices.

In January 2010, researchers at Harvard University's John F. Kennedy School of Government released a working paper on "Rail Transportation of Toxic Inhalation Hazards: Policy Responses to the Safety and Security Externality." The paper recommends improvements in supply chain operations and government policy options to assess risks more effectively and to make better plans for the safe transport, storage, and delivery of TIH. It reported that many recent efforts to improve tank car design were initiated in the private sector and corporate participants in the TIH supply chain have looked for ways to mitigate transportation risks, "prompted by the desire to preempt government regulation, to gain advantage over competitors, as well as ethical consideration, public relations benefits, and a focus on enterprise risk management."

Following TIH accidents of 2002–2005, the Association of American Railroads Tank Car Committee (AAR-TCC) launched a study to develop a tank car that would reduce the conditional probability of TIH release upon impact. Chemical producers, shippers, carriers, rail car builders, and government agencies have joined forces to improve emergency response to a TIH release. They have also formed an initiative called the Next Generation Rail Tank Car Project (NGRTC) to design safer tank cars. Project participants include Dow Chemical, Union Pacific Railroad, and the Union Tank Car Company (UTLX), as well as the TSA, the FRA, and its Canadian counterpart, Transport Canada. Dow Chemical has installed GPS tracking on its TIH tank cars and has deployed a rail car tracking solution to provide real-time location and environmental sensor monitoring of temperature, product release, shock and dome condition of its chlorine and AHCl fleets.

As a member of the Chlorine Institute's Stewardship Program, Alexander Chemical's staff co-authored the Institute's Safety Pamphlet 99, "Hydrogen Chloride, Anhydrous (Non-Refrigerated) Use, Handling and Transportation of Cylinders and Tube

Trailers.” The third edition, approved by the Institute’s Transportation Issue Team, provides guidelines, recommended practices, and other critical information for the safe shipping, handling, and receiving of non-refrigerated AHCl in cylinders or tube trailers, based on members’ experience as of its publication date of October, 2008. The pamphlet and other related literature can be downloaded online at <http://www.chlorineinstitute.org>.

Users of AHCl are adapting to changes in the AHCl supply chain by seeking alternative sources and delivery methods. While a handful of customers with high profit margins, such as select polysilicon manufacturers serving the electronics industry, might be able to import AHCl from overseas producers, acquire new modes of transport, or invest in on-site AHCl generators, users that cannot afford the higher prices or new delivery networks are increasingly switching to hydrochloric acid or non-HCl chemistries if such substitutions are technically feasible.

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