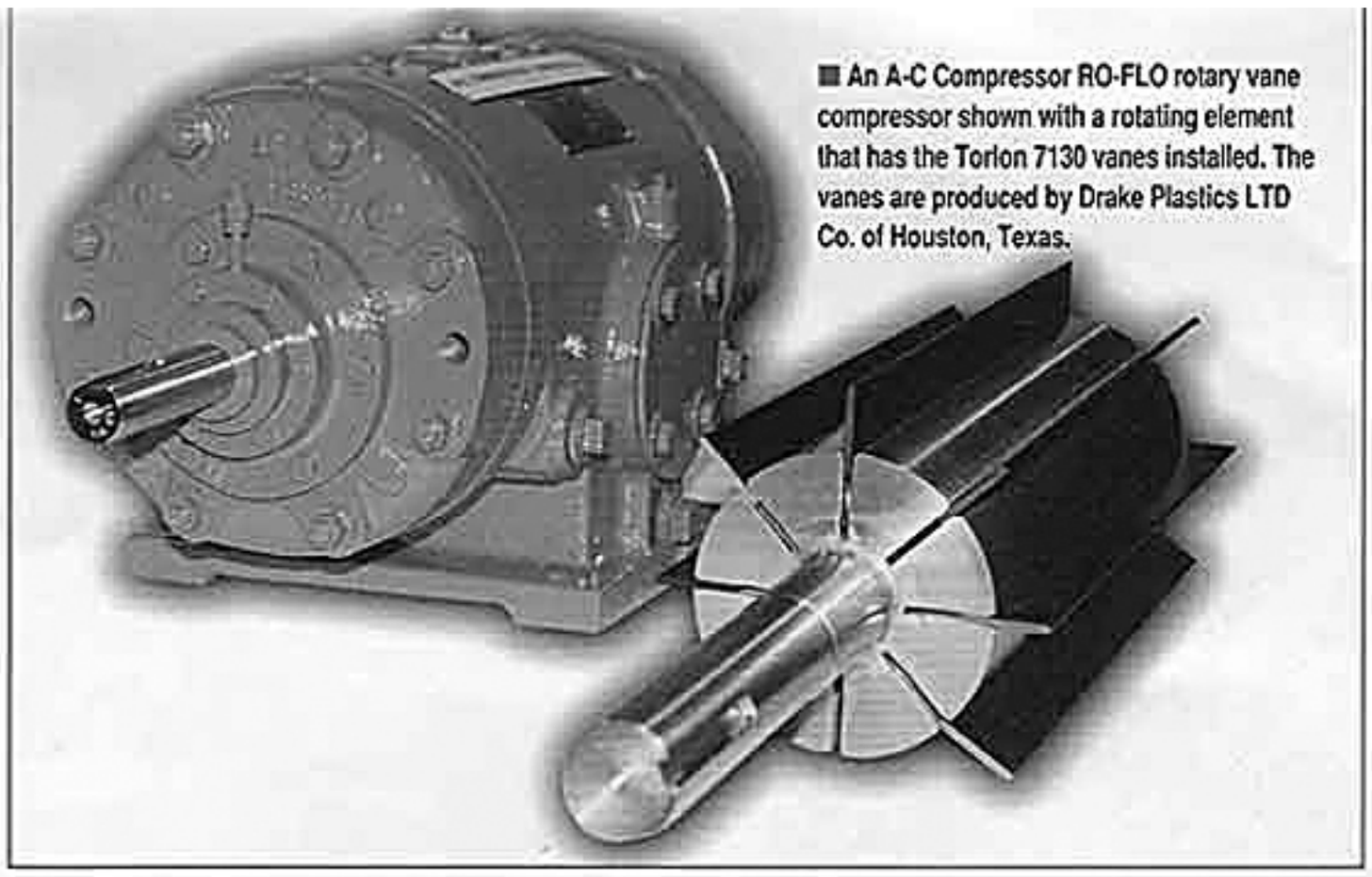


■ An A-C Compressor RO-FLO rotary vane compressor shown with a rotating element that has the Torlon 7130 vanes installed. The vanes are produced by Drake Plastics LTD Co. of Houston, Texas.

Torlon Blade Material Promises Longer Wear Life And Reduced Oil Consumption For Rotary Vane Compressors

Drake Plastics Develops Extrusion Process to Produce Highly Durable Vanes Using BP/Amoco Chemicals' Torlon 7130 Poly Amide-imide Material

By Jake Elliott

In this age when equipment reliability is expected and cost reduction a must, the term "lower operating costs" is a command to be observed. This situation, often troublesome for plant engineers and users of compression equipment operating with high temperature gases and in harsh environments, provides opportunities for those who invest their time and talents to find solutions to such problems.

One such case involves rotary vane compressors, where a material upgrade in the key working component, the blades, offers a performance leap comparable to the turbocharging of naturally aspirated engines. Rotary vane compressors are used primarily for medium volume and medium-pressure gases in various applications such as hydrocarbon services, vapor recovery, digester gas (waste water treatment) and various other gas compression services.

Rotary vane designs are positive displacement compressors having a rotor eccentrically mounted inside a cylinder. The rotor is fitted with blades, or vanes, that are free to move radially in and out of longitudinal slots. The blades are forced out against the cylinder wall by centrifugal force, creating individual cells of gas that are compressed as the rotor turns. The compressors are driven by either electric motors or engines.

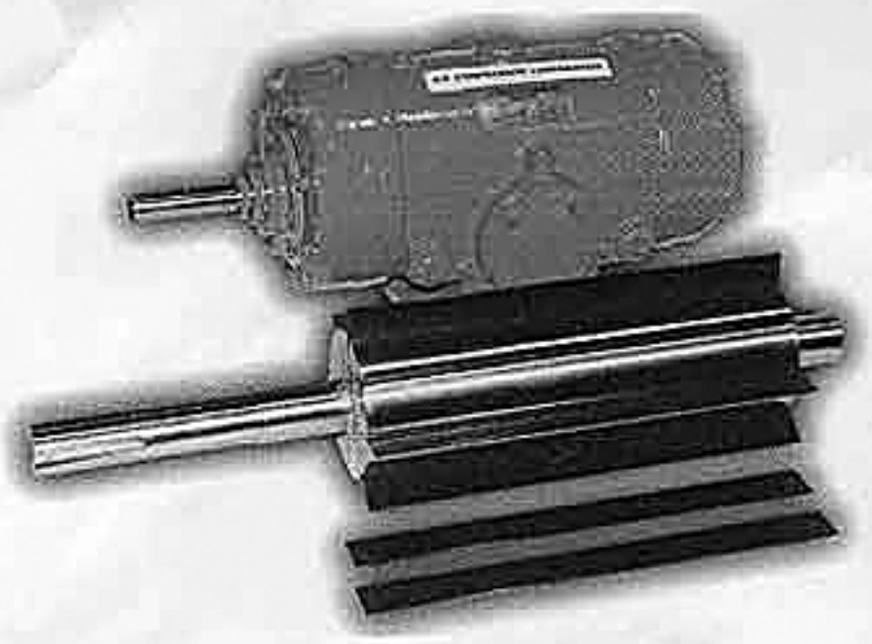
Historically, compressor vane materials have been made of phenolic laminated composites, including phenolic/asbestos, impregnated with oil. Aside from potential asbestos content, the primary shortcoming of vanes produced from these materials is the relatively short service life, approximately 12 months in most applications and often less when subjected to hot or abrasive gases.

With state and Federal government agencies scrutinizing the use of asbestos, and with the negative connotation that accompanies the name, as well as the performance shortcomings of laminated blades in general, it naturally fell upon industry to find other materials to replace them. In the case of rotary vane compressor manufacturers, other vane materials such as thermoplastics have been experimented with, but essentially all lose their stiffness when exposed to temperatures over 300°F (150°C). Thermoplastic materials have been tested and found undesirable by one U.S. compressor OEM, A-C Compressor Corporation in Appleton, Wisconsin, U.S.A. Its testing of scores of reinforced PEEK, PPS and other thermoplastics all exhibited deformation of the blades at 2800 psi (193 bar) bending stress and 300-400°F (150-204°C) gas discharge temperatures. The resulting failures were caused by the blades jamming in the rotor slots.

Drake Plastics LTD Co., located in Houston, Texas, U.S.A., and founded in 1996, has developed an extrusion process technology that uses BP Amoco Chemicals' Torlon 4301 and 7130 resins to extrude vanes on-size for the various rotary vane compressors being manufactured. Drake Plastics is owned and managed by Steve Quance, who spent the past 11 years as manager of advanced materials for DSM Engineering Plastic Products, Inc., formerly Polymer Corporation, and as production and business development supervisor for Gates Rubber Company's Molded Products Division.

The Torlon 7130 material, which is reinforced with 30% graphite fiber, has been found superior to the phenolic/laminated material in several ways. It contains no asbestos, and retains its stiffness qualities in severe service applications and where operating temperatures up to 400°F (204°C) are encountered. "In addition," Quance said, "Torlon vanes are tracking to provide at least two to three times longer wear than asbestos laminates. With the material's natural lubricating qualities, a potential savings of 50% or more in lubricating oil can be achieved as a result of Torlon's low coefficient of friction. Torlon also has a very low moisture absorption relative to laminates. This translates into dimensional stability, another problem that plagues laminate blades and haunts users."

The flexural strength of Torlon 7130 is 50,700 psi (3564 kg/cm²) at room temperature and 25,200 psi (1772 kg/cm²) at 450°F (232°C), tested hot. This compares to 20,000 psi (1406 kg/cm²) at room temperature and a 50% retention at 392°F (200°C), tested hot, for the phenolic/asbestos laminate material. Likewise, the flexural modulus at room temperature for Torlon 7130 is 2,880,000 psi (202,464 kg/cm²), compared to 1,500,000 psi (105,450 kg/cm²) for the laminates. Tested hot at 392°F (200°C), the laminate has a 50% retention. Torlon 7130 tested 2,280,000 psi (160,284 kg/cm²) at 450°F (232°C). In summary, Torlon 7130 is significantly stronger and stiffer at 450°F than phenolic laminates are at room temperature.



■ The Torlon 7130 vanes, shown next to the rotating element, are extruded "on-size" by a special process developed by Drake Plastics, and then precision cut to meet the OEM's specifications. Torlon 7130 and 4301 resins are produced by BP Amoco Chemicals, Atlanta, Georgia. The Torlon vanes provide three times longer wear than do the current asbestos-laminate vanes.

We spoke with Mike Van De Voort, senior design engineer for rotary compressors at A-C Compressor in Appleton, Wisconsin, to determine its experience with the Torlon vane material. "We have been looking into the application of Torlon vanes supplied by Drake Plastics," Van De Voort said, "and have found Torlon to be a superior material compared to the phenolic/laminate vanes. Given our test results with our Ro-Flo Sliding-Vane compressors in wellhead gas service in west Texas, we project the life of the Torlon vanes to be around 30,000 hours, compared to the normal life expectancy of six-to-eight thousand hours for our standard vanes. We also had excellent results with the Torlon vanes in a series of tests we've run in the Bakersfield, California area.

"However," said Van De Voort, "the cost of the Torlon vanes is quite a bit higher than for phenolic vanes. For this reason, we will be offering the Torlon vanes as an option for severe services and to value conscious customers."

Van De Voort said that A-C Compressor will be exhibiting the optional Torlon vanes at the Canadian International Petroleum Conference in Calgary, Alberta, Canada, scheduled for June 11-15, 2000.

In relation to the higher cost of the Torlon vanes, Steve Quance told us, "Extruded Torlon vanes are more expensive than laminate vanes. However, we believe the higher cost is more than offset by the elimination of the asbestos problem, the dramatic improvement in service life, and the savings in lubricating oil consumption. These factors combine for a significant reduction in net operating costs. Torlon is a vastly superior product in applications where temperatures approach or exceed 300°F (149°C), where laminates tend to delaminate, and where the gases handled are abrasive, such as with wellhead gas and landfill gas, where laminates wear out."

Duncan Hogg, BP Amoco's product development manager for Torlon, stated, "Torlon's high strength, high temperature capability and friction and wear properties make it an excellent material for sliding vane applications. Few plastics are tough enough to be successful in these demanding services. Although technically proven, Torlon had been precluded from the majority of the sliding vane market because of the high cost of machining the vanes from Torlon stock. Drake Plastics eliminated the machining cost and yield problem by extruding the sliding vanes on-size. Drake's capability puts us in the position to propose Torlon as a cost-effective solution in a myriad of sliding vane equipment, from compressors, to air motors, to vacuum pumps, even pneumatic tools. We are very encouraged by A-C Compressor's decision to lead its market and meet the challenges of its customers by offering Torlon vanes. We will continue to do our part in support of these efforts." ■