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A Satisfying Solution

SMARTFLOW TECHNOLOGIES SOLVES THE PUMPING CHALLENGES FOR ITS OPEN-CHANNEL TFF SYSTEMS WITH SMOOTH-OPERATING QUATERNARY (FOUR-PISTON) DIAPHRAGM PUMPS FROM QUATTROFLOW™

By Dr. Andreas Frerix

Located in Apex, NC, USA, SmartFlow Technologies is a solutions provider focusing on customer separations problems and applying its open-channel tangential flow filtration (TFF) solutions as a component of the overall problem resolution. To help optimize these systems, SmartFlow Technologies utilizes Quattroflow™ Quaternary (Four-Piston) Diaphragm Pumps to ensure a smooth operation.

Chris Thomas, a Sales Manager with Triangle Process Equipment (TPE), Wilson, NC, USA, which is a distributor of processing equipment and systems for use in sanitary-manufacturing operations in the biopharmaceutical, cosmetic, and food and beverage markets, may have discovered a new axiom for the sales game: "The best way to a customer's heart is through his stomach."

"I do lunch-and-learn presentations where I'll come into a facility at lunchtime and talk about all of our pumping technologies because we sell all of them," Thomas explained. "I'll tell them here's what I recommend and why, the advantages and disadvantages of each, the cost differences, etc."

One of Thomas' mid-day excursions took him to the headquarters of SmartFlow Technologies in nearby Apex, NC, USA. SmartFlow is a solutions provider focusing on customer separations problems and applying its open channel tangential flow filtration (TFF) technology to resolve the challenges in the biopharmaceuticals, nutraceuticals, chemicals, food and beverages, water and renewable fuel markets. Recently, it has begun to address the in-process recovery applications in these markets, where either high value components are being lost in the process stream or the high cost of disposal makes the recovery cost effective.

QUICK FACTS

Company: SmartFlow Technologies
Location: Apex, NC, USA
Market: Biopharmaceuticals
Distributor: Triangle Process Equipment, Wilson, NC, USA
Challenge: Identifying and implementing a positive displacement pump style that operates more effectively in TFF-system applications for biopharm manufacturing
Solution: *Quattroflow™ QF1200S Quaternary (Four-Piston) Diaphragm Pumps*

SmartFlow, which was founded in 1989 as SRT, Inc., has accumulated more than 60 patents for its unique TFF platform that features open-channel design, equal flow paths through the multiple channels in the modules and the ability to incorporate virtually any flat-sheet membrane within the modules. The open-channel design enables precise control of the fluid stream at the membrane surface, with the ability to manage the fluid at the membrane surface producing higher flux rates.

SmartFlow's patented TFF-platform design also incorporates the use of transverse inlet and outlet ports. With this orientation, the fluid path's length is identical for each of the channels in the module, resulting in even flow through the module and total utilization of the membrane surface. The even flow pattern simultaneously eliminates dead spots or low-flow areas that can be found in other filter formats, with the even-flow pattern improving filter cleaning and resulting in a longer operational life cycle.

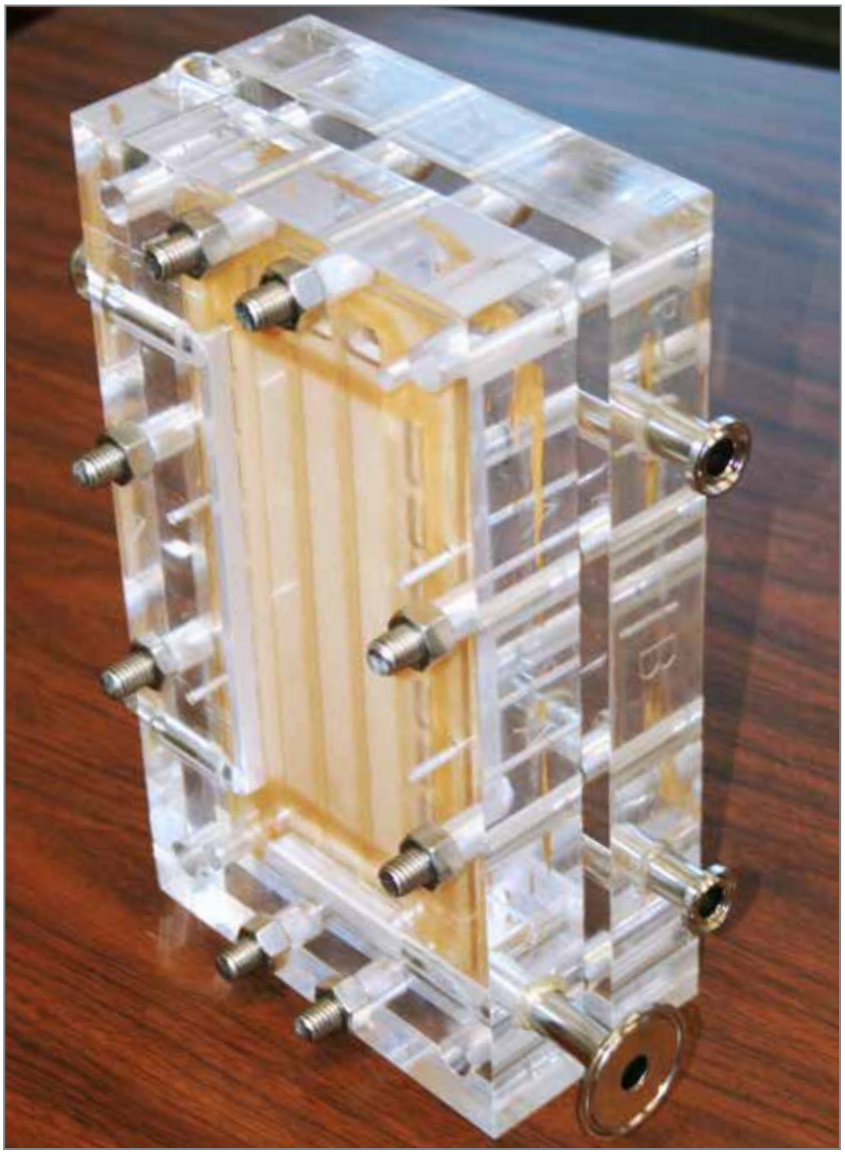
"Our business model is to basically have the customer send a sample of the material they are handling to us and we'll process it to get preliminary performance information so we can give the customer a feasibility report and budgetary estimate," said Mark Vander Hoff, Business Development Director for SmartFlow Technologies. "If they want to proceed further, we have three options to help them; they can purchase a small development system, they can rent a small development system, or they can use the SmartFlow Applications Development laboratories to develop an optimized process for them at a nominal fee. In each case, we recommend that they start by doing systematic process-development work—checking different membranes, observing a series of process parameters at different pressures, temperatures and flow rates. Basically, they create a matrix of performance-versus-process conditions and select the optimal operating range of process conditions. From there, because the SmartFlow TFF technology scales linearly, we can build up a detailed and very precise quote for their production scale TFF operation."

Satisfying A Hunger

Returning to Thomas' lunch-and-learn visit to SmartFlow, he found through his discussions with on-site personnel that the company was relying on various types of centrifugal or, more commonly, positive displacement (PD) pump technologies—most notably rotary lobe— for TFF systems that it was designing for biopharmaceutical-manufacturing applications. That being said, SmartFlow identified instances where the PD pump styles were not meeting the customer's needs.

"SmartFlow uses different pumps for different applications with the majority being PD pumps like rotary lobe or circumferential piston for high-pressure and low-to medium-flow applications, but the fact that they aren't self-priming, can't pump air and dry-running is a big problem because of the failures you can have," Thomas said. "They also avoided using a less-expensive technology, the peristaltic pump, because it has its own concerns. They may be seal-less, but they are typically pulsatile, the tubing can start to spall and they can only handle low pressures unless you use a more expensive tubing that can cost upward of $600 per foot."

As it turns out, Thomas had a competitive PD pump technology with him whose operation can provide the benefits



SmartFlow Technologies' open-channel design enables precise control of the fluid stream at the membrane surface, with the ability to manage the fluid at the membrane surface producing higher flux rates.

Mark Vander Hoff, Business Development Director for SmartFlow Technologies, appreciates that Quattroflow pumps feature linear-turndown capability that allows the user to change the membrane area by a factor of 10 and still successfully use the pump.

that SmartFlow was seeking to meet the identified customer needs: the Quaternary (Four-Piston) Diaphragm Pump from Quattroflow™ Fluid Systems, which is a leading brand from Almatec®, Kamp-Lintfort, Germany, a product brand of PSG®, a Dover company, Oakbrook Terrace, IL, USA.

The quaternary-diaphragm operation of Quattroflow pumps most closely resembles the workings of the human heart. This technology enables gentle pumping through soft "heartbeats," with each stroke of the four diaphragms delivered through an eccentric shaft that is connected to the electric motor. The result is a seal-less pump that offers low pulsation, superior containment, no particle shedding, variable and wide flow rates, self-priming and dry-run capabilities, quiet operation, compact design, clean-in-place/sanitize-in-place (CIP/SIP) ability, and minimal downtime and maintenance.

"The sweet spot for the Quattroflow pumps fills a void in biopharm or pharma-like manufacturing, such as with enzymes that are used for human or animal health, or enzymes that are not the final product, buffer media and cell-growth media," said Thomas. "Since the Quattroflow is seal-less it is a different animal in that you don't have a seal to fail. With other PD pumps, when the seal fails you can do $20,000 to $30,000 of damage in just a few minutes."

Perfect For Fluctuating Flow

Since Quattroflow pumps have no mechanical seal, are self-priming, can pump air and are dry-run capable, they are ideal for transferring 100 to 200 cP (water-like) low-viscosity fluids that don't contain a large concentration of particulates. This also made them ideal for the TFF systems that SmartFlow was creating for its biopharmaceutical clients.

"The thing we may appreciate most with the Quattroflow pumps is the linear-turndown capability over the full pumping scale," said Vander Hoff. "Other pumps will have different flow curves and have to operate in different areas in order to hit their sweet spot, but with Quattroflow someone can change the membrane area by a factor of 10 and you can still successfully use the pump. Consistency of performance is also important. Quattroflow pumps can generate 87 psi (6 bar) of pressure, so for protein purification it works very well as a feed pump in a larger system."

As previously mentioned, one of the unique services that SmartFlow offers its customers, especially the ones who operate with smaller production scales, is the rental of small lab-development TFF systems, outfitted with Quattroflow QF1200S Series pumps. The 1200S pumps have a flow-rate range of 6 to 1,200 L/hr (1.6 to 317 gph) and can handle pressures up to 6 bar at 20°C (87 psi at 68°F). They offer stainless-steel body construction with EPDM valves and TPE diaphragms.

"Our smaller customers may have three products in development, so the way we facilitate their research efforts is by renting them a small lab-development system, which enables them to complete their research efforts without the capital investment of purchasing a system," said Vander Hoff. "We use the QF1200S pumps on those pharmaceutical-rental systems and it's a nice little unit. What we like about the Quattroflow is it has very even flow, very low pulse. It's linear, it holds pressure well and it works very well in driving a TFF system."

In addition to the QF1200S, Quattroflow offers four other sizes of multi-use pumps: the QF150S with a flow rate of 1-180 L/hr (0.26-48 gph); the QF4400S (150-5,000 L/hr/40-1,321 gph); the QF5050S (50-5,000 L/hr/13-1,321 gph); and the QF20K (1,000-20,000 L/hr/265-5,283 gph). All models except the QF20K are also available in single-use versions that feature a product-wetted plastic pump chamber that can be replaced as a complete unit. Additionally, Quattroflow recently introduced the QF1200CV model for use in European markets. The QF1200CV, which is available in both multi- and single-use configurations, features a pump chamber, drive, motor and control that are integrated into one unit, making the pump ideal for use in labs that have strict space-use requirements.

Conclusion

All successful businesses possess a built-in hunger to deliver the best service and products to their clients. SmartFlow Technologies is no different and when the company sought out better solutions to the peristaltic or PD pumps it had as alternatives in some of its TFF systems designed for biopharmaceutical research, development and manufacturing, it was open to identifying and implementing an a new technology. Recognizing this, Chris Thomas and TPE were quick to recommend Quaternary (Four-Piston) Diaphragm Pump technology from Quattroflow. The result has been the satisfaction of the hunger that SmartFlow had to provide a better solution for its clients.

"In the end, the Quattroflow advantage was the fail safes its pumps provided to the customer," said Thomas. "If a valve was mistakenly not opened upstream, the pump could run dry. The customer also wanted to air blow the lines and the Quattroflow can do that. They also had shear-sensitive products that couldn't be damaged prior to filtration and the Quattroflow pumps handle the media very gently. Quattroflow has been a perfect choice for SmartFlow Technologies."

Quattroflow™ Quaternary (Four-Piston) Diaphragm Pumps incorporate a variety of design features that make them ideal for TFF-system applications for biopharm manufacturing.

About the Author:

Dr. Andreas Frerix is the Applications Manager Biotech/ Biopharma for Quattroflow™ Fluid Systems, the developer of positive displacement quaternary (four-piston) diaphragm pumps and a leading brand of Almatec®, Kamp-Lintfort, Germany. Dr. Frerix can be reached at andreas.frerix@psgdover.com or +49 2842 961 0. Quattroflow is also a product brand of PSG®, a Dover company, Oakbrook Terrace, IL, USA. PSG is comprised of several leading pump brands, including Abaque®, Almatec®, Blackmer®, Ebsray®, Griswold™, Maag Industrial Pumps, Mouvex®, Neptune™, Quattroflow™, RedScrew™ and Wilden®. For more information Quattroflow or PSG, please go to www.quattroflow.com or www.psgdover.com.

QUATTROFLOW™ Fluid Systems

quattroflow.com

PSG
ALMATEC Maschinenbau GmbH
Carl-Friedrich-Gauß-Straße 5
47475 Kamp-Lintfort, Germany
O: +49/2842/961-0 / F: +49/2842/961-40

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