

TRANSPORTATION OF CHLOR-ALKALI PRODUCTS

Pipeline transport of chlorine now a reality following framing of guidelines

While manufacturing plants in the Indian chlor-alkali industry have capabilities for safe operations on par with global standards, transportation of the chemicals it produces, especially chlorine, at times over distances as long as 1,000-km, has been a matter of concern. The challenges arise from several factors: the quality of vehicles that ply; the conditions of roads they take; and the poor training of drivers, especially at times of accidents, when the hazards evolve into considerable risks.

In the past, chemical companies, in general, were content to transfer these risks on to fleet operators, but that is no longer the case. Responsible companies – taking a cue from those in developed countries – are recognising transport safety as an extension of plant operations and taking several steps to ensure safe transport of chemicals from the point of production to that of consumption.

The chlor-alkali industry, under the aegis of its lobby-group, the Alkali Manufacturers Association of India (AMAI), was the first in the chemical industry to roll out an emergency response system to accidents and incidents involving the industry's products. Operating since 2013 with a nationwide toll-free number that reaches emergency responders 24x7 all-year round, it has attended to several accidents and near misses, and AMAI is in the process of expanding the capabilities of this system. The 'NicerGlobe' initiative, operated by the Indian Chemical Council (ICC) with participation of about a dozen companies, is another effort in mitigating the risks of chemical transportation safety.

Road transportation of chlorine

The lack of integration of chlor-alkali producers here to large chlorine-consuming industries, such as vinyl or isocyanate, has led to a situation

wherein a vast majority of the chlorine is moved to a fragmented user base in tonners, each of which contain about 930-kg of liquid chlorine when full. In the area around Dahej (Gujarat) on any given day about 2,000 tonners are estimated to be on the road, posing a not inconsiderable risk.

The obvious solution is to move chlorine by pipeline, but in the absence of clear guidelines and procedures for approvals the idea has not caught on, barring a few isolated cases.

But very recently, thanks to efforts taken by Gujarat Alkalies and Chemicals Ltd. (GACL), the Petroleum and Explosives Safety Organisation (PESO), formerly known as the Department of Explosives, has framed guidelines for short-distance transportation of gaseous chlorine in industrial parks and estates.

Guidelines for pipeline transportation of chlorine gas

According to Mr. Shirish Pathak, Reliance Industries Ltd., the regulations have been framed with the support of the Department of Chemicals and Petrochemicals, Government of India, after taking into consideration best practices elsewhere in the world. The draft guidelines were prepared by ThyssenKrupp Industrial Solutions India Ltd. (TKIS), which acted as a consultant to the committee formed for the purpose, with assistance from Euro Chlor and The Chlorine Institute – two international agencies that have considerable experience with chlorine handling in Europe and USA respectively.

“The draft guidelines published by



From L to R: Mr. Samir Biswas, Jt. Secretary, DCPC; Mr. Jayantbhai Patel, President, AMAI; Mr. B.S. Gilra, Past President, AMAI; and Mr. Tom Manders, Euro Chlor

PESO in July 2019, currently restrict the pipelines to a distance of 15-km in notified industrial zones, but once sufficient expertise is gained it could be extended to public lands as well,” Mr. Pathak told a seminar on ‘Safe and efficient transportation of chlor-alkali products in India’ organised by AMAI in Vadodara on September 25-26, 2019.

The guidelines are comprehensive and follow international best practices. They mandate:

- Pipelines be installed below or above the ground;
- There be no sectional isolation of the pipeline;
- Flange joints and unnecessary tapping are avoided;
- All valves, seals, gaskets etc. be compatible with chlorine;
- Scrubbers be installed at both ends of the pipeline (at the producer and consumer);
- Separate flow measuring and monitoring systems be provided at both ends;
- Steps to control moisture levels; and
- Installation of a Pipeline Intrusion Detection System (PIDS).

According to Mr. Pathak, while it is easier to monitor an above-the-ground system, for cross-country pipelines it may be prudent to go underground and install the pipeline in a concrete trench, filled with sand.

Mr. Pathak also urged the government to include cross-country chlorine pipelines under the purview of the Petroleum and Minerals Pipelines Act. This will bring clarity on the Right of Utilisation (RoU), and compensation to be paid to landowners (at 10% of land value for 30 m width alongside pipeline).

“The payback period for cross-country pipelines is 7-8 years and then it is free for life,” he observed.



Mr. Jayantbhai Patel, President, AMAI presenting memento to Mr. Samir Biswas, Jt. Secretary, DCPC

Safe operations for several decades in Europe

In sharp contrast to India, in Europe nearly 80% of the chlorine produced (about 9.5-mt) is moved by pipeline inside industrial parks, and another 16% is transferred by pipelines that run through public areas. Only about 2-3% of all chlorine produced is moved in railcars and just 1-2% by road. “The focus is in minimising the risks,” Mr. Tom Manders, Euro Chlor, who helped in the framing of the Indian guidelines, said.

Although more and more European governments are pushing companies for installing double-wall pipelines – assuming it has a lower failure risk – EuroChlor believes single-wall pipelines are a more prudent choice. The industry body believes that double-wall pipelines and branches are more challenging to construct; make it difficult to determine the exact location of a leak; and are more problematic when it comes to dealing with the affects of thermal expansion.

“Both liquid and gaseous chlorine can be transported safely through single-wall pipelines, provided appropri-

ate design and operating conditions are met, and two-phase flow is avoided to avoid erosion,” Mr. Manders observed.

From a risk perspective what matters is the amount of chlorine in the pipeline at any point in time and on that score gaseous chlorine wins. A 10-km pipeline, designed to transfer 25-ktpa of chlorine at a pressure of 8-bar, will have just 18-tonnes of chlorine. Having said that, Europe has several kilometres of pipelines for liquids with pressures up to 40-bar, which have been operating without incidents for several decades. The last reported incident was in a gaseous chlorine pipeline in 2005, when an explosion of hydrogen and chlorine released about 450-kg of chlorine into the atmosphere and there were no victims.

... and in the US

In the US too, about two-third of the chlorine produced is for merchant sales, and an overwhelming majority (78%) of this is transported via pipeline.

According to Mr. Frank Reiner, The Chlorine Institute, USA, corrosion is a major threat to the integrity of chlorine pipelines and can be controlled by using

thicker-walled pipelines and coating the exterior of the pipes with polyethylene. The US too does not recommend double-walled pipelines for several reasons including chlorine accumulation in the annular space. "There is a need to consider how access to the pipeline is controlled, especially in public areas not controlled by the producer or consumer," Mr. Reiner noted.

In the US it is acceptable to install chlorine pipelines above or below the ground. Inspection and testing of welds is in line with national and international codes, and pipelines are pressure tested until all leaks have been identified and plugged. The preferred method of cleaning is by use of pigs forced through the pipeline by dry air or nitrogen.

"Standard operating procedures need to be developed, spanning start-up and shutdowns, abnormal process operations, and emergencies. All operators need to be trained on the procedures, which should be reviewed for updates once at least 15 months," he added.

During maintenance, he stressed the need to prevent moisture ingress. Furthermore, all materials such as gaskets, seals, lubes, greases etc. must be non-reactive to chlorine. Valves need to be periodically inspected to ensure reliable operations. Surveillance of the pipeline is important to determine appropriate repairs and their urgency. "The preferred method of inspection is through use of smart pigs that measure pipeline wall thickness, and detects pits and cracks around the full circumference of the entire length of the pipeline.

According to Mr. Reiner, the most common reasons for pipeline failure in US (in order of importance) are external force, corrosion, construction/material failure (design defects), ground movement, procedural or operator errors and stress corrosion cracking.

25-tonnes ISO tanks popular in China

Highlighting chlorine transportation practices in China, Mr. Wang Xiwen, JOC Technical Engineering Co. Ltd., China, pointed to several options used by chlor-alkali producers: Pipelines, ISO tanks (25-tonnes) and cylinders (1-tonne, 125-kg, and 65-kg). "More than 50% of chlorine transportation in China is by pipeline, but 25-tonne tanks are also popular as they are easier to transport and more economical," he added.

Several chemical parks in the country have pipeline networks for several gases and utilities, including dedicated ones for chlorine, and these are often operated by independent agencies, not the producer or consumer. The Shanghai Chemical Industry Park, for in-

stance, uses robots to patrol the chlorine pipeline.

ISO containers for chlorine

Mr. Ranga Rao, Thyssenkrupp Industrial Solutions (India) Pvt. Ltd., noted that in India hydrogen, vinyl chloride monomer and liquid bromine are being transported long distances in bulk ISO tanks. "Why can't we have chlorine convoys using ISO tanks and vehicle tracking?" he asked. "Even chlorine transport by ISO rail cars should be possible in the plants that have railway siding."

Mr. Manders noted that the practice in Europe is to use drums and cylinders only if chlorine usage at a customer is below 1,500-tpa. "Else we suggest ISO containers or rail cars," he said.

Wider adoption of tonner management systems

With the vast majority of chlorine now being transported in tonners, chlor-alkali companies are investing in hardware and software to better manage the inventory of tonners at their sites and that of their customers, and improve safety when handling these containers – be it in transportation and in filling.

Several companies including Nirma Ltd., DCM Shriram Ltd., Grasim Industries Ltd. and GACL have implemented RFID-based chlorine tonner management systems to track, trace and monitor their tonners.

At DCM Shriram, with chlor-alkali operations at Kota (Rajasthan) and Jhagadia (Gujarat), for instance, the comprehensive system integrates a lot of functionality that was earlier done manually and was prone to errors. For one, the hydrotesting process (for checking for leakage) is part of the system and ensures that no tonners for which hydrotesting are due are filled and sent out to customers. End-user license of the customer is also integrated into the system, ensuring that no dispatch happens to a customer whose license is not valid. System-based control also ensures a gap of 24 hours between tonner filling and dispatch.

GPS tracking systems, however, cannot be installed on the tonners as they would need a battery, which is not permitted as per gas rules.

While the RFID tags can be glued on to the tonners, there is a risk that they could fall off. In response to this need, tonner manufacturers, such as ISGEC Heavy Engineering Ltd., are now incorporating a pocket on the nameplate of tonners, into which the RFID tags can be attached.

CHEMICAL LOGISTICS

Bulk transportation of other chlor-alkali products make some headway

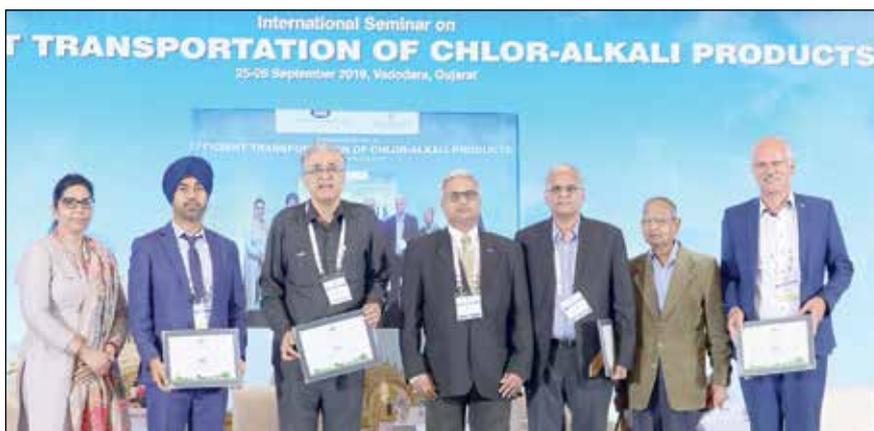
Besides chlorine, the chlor-alkali industry also produces caustic soda and hydrogen. Soda ash is another large-volume alkali that finds some common applications with caustic soda. A somewhat related industry produces bromine – a more hazardous halogen.

While the vast majority of these chemicals are currently moved in small lots – be it bags (soda ash), cylinders (hydrogen) or bottles (bromine) – bulk transportation is making some headway – for reasons of cost savings, improved safety or convenience of customers.

Bulk movement of soda ash

Tata Chemicals Ltd. (TCL), the second largest producer of soda ash in the world, is now moving about 10% of its soda ash sales in India in bulk form – still small when compared to bulk sales of 90% in Europe. This has helped the company avoid customer complaints concerning weight variations from bag to bag; damage in transit leading to unhygienic conditions and moisture ingress; improper storage of bags; and issues related to empty bag handling. “Customers also had issues with respect to labour availability for unloading, especially during local festivals and elections. We also wanted to replicate global practices,” Mr. Lalit Khatri, TCL, observed.

TCL has experimented with using dumpers to transport soda ash, and found that it was economical for distances up to 500-km, but not beyond due to restrictive return loads. The dumpers also had the dis-



Participants in panel discussion with AMAI officials (From L to R): Ms. Harjeet Anand, Jt. Director (Technical) AMAI; Mr. Jagdeep Singh, Logistics Head, Grasim Industries Ltd.; Mr. P.K. Gera, IAS, Managing Director, Gujarat Alkalies & Chemicals Ltd.; Mr. K. Srinivasan, Secretary General, AMAI; Mr. Ravi Raghavan, Editor, Chemical Weekly; Mr. B.S. Gilra, Past President, AMAI; and Mr. Tom Manders, Euro Chlor

advantage of causing air pollution due dusting when loading and unloading and loss of material. Customised bulkers with controlled pneumatic discharge (for the non-tilting type) or gravity discharge (for the tilting type) have also been developed for short runs up to 500-km. However, they too suffer from disadvantages including higher freight costs (due no return load), need for dedicated vehicles, and high investment in infrastructure – by the customer and the transporter.

The company has, however, met with some success in transporting loose soda ash in traditional trucks over long distances. It is the first company in India to transport light soda ash in standard Punjab trucks, and has made several improvisations to overcome the challenges including three layers of tarpaulin to protect the material in all seasons;

and reduced height of rear body stopper to avoid obstruction on hopper mesh when tilting.

Bromine via ISO tanks

In the case of bromine, TCL is now using 18-tonnes capacity ISO tankers, instead of the traditional bottles, and in the process reduced the number of steps in the process from 16 to just seven. While three trucks were needed to dispatch 15-tonnes of bromine in bottles, this is now done with just one ISO tanker.

“We have reduced the safety hazards associated with truck loading and unloading by moving away from bottles to ISO tanks,” Mr. Khatri observed. As the industry gains confidence and customer demands grow larger, bulk transportation of chlor-alkali and related products are expected to grow.

ROLE OF GOVERNMENT

‘Industry must set vision for itself in line with national vision’

Mr. Samir K. Biswas, Joint Secretary, Department of Chemicals and Pet-

rochemicals (DCPC), Government of India, urged the chemical industry to set

a vision for itself in line with the national vision spelt out by the Prime Minister

of reaching a \$5 trillion economy by 2030. “The strategies to achieve this vision need to be clearly spelt out. India is the fastest growing major economy and this poses tremendous opportunities for the chemicals sector. Never before have we had an opportunity to grow so fast,” he observed in his remarks at the inaugural session of the conference.

While the chlor-alkali industry has been seeing growth, he questioned whether this was enough? “PVC manufacturing is attractive today, as import duties have been hiked. Can’t the industry come together to set up a cracker to source ethylene for PVC?” he asked.

The government, he added, has been responsive to the needs of the industry. “In the history of India, we never had a standard for any chemical, but this was done for caustic soda. Fiscal incentives recently announced provide an excellent platform for new investments in the sector,” Mr. Biswas added.

He pointed out that a permanent forum for the chemical and petrochemical industry has been formed under the DCPC, with representation from other concerned ministries as well, to address industry concerns. “The key is sustainable development and steps need to be taken keeping this in mind,” he noted.

‘No need for National Chemical Policy’....

Questioning the need for a National Chemical Policy, Mr. Biswas pointed out that notwithstanding its absence, several initiatives have been taken by the DCPC to aid the development of the chemical industry.

.... ‘Or allocation of feedstock’

On the issue of allocation of olefins and other feedstock from crackers to other companies, Mr. Biswas pointed out that policies and mandates cannot



Mr. Samir Biswas, Jt. Secretary, DCPC, addressing the gathering

override commercial considerations. “Mandating feedstock allocations is not the way forward,” he said.

Protection for industry against imports

Mr. Jayantibhai Patel, President,

calling for a 15% import duty on caustic soda imports to protect the domestic industry, he pointed out that Japan is now dumping caustic soda at 7.5% duty. “Environment clearance norms need to be simplified,” he added.

Initiatives for safer transportation on roads

To improve road safety several companies now routinely do journey route mapping for their consignments, lay down selection criteria for vehicles and vehicle drivers, and avoid late night movement of vehicles. They are also experimenting with Advanced Driver Assistance Systems that include collision avoidance system, sleep alert, adaptive cruise control, tyre pressure monitoring, alcohol detection, driver evaluation, and accident detection and calling, among other features.

Grasim Industries Ltd., for one, is using technology to track all vehicles carrying their cargo, including the non-dedicated fleet, which accounts for about half of the total number of vehicles employed. This is done in a Central Control Tower, which according to Mr. Jagdeep Singh, Logistics Head, has helped greatly enhance en-route safety. “For the non-dedicated vehicle we have developed a ‘plug and play’ device, which works as a normal GPS device, but is brought back to us once the delivery is made to the consumer,” he observed.

Grasim is also working on a two-rack system for transporting chlorine tonners in which the upper layer is hydraulically operated. It has installed marshals to observe behaviour of vehicles and drivers in the premises of plants, and evaluates the fitness of drivers and vehicles on 60 parameters, of which 20 are critical and non-negotiable, while for the non-critical a minimum of 75% compliance is needed. The company has also started auditing chlorine consumer storage & handling infrastructure, and plans to even stop supplies for those who make no progress towards better compliance.

Customers can track their vehicles and consignments on a live basis using an app. Some progress has clearly been made, but improving road safety is a journey in which the industry still has some way to go.