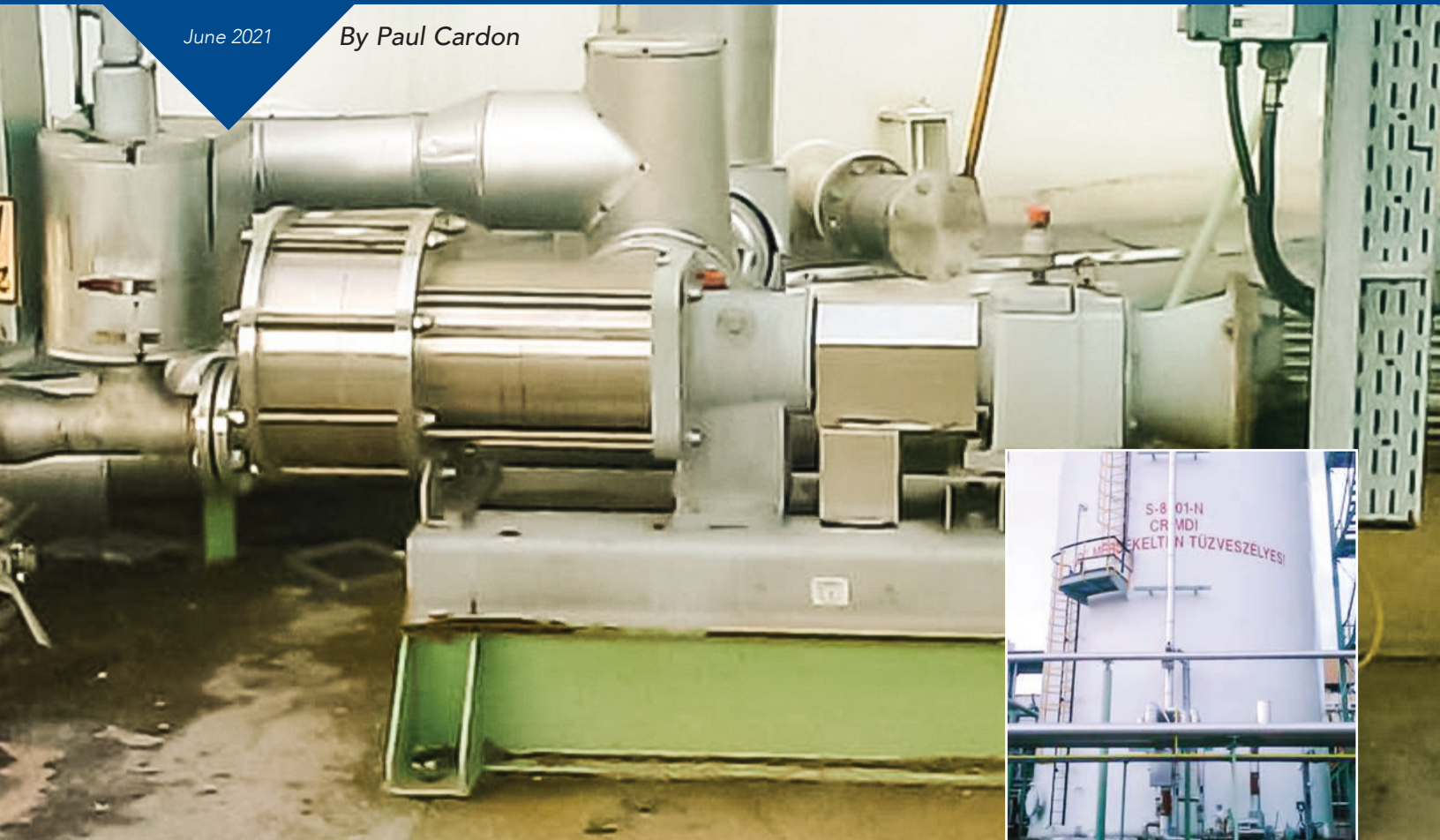


Isolating the Best Pumping Option for Isocyanates

Seal-less eccentric disc pumps provide the strong suction, wear compensation and product containment needed for transferring dangerous isocyanates

June 2021

By Paul Cardon



A leading European producer of MDI and TDI has been running an eccentric disc pump without interruption or maintenance since its installation in 2005.

Introduction

In the early hours of December 3, 1984, water was able to enter a tank containing 42 tons of methyl isocyanate (MIC). The resulting exothermic reaction increased the temperature inside the tank to more than 200°C (392°F) and dramatically raised the atmospheric pressure. As a result, about 30 metric tons of MIC escaped from the tank into the atmosphere in less than one hour. The gases were blown by southeasterly winds over the Indian city of Bhopal, and the chaos that followed would result in the greatest industrial disaster in history.

The Bhopal gas tragedy, which originated at the Union Carbide India Limited (UCIL) plant in Bhopal, Madhya Pradesh, India, was reportedly responsible for 3,000 deaths within weeks of the leak, as well as another 8,000 people that have

since died from gas-related diseases. In a 2006 government affidavit, it was estimated that the toxic substance caused more than half a million injuries.

Theories vary on how water entered the tank in the first place. Some believe a disgruntled worker introduced water directly into the tank as an act of sabotage, while others cite management negligence. But one thing that is undeniable: the Bhopal gas tragedy demonstrates the destructive power of isocyanates if not properly handled and contained.

Isocyanates

Isocyanates are a family of highly reactive, low molecular weight chemicals. Methyl isocyanate is a monofunctional isocyanate, while the most widely used compounds are



The methyl isocyanate leak at the Union Carbide plant in Bhopal, India, is considered the greatest industrial disaster in history.

diisocyanates and polyisocyanates. Diisocyanates contain two isocyanate groups while polyisocyanates are usually derived from diisocyanates and may contain several isocyanate groups. The most commonly used diisocyanates include methylenebis (phenyl isocyanate), known as MDI, and toluene diisocyanate (TDI).

MDI and TDI are widely used in the polyurethane industry, including the manufacture of flexible and rigid foams, fibers, elastomers and coatings such as paints and varnishes. Isocyanates are being increasingly used in the automobile industry, as well as in auto body repair and building insulation materials. Spray-on polyurethane products containing isocyanates have been developed for a wide range of retail, commercial and industrial uses to protect cement, wood, fiberglass, steel and aluminum, including protecting coatings for truck beds, trailers, boats, foundations and decks.

The Risk and Results of Exposure

Isocyanates are powerful irritants to the mucous membranes of the eyes and gastrointestinal tracts. Direct skin contact can also cause marked inflammation. Isocyanates can sensitize workers, making them subject to severe asthma attacks if they are exposed again.

The most common occupational exposure to isocyanates is inhalation of the vapor or aerosol, although exposure may occur through skin contact during the handling of liquid isocyanates. Exposure typically occurs during the production and use of isocyanates, particularly during the manufacturing process in the polyurethane foam industry. This includes the pumping of isocyanates.

Isocyanates are toxics and pollutants, but they can also be flammable as well. While their flammability is low, specific concentrations or the presence of explosive vapors or other flammable liquids on the same site can create a hazardous environment for workers as well as the community, as referenced earlier in the Bhopal example.

To safely transfer and contain isocyanates, operators must choose the correct pumping solution for this application. Given their unique properties, isocyanates requires a pump that handles product gently (low shearing), has strong suction capability, and offers a low-maintenance wearcompensation design. Various technologies can be used to transfer isocyanates, but the safest and most efficient pumping solution that meets all of the above criteria is the eccentric disc pump.

Advantages of Eccentric Disc Pumps

Eccentric disc technology provides less risk and more efficiency than other pumps, including mag-drive gear pumps, which are commonly used in handling MDI. The advantages of using eccentric disc over gear starts with its unique design.

- **Design** – Eccentric disc pumps consist of a stationary cylinder and mobile disc. The disc is moved by an eccentric shaft housed inside a bellows end, which holds the disc. As the eccentric shaft is rotated, the disc forms chambers within the cylinder, increasing at the suction port and decreasing at the discharge port. During operation, the discharge pressure exerts itself against the eccentric disc, preventing it from slipping. The low slip between the disc and cylinder gives eccentric disc pumps their ability to strip, or clear, lines of product, key advantages over gear pumps.

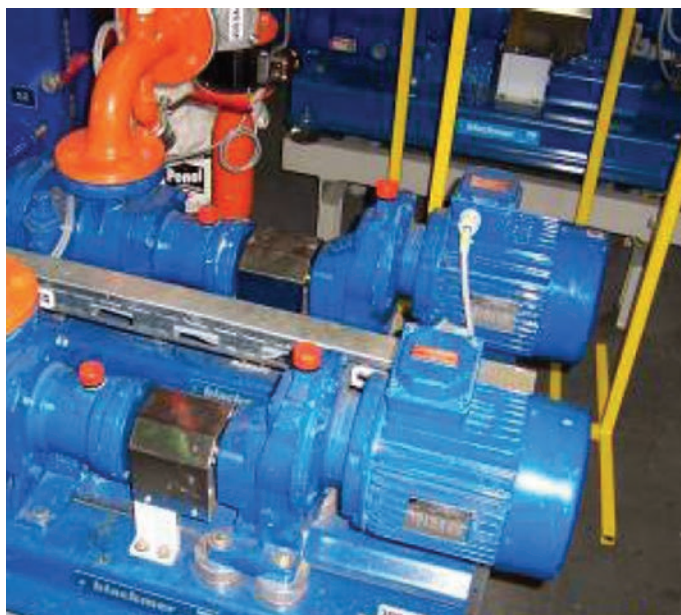
Isocyanates are toxic by nature so they require sealless pumps to eliminate leaks and provide maximum product containment. Both eccentric disc pumps and



This eccentric disc pump has successfully handled polyurethane paints made from MDI at an automotive paint plant since 2001.

mag-drive pumps are seal-less. Mag-drive gear pumps utilize a magnetic coupling to create a static shaft seal rather than packing or mechanical seals, while eccentric disc pumps have no magnetic couplings, packing or mechanical seals, which eliminates a potential leak point that can lead to failure.

- **Strong Suction** – When transferring MDI in truck or railcar loading and unloading, for example, it's important to have a pump capable of clearing lines. As isocyanates are a highly toxic pollutant, it makes loading and unloading much safer and cleaner as hoses and pipes are emptied prior to hose disconnection at the end of the transfer. Eccentric disc pumps also feature superior suction at low speeds, ensuring a minimum of product is left in the piping prior to proceeding with any maintenance.
- **Low Shear** – Isocyanates are dilatant liquids, meaning that when they are subjected to high shear and agitation, their viscosity tends to rise. Gear pumps by themselves shear more liquid than eccentric disc pumps, which can lead to overheating and blockages. The end result is pump failure and downtime. This is a problem more common with gear pumps, but cannot happen with eccentric disc pumps due to their low shear rate as well as consuming more energy.
- **Limited Regular Maintenance** – The transmission oil in an eccentric disc pump only needs to be changed every 24,000 hours or 2.7 years for 24/7 duty. This is essential for isocyanate applications since these pumps are generally operated on a 24/7 basis. As a matter of fact, isocyanates cannot be left static in a tank as they then tend to solidify. So when a pump isn't loading or unloading a tank truck or railcar, it needs to continually circulate the product in the storage tank.

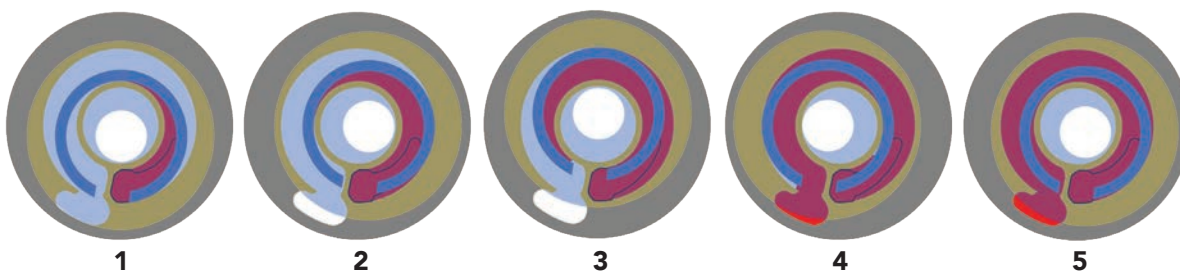


Eccentric disc pumps can be used in tank truck unloading of toxic vapors due to its seal-less design.

Mouvex SLC Series, C Series and G-FLO Series Eccentric Disc Pumps

Leading French eccentric disc pump manufacturer Mouvex, Auxerre, France, features three pumps series that are ideally suited for isocyanate transfer—the SLC Series, C Series and G-FLO Series Eccentric Disc Pumps, all based on Mouvex's eccentric disc technology. They require no magnets, mechanical seals or packing, and are ATEX-rated and TA Luft-certified to handle the most dangerous properties in the most explosive environments. They pumps are self-priming, have line-stripping capabilities, can run dry for up to 10 minutes, have a low shear rate, as well as a high vacuum and compression effect. Both also have a reduced number of components, which leads to reduced maintenance. SLC models are available in stainless steel, C Series pumps are available in stainless steel and ductile iron, and G-FLO Series are available in stainless steel. All of these models are suitable for handling any type of isocyanate.

Mouvex Principle



Eccentric disc pumps consist of a cylinder and pumping element mounted on an eccentric shaft. As the eccentric shaft is rotated, the pumping element forms chambers within the cylinder, which increase in size at the intake port, drawing fluid into the pumping chamber. The fluid is transported to the discharge port where the pumping chamber size is decreased. This action squeezes the fluid out into the discharge piping.

Conclusion

The Bhopal disaster demonstrated the hazards involved with handling isocyanates. In today's manufacturing environment, particularly in the polyurethane industry, isocyanates are one of the most important compounds within the production process. Many short- and long-term risks are involved with handling isocyanates. Therefore, operators need the peace-of-mind that only eccentric disc pumps can deliver.

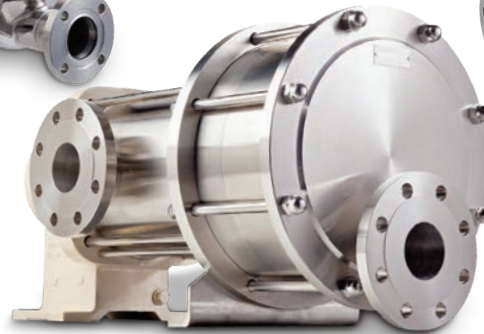
Eccentric disc pumps are low-maintenance and deliver the superior wear compensation, strong suction and low shear that is mandatory when handling this dangerous chemical. Mouvex is leading the way in safe isocyanate transfer with its SLC Series, C Series and G-FLO Series Eccentric Disc Pumps.

About the Author:

Paul Cardon is Business Development Manager PSG Auxerre - FRANCE. He can be reached at (+33 6 88 70 22 90) or paul.cardon@psgdover.com. Mouvex is a product brand of PSG®, a Dover company, Oakbrook Terrace, IL, USA. PSG is comprised of leading pump brands, including Abaque™, All-Flo, Almatec®, Blackmer®, Ebsray®, em-tec, EnviroGear®, Griswold®, Hydro Systems, Mouvex®, Neptune™, Quattroflow™, RedScrew™ and Wilden®. You can find more information on PSG at psgdover.com. Headquartered in Auxerre, France, Mouvex® is a leading manufacturer of positive displacement pumps, screw compressors and hydraulic coolers for use in the refined-fuels, oilfield, energy, food/sanitary, military, transport and chemical process industries worldwide. For more information on Mouvex, please visit mouvex.com.



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