ATEX: The Symbol of Safety in Dangerous Chemicals Handling

Safety-conscious chemical companies are making ATEX-certified pumps and equipment mandatory in their day-to-day operations.

By Edison Brito

Legislation and regulations have been implemented in the chemical industry as a direct result of accidents that could have been prevented if companies had followed necessary safety precautions. This includes the classification, labeling and packaging of chemicals that could potentially pose a threat. For example, in 1967, the Dangerous Substances Directive (67/548/EEC) was passed, and its orange-and-black hazardous substance symbols became instantly recognizable to anyone in the world who was handling these hazardous chemicals—anything from basic cleaning products to acids. However, this applied to Europe only, and as a result, the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS) was created in 1992 and standardized by 2000.

In Europe, the most important legislation introduced in recent years has been Registration, Evaluation, Authorization and Restriction of Chemicals—better known as REACH. Implemented in June 2007 by the European Union, REACH replaced 40 existing directives. There are 73 substances on the Substance of Very High Concern (SVHC) candidate list. The regulation puts greater responsibility on the industry to manage the risks of chemicals and provide safety information on the substances. However, REACH remains a work in progress.

One other way that the chemical industry is creating a safer environment is through certifications. Equipment must meet certain standards to gain certification and must be considered safe to handle known dangerous chemicals—such as acids, solvents and caustics. In the past, the CE symbol was the recognized symbol for safety. Since 1993, the CE mark has been a mandatory conformity marking for products sold in the European Economic Area. The CE mark indicates that a product conforms to essential health and safety requirements set in European Directives. In recent years, one symbol has joined CE as a trusted symbol of safety: "Ex," better known as ATEX.

ATEX

The ATEX directive is meant to protect employees and the surrounding communities from the risk of explosions. Deriving its title from the French Appareils destinés à être utilisés en ATmosphères EXplosives, ATEX consists of two European Union directives: one for the manufacturer (ATEX 95 equipment directive 94/9/EC) and one for the end user (ATEX 137 workplace directive 99/92/EC).

In July 2003, the EU made the following ATEX directives mandatory for organizations within the EU. Equipment in use before July 2003 can still be used, although a risk assessment showing that the equipment is safe is required. Equipment that is capable of causing an explosion through the equipment's own potential sources of ignition falls under this mandate. Examples of these types of equipment are any machine, apparatus, fixed or mobile device, control component and instrumentation intended for the generation, transfer, storage, measurement and conversion of energy and/or processing of material.

Hazardous area atmospheres are classified into zones based on size, location and the likelihood of an explosion. Zones 0, 1 and 2 specify gas-vapor-mist, while zones 20, 21 and 22 specify dust. These classifications dictate that those properties be protected from sources of ignition. Zones 0 and 20 require Category 1 designation—the highest risk of an explosive atmosphere being present. Other categories are Zones 1 and 21, which fall into Category 2. Zones 2 and 22 require Category 3.

ATEX 95 directive 94/9/EC is designed to allow the free trade of ATEX-conformed equipment and protective systems within the EU by removing the need for separate testing and documentation for each member state. The regulation applies to all equipment intended for use in explosive environments, including electrical and mechanical. Equipment affixed with the "CE" marking and the "Ex" marking certify that the piece of equipment can be sold anywhere within the EU without further requirements.

Some of the most common areas in which a potentially explosive atmosphere could exist include offshore platforms, petrochemical plants and mines. Three preconditions are required for the ATEX directive to apply. First, the equipment should be intended for use in a potentially explosive environment. It should also be under normal atmospheric conditions. Finally, the equipment must have its own effective source of ignition.

IGNITION SOURCES

The ATEX directive defines an effective ignition source as an event that—in combination with sufficient oxygen and fuel in gas, mist, vapor or dust form—can cause an explosion. Many ignition sources must be taken into account by end users, including:

- Lightning strikes
- Open flames and hot gases
- Arcs and flashes
- Electrostatic discharges
- Electromagnetic waves
- Ionizing radiation
- Hot surfaces
- Mechanically generated sparks
- Optical radiation
- Chemical flame irritation

Electrostatic discharge, for example, is considered one of the greatest hazards when handling dangerous chemicals. In this process, static electricity is generated by surface friction when chemicals come in contact with other materials. Typically, this occurs when the product is moved or transferred through pipes, filters, mixers and/or pumps. Static electricity may accumulate in the liquid (liquid hydrocarbons, in particular). This can lead to sparking in a flammable, vapor-air mixture.

Ignitable discharges can occur between an insulated or earthed conductive object and a charged, insulated conductive or non-conductive object. Avoiding electrostatic discharge starts with selecting the right equipment to transfer those chemicals—equipment that meets the criteria of the ATEX directive.

A PUMP'S ROLE IN SAFE CHEMICAL TRANSFER

Dr. Georg Baum is the owner of CTB-Chemical Technologies, a Germany-based company that supplies systems and solutions for the safe transfer of hazardous material in chemical plants. As an authority on the subject of safe, ATEX-compliant chemical transfer applications, Dr. Baum stresses three factors when selecting a pump for dangerous-chemical transfer.

"One important point is the compatibility of the material with the chemical," Dr. Baum said. "The second factor is, if we use solvents, for example, we must use the appropriate pump that won't cause an ignition. This means using pumps with electric conductive material. The third factor is suction capability."

One pump technology that meets all Baum's criteria is ATEX-certified, solid-body, air-operated double-diaphragm (AODD) pumps, which can be built using conductive plastic materials. This technology offers the material compatibility and strong suction that other pump technologies cannot. The many factors to consider when selecting an AODD pump for a dangerous-chemicals application are discussed in this section.

Material Compatibility

Matching the proper pump to the materials being transferred starts with the housing. Pumps made of polyethylene (PE) have better wear resistance than pumps made of polypropylene (PP), enabling the units to transfer highly abrasive chemicals. Polytetrafluoroethylene (PTFE) construction, on the other hand, provides the superior chemical resistance necessary in dangerous-chemical transfer. Operators should also focus on the materials of construction for a pump's internal components. Diaphragms made of ethylene propylene diene monomer (EPDM), PTFE/EPDM-composite or nitrile rubber (NBR) feature large diameters and short strokes with low flexural loads, which ensure uniform delivery regardless of chemical properties.

Conductive Materials

Pumps with non-conductive housing materials are susceptible to electrostatic discharge. Static can accumulate in liquid being moved or transferred through a non-conductive pump, leading to sparking in a flammable, vapor-air mixture. Pumps with conductive PE or PTFE housing are preferred in explosion-proof areas in which flammable liquids are present. These conductive PE and PTFE housings enable pumps to meet ATEX requirements.

Strong Suction (Self Priming)

Totes or barrels of chemicals are often placed at ground level in protective cabinets with pumps located on the top or to the side of these containers. Strong suction is imperative. AODD pumps, by their nature and design, provide sufficient suction to draw fluids from tanks regardless of location. Other technologies, such as centrifugal pumps, require fluid pressure into the impeller to create suction and flow. Operators should also consider that AODD pumps offer superior containment, shear-sensitivity and run-dry capabilities over other pump technologies.

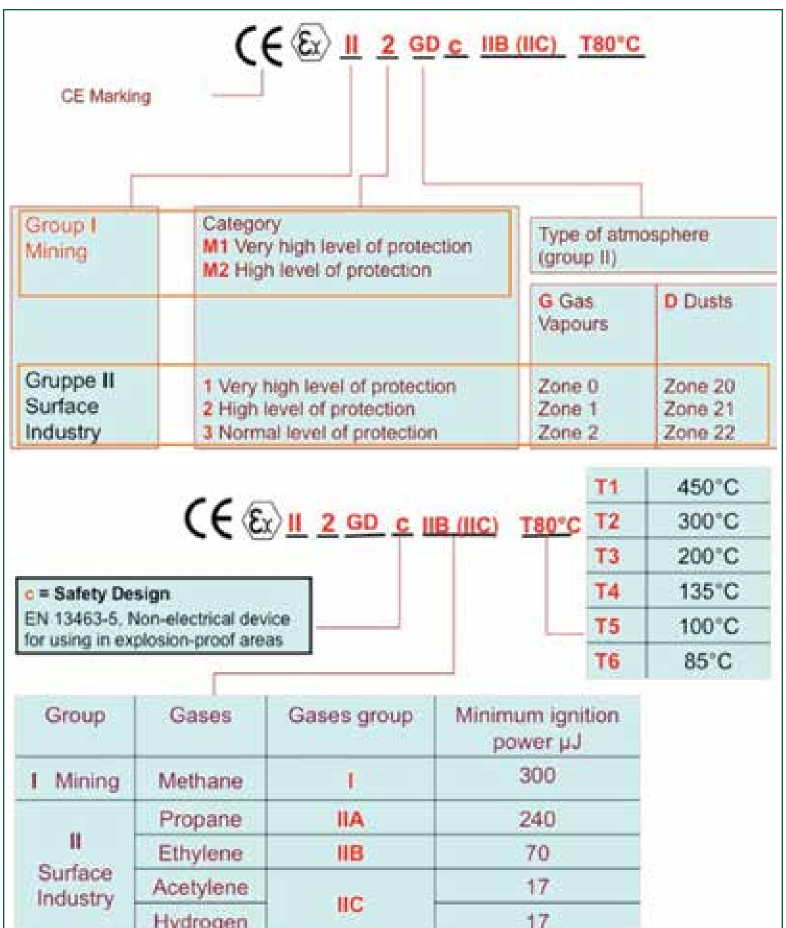

Figure 1. ATEX 94/9/EG directive requirements

Solid-Body Construction

Solid-plastic-block machining increases the pump's strength and life cycle while eliminating maintenance concerns. A computer numerical control (CNC) machined solid block of PTFE or PE allows the pump to deal with the harshest environments. Plastic injection-molded construction, by comparison, deforms in harsh environments, creating a potential leak path when the temperature varies—regardless of how tight the bolts are torqued. However, with solid-plastic-block machining, no crevices exist for a potential leak path. It is also more robust, and the integrity of the material is stronger. In addition, CNC technology enables tight tolerances, with reduced vibration and greater stability and durability.

Containment

Containment is another important consideration when selecting a pump that will effectively handle and transfer dangerous chemicals. Mechanical seals found in centrifugal pumps, progressive cavity pumps and gear pumps can be prone to failure. Seal failure can lead to bearing failure, which results in costly downtime

Robust AODD pump technology meets all the ATEX criteria.

and unscheduled maintenance. The safest way to avoid seal failure and avoid product contamination is by removing the seal from the equation. AODD pumps are free of mechanical seals and are designed so that the diaphragm acts like a seal. When matched with materials that are appropriate to the chemical being pumped, the diaphragm acts as a gasket, which is not subject to wear from shaft friction.

Run Dry

Friction can lead to static discharge, which in turn creates a dangerous environment. When handling chemicals, operators will continue to operate the pump—even after the chemical has been depleted—to more fully clear the lines. This is known as running dry. When certain pump technologies run dry, their components can burn and seize, creating a dangerous situation when hazardous chemicals are involved. AODD pumps are designed to run dry. When the fluid is depleted, they pump air with no damage to the pump internals.

Shear Sensitivity

Pumps that have a propensity for shearing or damaging the product typically have meshing teeth or introduce the fluid to multiple moving parts. When transferring chemicals, providing gentle handling to eliminate any change to the chemical properties is critical. AODD pumps are considered one of the gentlest pumping technologies available because the fluid is simply drawn into a chamber and then pushed out without contacting moving parts.

Deadheading

Many chemical applications require accurate flow rates to maintain the consistency and quality of the product. To maintain this consistency, valves on the discharge side of the pump close swiftly, interrupting the product flow. This creates a jolt to the pump, also known as deadheading. AODD pumps are designed to handle such start-and-stop deadhead conditions without any adverse effects to the product or the pump.

ROBUST AODD PUMP TECHNOLOGY

One robust AODD pump technology meets all the ATEX criteria. This technology features housing constructed of PE, PTFE, PE-conductive material and PTFE-conductive material. The PE-conductive and PTFE-conductive pumps meet the requirements of the ATEX 94/9/EG directive (see Figure 1).

For use in device group IIC without additional protection measures, these plastic AODD pumps also feature electrically conductive PTFE diaphragms to provide safer transfer of chemicals while avoiding dangerous electrostatic discharge. They continue to pump even after the chemical has been depleted.

By comparison, other pumps require operators to pump nitrogen, water or carbon dioxide after the fluid transfer has been completed to avoid potentially dangerous electrostatic discharge. These plastic AODD pumps pump air with no damage to the pump internals. The pumps' diaphragms have a large diameter and short stroke with low flexural load, ensuring uniform delivery regardless of the diaphragm's material of construction. The EPDM diaphragms are conductive as standard.

They are available in seven sizes, from 6 to 76 millimeters (¼ inch to 3 inches), with maximum temperatures to 120 C (248 F). The pumps feature maximum flows to 800 liters per minute (210 gallons per minute); suction lift to 5 meters (16.4 feet), dry, 9.5 meters (31.2 feet), wet; and maximum solids sizes to 15 millimeters (9/16 inch).

CONCLUSION

Chemical plants have a great responsibility to take every necessary precaution to protect their employees and the surrounding communities. During the past half-century, legislation has been put in place because of a number of preventable chemical accidents. While adhering to these rules remains mandatory, chemical companies worldwide need to consider installing ATEX-conformed equipment as standard, despite it only being required in the EU. ATEX is widely considered the accepted symbol of safety, and using ATEX-rated pumping equipment can provide operators with the peace of mind they need to work in potentially dangerous environments. **P&S**

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