

■ A compressor for development and validation of hydrogen purification equipment. The skid contains three compressors, two, two-stage and one duplex machine. The Skid contains a closed-loop water cooling system and water separation system. The pipes are welded.

A BREATH OF FRESH AIR

Pdc Machines Is Compressing Its Way to a Cleaner Future

By Gay Walley

Pdc Machines started in 1977 in the Warminster, Pennsylvania, U.S.A., garage of Syed Afzal. It was originally a one-man business, dedicated to trouble-shooting diaphragm compressors, reactors and other high-pressure equipment. Under his vigilant leadership, Pdc quickly grew. Now it is a multimillion dollar company, supplying a thriving line of high-pressure equipment to the chemical, petrochemical, gas and pharmaceutical industries. Pdc today occupies 30,000 sq.ft. (2787 m²) of floor space and houses 34 employees. Its manufacturing area has the latest in state-of-the-art machinery and a full testing area. What are they manufacturing now? Proprietarily designed diaphragm compressors, syringe pumps, reactors, magnetic stirrers and skid-mounted pilot plants.

Pdc's products are marketed to a wide variety of customers in different industries. Some of their customers include Air Liquide, Air Products and Chemicals, BOC, ChevronTexaco, Dow Chemicals, E.I Dupont, ExxonMobil, Fiba Technologies, General Electric, Hydrogenics (Stuart Energy), Praxair, Rohm & Haas, Shell, Teledyne Energy Systems and many others.

Much of Pdc's business is servicing

the hydrogen processing area. This area has grown because of today's worldwide push to convert to a hydrogen-based economy so as to reduce our dependence on oil as well as control pollution in the atmosphere. Pdc helps service the cause by providing diaphragm compressors for many different applications within this diverse field. Its compressors are being used by hydrogen generation companies, gas producers, automobile manufacturers, government affiliations and universities.

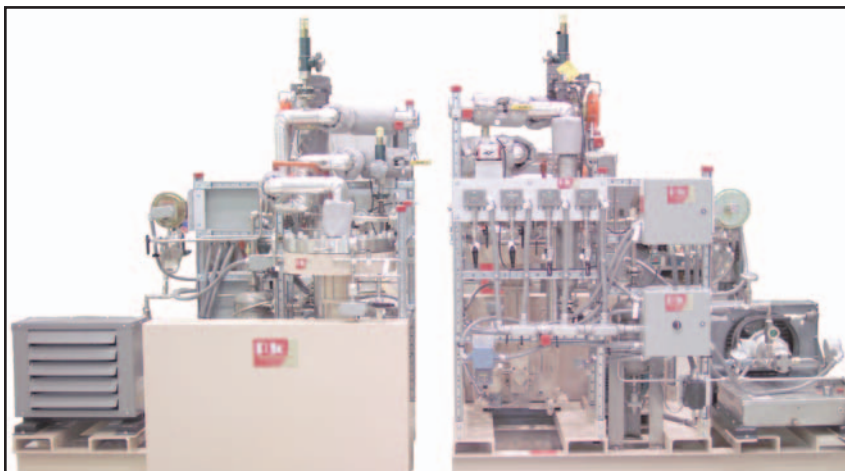
According to the company, Pdc's diaphragm compressors are ideal for compressing rare, ordinary and toxic flam-

mable gases without incurring any contamination of the process media or leakage of the gas to ambient air. Pdc's compressor design addresses the growing demand for processing high-purity and difficult-to-handle gases as well as the need for protection of the environment and the health and safety of workers. Applications include filling and off-loading of gases from tube trailers; filling gas cylinders and bulk storage tanks; and life cycle testing of onboard tanks; feedstock for chemical, petrochemical and pharmaceutical industries.

The reason why Pdc's diaphragm compressors are such a dominant force, the company said, is due to



■ The 175 hp package, with a suction pressure of 400 psi (27.6 bar) maximum and discharge of 500 psi (34.5 bar). Flow rate is 2000 SCFM (3170 Nm³/hr). This is a stand-alone system with several shutdown alarms, transmitters, flow control valve, ASME Code Section VIII inlet and outlet tanks and filters. Two duplex compressors with one as back-up. The compressor offers an automatic unloading system. Electrical classifications are to European standards.



■ Pdc's sour gas compressor utilizes a closed-loop water cooling system and crankcase heater and heat-traced oil piping and lower heads for cold temperatures. The compressor is designed to plant specifications.

several operational benefits. These benefits include compressing gases at the pressures and purity needed, high reliability and up-time, low maintenance, very quiet operation and lower power consumption. In order to achieve these ongoing operational benefits, for many years, Pdc has conducted extensive research to develop new techniques in cavity contour designs and manufacturing processes.

At Pdc, all aspects of diaphragm compressor design are intended to enhance component life. Diaphragm cavity contours, which control stress in diaphragms, are carefully controlled to provide uniform stress distribution. Special processing is used on the diaphragm surfaces to enhance fatigue life. As a result of these efforts, customers have reported between 10,000 to 40,000 hours of continuous 24/7 operation without any diaphragm or spare parts replacement.

The hydraulic system is designed in such a way to assure uniform diaphragm deflection, prevent cavitation and yield smooth, quiet compressor operation. Unique oil distribution techniques are employed to eliminate pressure differentials and gradients. The system utilizes an automatic priming pump, a positive displacement high-pressure injection pump, and an oil relief valve with bypass valve for easy starting.

Another key area Pdc builds compressors for is the pilot plant industry. This area of their business is in response to the recent changes that have taken place in the chemical and petrochemical sector. An increase in demand on research for new products and improvements to existing products, coupled with downsizing and mergers, has left many companies to outsource the fabrication of their

process systems. Much of Pdc's business is supplying on a turnkey basis skid-mounted systems ranging from simple laboratory bench scale to complex computer-controlled pilot plant and mini-plants. "The pilot process plants are self-contained, and are essentially plug-and-play by the end user," said Osama Al-Qasem, sales and marketing manager.

The pilot plants are equipped with the latest advanced instrumentation and control packages which provide precise data acquisition to automatically record and manipulate multiple process parameters in such ways as data logging, alarm monitoring, real-time and historical trending, etc. These features are essential for predictable and repeatable process performance and scale-up.

Some of the applications its compressors are working in are hydrogen

demonstration fueling stations for vehicles and buses; fueling fuel cell-powered cars, buses and forklifts; power back-up using hydrogen fuel cells for telecommunication towers and power plants; and residential re-fuelers for fuel cell cars and power generation.

Pdc also entered this market in Europe by being the first company in the United States to manufacture diaphragm compressors in accordance with European CE, ATEX and PED regulations. In accordance with the Clean Urban Transportation Europe (CUTE) project, one of Pdc's compressors is operating in Madrid and another is destined for Stockholm, both for refueling demonstration buses with hydrogen. A third compressor will be placed in Athens and will be powered by wind-generated electricity.

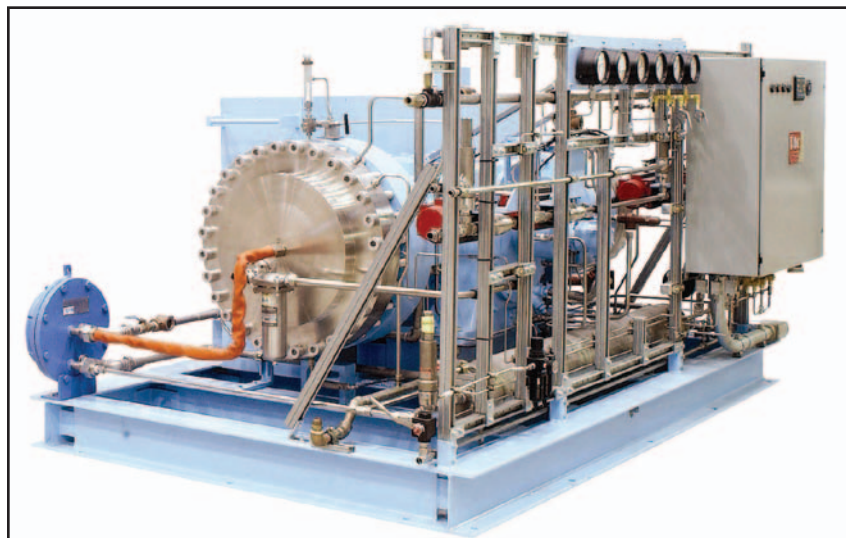
"Today, Pdc holds over 80% of the fuel cell market where there is a need to compress hydrogen gas at the purity and pressures needed within this industry," explained Al-Qasem.

What is the secret of their success in this market? Uniquely designed diaphragm compressors.

As the fuel cell market continues to look for higher and higher discharge pressures, Pdc already has the experience in designing compressors reaching as high as 40,000 psi (2757 bar).

Pdc has developed a crank-case that is specifically geared for the needs of the fuel cell market. Some of its attributes include high compression ratios, lower flows, reduced energy consumption, no water cooling, and a more compact and quiet design (less than 85 dbA at one meter). ■

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■ A 150 hp duplex compressor, boosting pressure from 3000 psi (205 bar) to 6000 psi (412 bar) and a flow rate of 2000 Nm³/hr. This fully automated compressor system conforms to European CE requirements.