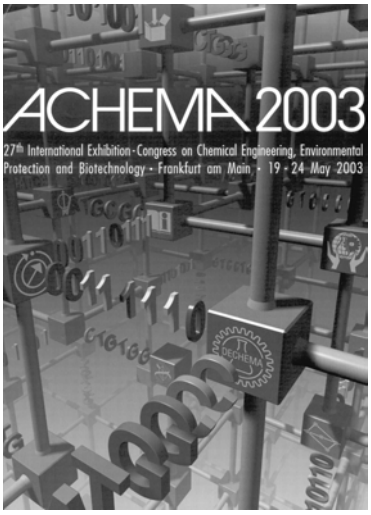


ACHEMA 2003
19–24 May 2003
Frankfurt am Main/Germany

The opening ceremony of the 27th ACHEMA was performed in the Congress Center at the Frankfurt Exhibitions Grounds. From Monday, May 19 2003 the gates to the world's biggest chemical engineering Exhibition/Congress and International Meeting on Chemical Engineering Environmental Protection and Biotechnology were opened to the public for 6 days.
The special technical and trend reports of ACHEMA 2003 exhibition were prepared for publication and realesed by internet as press informationby authorities from DECHEMA. Trend reports covering present and future state of. Pumps, filtings and seals, as well as on the Packaging technology and Ultrapure processing.

PUMPS/FITTINGS/SEALS

German centrifugal pump manufacturers saw their business increase in the first half of 2002, exporting 3.3% more than in the same period in the previous year. The situation has deteriorated slightly for positive–displacement pumps (oscillating positive–displacement pumps –1.2% and rotating positive–displacement pumps –3.8%). These results underline the fact that the centrifugal pump market is showing moderate growth following a period of stagnation in recent years. A study conducted by Frost & Sullivan predicts turnover in Europe to increase from $US 2.87 billion in 2000 to $US 3.34 billion in 2006, which equates to an average annual growth rate of 2.5 percent.

Increasing requirements are being placed on centrifugal pumps, leading to strong demand for innovative high–tech products. This is also having a positive impact on quality standards. It is not surprising that sealless pumps show the highest growth rates: Given the enormous pressure and temperatures that are sometimes present in process technology applications as well the toxicity and explosive potential of pumping media, hermetically sealed drives such as canned motors and magnetic couplings already play a very important role in today's chemical process technology. Operators claim that the use of non–leaking aggregates is expected to increase in the future. There is still significant potential to push forward the development of canned motors and magnetic drives and possibly combine the two technologies. More stringent environmental regulations (such as the German Clean Air Act) and an expanded range of applications are the primary reasons why experts expect very high growth rates for sealless pumps.

Plain bearings in hermetically sealed centrifugal pumps are lubricated and cooled by the pumping medium. This can lead to problems in practical application, such as dry running or vaporization of the medium. Magnetic rotor bearings represent a possible solution to the problem, at least for niche applications. One manufacturer claims that by using a self–bearing disk–type motor, it can build a very simple centrifugal pump with a magnetically free–floating impeller. The company explains that a single motor/bearing unit provides both the drive and magnetic bearing function and is capable of magnetically stabilizing the spatial degrees of freedom of the impeller without direct contact with the walls of the pump housing. Pumps of this type move media in biotechnology and ultra–pure chemical applications as well as CMP slurries in the semiconductor industries. However, their performance is limited to low drive power of less than 1 kW.

The increasing importance of attractive service strategies

There is also intense discussion in the industry on the topic of service/maintenance. There is an increasing awareness that condition–oriented maintenance and repair can significantly increase MTBF (mean time between failure), reduce downtime and decrease cost. It is of primary importance that the operator checks from time to time whether the design parameters are still correct (maybe they never were). The focus should be on a detailed analysis of faults, ranging from non–matched materials and a non–optimal operating point to an unsuitable mechanical seal.

The "total pumping concept" is now being offered as well as a service package. A manufacturer of wastewater pumps covers the entire operational performance of pump stations and provides total 24–hour monitoring. The package includes assurance of operational reliability, repair, maintenance, cleaning, refurbishment and operating documentation over a period of 10 to 20 years. The operator has a choice of various service levels tailored to meet his/her individual needs. Benefits include predictable levels of expenditure in the long term, constant monitoring of the facility and permanent operational optimization.

The trend towards integrating intelligence in the shape of electronics directly at the pump remains intact.

Sensors monitor the pumps around the clock and send out an alarm in time if a fault is about to occur. In some cases, the alarm is raised in a conventional manner using signal contacts, which are connected to higher–level control circuits. Using a digital field bus appears to have advantages, because a greater volume of more detailed information can be sent. If a variable rotational speed drive is involved, action can be taken to address impending faults and avoid malfunctions. Concepts for remote monitoring and diagnosis of aggregates, including monitoring via the Internet, are becoming increasingly important in this context. A number of manufacturers were presented service products of this type (including teleservice) at ACHEMA 2003.

Feasible early recognition of faults begins to take shape

As pumps become more expensive and as the complexity of the circulation system in which they operate increases, there is a greater need to continually record and monitor the condition of the pumps. Because the pumps react to changes in a system, they can act as an indicator of unplanned conditions in the system. Damaged plain bearings, for example, often result from gas penetrating into the pumping medium. To increase system availability, it is important to understand at the outset the relationship between system conditions and the corresponding reaction in the pump. This was the starting point for intelligent state monitoring of centrifugal pumps that only use a minimum of sensor mechanisms. One analysis of failure statistics showed that two or three sensors are sufficient to properly monitor a pump and also to provide a significant amount of diagnostic capability. The sensors are used to detect dry running, to measure bearing temperature and above all to detect vibration.

The frequency spectrum, which describes the sound of the pump, contains a wealth of information. New diagnostic systems relieve personnel from the task of routinely checking the pumps, leaving them free to concentrate on operation and maintenance of the system. Initial field tests have confirmed the potential and functionality of modern diagnostic methods.

Seals: the need to fine tune materials

High pressure, temperatures ranging between –40°C and +300°C, together with ambient conditions such as humidity or heavy levels of contamination are typical in process technology applications. Other factors include strong vibration, pressure peaks, lateral forces, etc. To guarantee functional reliability across the entire range of operational conditions, materials and geometry in sealing systems must be very carefully matched.

Users, however, are no longer satisfied with the reliable command and control of forces. They expect fast, exact predictions about the long–term behavior of sealing elements. On–going basic research is needed to meet these demands. Knowledge of tribological processes is continually increasing. FEM (finite elements method) is being used in the design phase to optimize seal geometry calculations to achieve the desired results in a shorter period of time.

Suppliers of sealing systems are not only faced with meeting the challenge of conforming to legal requirements such as the new version of the German Clean Air Act. They also have to offer their customers economical solutions. Favorable investment costs, long service life and easy access for maintenance are high on the priority list. There is another development that is receiving increased attention. Whereas the focus for a long time was on increasing sophistication in seal geometry, today part of the emphasis is being placed on optimization of materials. Fine–tuning is at the forefront of this effort. Materials are trimmed exactly to match the requirements of a particular application. There are good reasons for this. Today, for example, there are reactors available for the chemical synthesis of small material volumes together with appropriately fine–tuned process management systems. This eliminates the dependency of seal manufacturers on what products the large chemical companies offer.

Experts agree that despite the considerable success of sealless pumps in less demanding pumping applications, the mechanical seal will retain its position of importance. As with pumps, new sensor technology designed to help monitor the condition of dynamic seals is expected to create new application opportunities and also reduce costs. In the past, a mechanical seal was not replaced until it failed. Where safety was an issue or where the potential risk to operational reliability was high, the seal was replaced at regular intervals. Modular diagnosis systems now provide the operator with a continuous stream of information about the state of his/her seals. A seal is not replaced until there is a real need to do so.

Fittings: a growing number of automated control fittings

The oil and gas industry represents the largest customer base for industrial fittings in 2002 with a market share of 32.6%. The chemical and petrochemical industry is the second largest sector at 19.9%. The German Engineering Federation has reported that the approximately 170 German manufacturers produced industrial fittings with a value of 2.06 billion Euro in 2001, an increase of 2% compared to the previous year. A 5% increase in exports lifted the industry's export quota to 65% (the direct and indirect export share of production output).

These figures lend support to an industry analysis performed by Frost & Sullivan, which views European producers as holding a firm position in the market for industrial fittings and actuators for the process industry.

Sales on the European market are expected to increase annually by 2.2%, from $US 3.53 billion in 2001 to $US 4.1 billion in 2008. Factors such as the increased use of natural gas should stimulate investment in the oil and gas industry, which is the largest application sector. Intelligent fittings equipped with actuators, which are an integral part of all modern fittings systems, together with field bus networks and online systems, will provide impetus for continued growth. A large installed base of fittings and actuators guarantees strong demand for spare parts as well as replacement and upgrade products, and this is also a significant factor in total sales volumes.

The medium determines the fitting design

Materials that are normally transported in the industry through pipelines (gas, process water, acid/alkaline solutions, powder and granulate) as well as operating temperatures determine to a large extent a fitting's design and the materials used to make fittings. If aggressive media are used, components that come into contact with the product must have good corrosion resistance. They must also be able to withstand the operating pressures present in the system. The fittings must prevent leaks within the flow system and above all to the outside environment (chemical, petrochemical and nuclear power applications).

Whether a valve, a butterfly valve, a ball valve or a slide gate valve should be used depends primarily on the type of pumping medium and operating conditions. There are other, higher–order factors to be considered when automation is being introduced for industrial valves (existing drive standards, available interfaces and bus systems, control technology, etc.).

An overall perspective as well as knowledge about individual characteristics are needed to choose the "right" valve design, since the valve is nearly always a component in a complete system. Actuators, which were developed during the introduction of automation in the user industries, are replacing the levers and handwheels that were used in the past to operate the valves. There are two different requirement profiles to consider when automation is being applied to valves. There is pure on/off control, where the valve must only to be moved to one of the end stop positions. In contrast to this, there is variable control, where a nominal value is used to monitor the change of position of the valve in the pipeline flow.

The proportion of automated industrial valves has doubled in recent years. The ratio of manual valves to automatic valves has already reached about the 70/30 level. Experts expect that in process technology applications this ratio will soon reach 50/50. This development is being driven by a reduction in staffing levels. If fewer people are available, manual operation of the widely dispersed valves in the system becomes very problematic. In addition, process automation using central control technology continues to expand, and this of course includes all process control valves.

Apart from pure pneumatic, hydraulic or electrical drive functions, control devices with interactive capability can also perform self–monitoring and diagnostic tasks (early detection of faults and identification of fault source) as well as communications tasks using standardized methods (e.g. field bus).

Intelligent control valves thus enhance safety and contribute to reduced use of resources during production as well as increased process reliability. They exchange information in digital form with their environment and act and react independently as needed in response to changing process requirements.

Joint research helps medium–size companies

As a result of increasing demands in the plant and pipeline construction industry, the research and development departments in the valves and fittings sector, which is principally made up of small and medium–size companies, are often stretched to the limit. A joint industry research effort, operating under the auspices of an industry group at the German Engineering Federation (VDMA), provides a well–proven alternative. A number of industrial valve and fitting manufacturers work closely with universities and research institutes to study optimization opportunities in the product development process. The project is focused on the idea that traditional product design using physical prototypes can be replaced with simulation tools that are less time and cost intensive.

PACKAGING TECHNOLOGY

The packaging industry is apparently one of the few sectors unaffected by the weak economy. Business has been growing for the past five years, seemingly at odds with the current scenario of a global slowdown. After all, the packaging industry is a good economic indicator, because it supplies packaging to all industries. Expressed in numerical terms, production volumes in the German packaging industry increased to 3.1 billion euros between 1996 and 2000. The estimate for 2001 is 3.6 billion euros.

This is a Europe–wide trend. According to a study conducted by the consultants Frost & Sullivan, business volume for packaging machines in the European market, which in 2000 was US$ 4.61 billion, is expected to increase to $US 6.52 billion in 2007. The German Engineering Federation (VDMA) reports that the world market for packaging machines is approaching 18 billion euros. The US is the most important producer country, with a production volume of 3.7 billion euros. However, the PMMI (Packaging Machinery Manufactures Inst., Arlington) reported a 4.1% decline in deliveries of packaging machines and packaging–related processing equipment by US manufacturers in 2001. The decrease is attributed to consequences stemming from the

terrorist attacks, the strong dollar and a very crowded competitive marketplace. However, for the next three years, the PMMI predicts annual growth of 3.7 percent.

The global marketplace is growing as customer expectations increase. Even so, manufacturers of packaging machines cannot afford to be complacent. More than 3,000 suppliers compete with each other in Europe alone. The shift towards complete packaging lines has led to several mergers and takeovers. In the near future, other producers will be on the lookout for partners in niche markets to help expand their product range. Despite intense competition, increased purchasing power in the emerging countries and rising demand for packaging resulting from Internet trade give the industry very good reason to remain broadly optimistic.

The customer is the decisive growth factorTo understand market trends and growth rates, it helps to take a look at the role played by state–of–the–art packaging solutions. Protection of the product is no longer the primary consideration. Demographic trends are the deciding factor driving packaging improvement in the consumer market. Because households are smaller, there is demand for prepared foods and smaller portions. Consumers are far less willing to prepare their own food. Convenience and user–friendliness are driving the market. Packaging must be easy to open and close, be visually appealing, and also provide an information platform.

Multi–layer foil is becoming more common, providing protection against light, moisture or oxygen. If you take a closer look at supermarket shelves, you will also notice that foil on the vegetable rack has hardly any visible moisture inside, the meat has a more distinctive red color and lettuce lasts longer. All of these achievements result from state–of–the–art process engineering and innovative materials research. Sophistication really becomes evident when drinks warm up or cool down at the push of a button, foil changes its color to show if the cooling chain has been interrupted or convenience food in the microwave tells you how to prepare it. Many of these innovations are ready for practical use. Whether they will be a success in the market depends on the customers.

Counterfeiting is another broad topic. Everything is copied, from CDs to software and brand–name clothing. Even professional car racing is not safe from counterfeit spare parts. Loss of sales due to counterfeit audio media products is estimated to be $US 5 billion, and counterfeit textiles cost about another $US 4.4 billion.

Counterfeiting, however, is driven to extremes in the field of medication. According to information published by the International Federation of Pharmaceutical Manufacturers Associations (IFPMA), around seven percent of medications worldwide are counterfeit. This equates to a volume of more than $US 20 billion. This not only means loss of sales – it also puts the lives of many people at risk, especially in developing countries. An enormous number of ideas have now been advanced to prevent counterfeiting. One of these strategies was on display at ACHEMA, although the manufacturers were not willing to reveal much detail for understandable reasons. In addition to traditional methods such as holograms or guilloche patterns, light–activated substances can be integrated into cardboard or paper. Mechanical structures and special labels can also be used to indicate whether the packaging has already been opened. The most effective strategy is to combine several of these methods. Cooperation between producers and packaging manufacturers is essential, if efforts to make life difficult for counterfeiters are to be successful.

Marking made easy

Even if no attempt is made to protect against counterfeiting, hardly any packaging leaves production without labeling or lettering. Quality control and global distribution requirements alone make marking essential. In processing industries, labeling or lettering must meet special requirements to withstand the harsh everyday environment.

Dust, dirt or moisture must not degrade printed information. Substrate layers, adhesives, special print colors and coatings can be used to produce labels that survive steam sterilization or freezing with no damage. Irregular geometries, such as sacks, pose significant challenges. The ink must also match the product. There are, for example, special inks suitable for food, and invisible ink is also available. High–resolution inkjet printing techniques, thermo transfer Print and Apply labeling systems are the methods of choice, so that every product is given the mark of distinction that it deserves.

Achieving the goal is a team effortA whole team of experts is needed to incorporate these ideas in a packaging machine. Materials scientists kick off the process. They are followed by process engineering and the construction of special machines. One thing is clear: the focus is still on packing performance, but whether that is meaningful from the economic standpoint is not always certain.

The packaging machine offers far greater savings potential. There is a tendency in the market to use small packaging units. This tendency cuts across all industries. Lot sizes in the pharmaceutical and fine chemical industries are decreasing each year. Containers are shrinking. Packaging machines must be extremely flexible, as there is no other way for producers to react quickly to customer and market demands.

As a result, the key trend is that automation and high–grade robot technology have become indispensable. There is good reason why packaging engineering has become the second most important application for robotic systems and is surpassed in this

respect only by the automotive industry. These systems can do more than simply pick and place. Special grasping tools and transport mechanisms pack, load and place products, sometimes at breathtaking speeds.

The future belongs to the integrated packaging machine with digital reconfiguration capability, which can perform an increasing number of tasks in ever decreasing space. The focus of development activity is on system availability, which translates into very high performance with minimal rejects and absolute flexibility. An increasing level of miniaturization is used to reduce space requirements. Packaging machines of this type shape, glue, punch, fill, print and close the package.

As is the case in the field of automation, software plays a key role in packaging machines. Only a few years ago, manual or mechanical adjustments were made to handle format changes, but today a software package makes tool change easy. Changeover times have been drastically reduced. The increasing use of modular construction in packaging machines simplifies subsequent modification. Modular designs also facilitate tailored machine solutions. This provides investment certainty in spite of shorter product life cycles. For companies that perform packaging as a service, these machines are a must, because they provide the capability of reacting to a wide range of requests in the shortest possible time, while maintaining quality standards and staying within cost parameters.

Know–how is in demandWhen you are looking at availability, you will soon run into the term "remote diagnosis". This technique can minimize down time and reduce service costs. For it to work, however, you need additional sensors, which monitor and document system status. The significance of image processing is on the increase in this field. It is used in quality control as well as for checking labels or reading bar codes. Many high–speed pill packaging machines or optical checks of vials have already stretched existing camera systems to the limit.

As an unavoidable consequence of the increased use of sensors, there are now more data to manage. This will in turn lead to an increased emphasis on a continuous flow of meaningful information across areas such process automation and production planning as well as functional areas such as finance and materials management. The increased use of software does not always equate to ease of use. Although it helps to identify and rectify errors, it assumes greater knowledge on the part of the user. The machines as well as the packaging must offer improved ease of use and better handling. This is the only way to facilitate start–up and simple operation. Additional interfaces introduce more difficulties, because there is often a need to integrate application–specific software.

The need for the right peripheralsInterfaces do not only refer to the software. There are many interfaces in the machine itself. Equipment such as feed and discharge systems as well as their linkages to the packaging machine warrant closer consideration. This equipment can often slow the system down. If the supply of items, for example bottles, does not run smoothly, the entire downstream process is held up. This can mean significant financial loss for the operator. As a result, some packaging machine manufacturers have begun to design these units themselves.

In a modern packaging facility, all elements in the process chain must be properly designed, connected together and optimized. Control balances, counting units, sealing machines or metal detectors may be part of a packaging line. This has led to a diminishing demand for insular solutions. Even small companies will prefer integrated solutions in the future. Professional advisors from the packaging industry at ACHEMA in Frankfurt were showed how these components can be smoothly integrated into the overall process.

New impetus for plastic packagingGood prospects are not limited to the packaging machine industry – packaging material producers also have no reason to complain about future prospects. Despite an increase in raw material prices, the plastic packaging industry federation has reported new impetus in the plastic packaging sector in 2002. There was significant growth in foil, seals and PET bottles as well as large packaging units made of plastic, such as drums, canisters and IBCs.

Special new drum products have been a market success. There are now plastic drums made of ultra–pure material, which can be used in cleanrooms at chip manufacturing facilities or in the pharmaceutical industry. In contrast, steel drums and other fine metal packaging, which are used primarily for shipment of chemical or petroleum products, have suffered from the difficult economic conditions worldwide. German chemical exports declined significantly in 2001 and the first quarter of 2002, and this had a direct effect on drum turnover. Problems were exacerbated by higher steel prices and higher wage–related costs. Whatever packaging material and packaging machine is used, it has long been clear to the industry that there is no longer a demand for insular solutions. Manufacturers must increasingly develop packaging solutions that deliver efficient, logistic optimization of the entire product chain. The key is to focus attention on all stages in the process rather than only the product which must be packaged. This year's ACHEMA again offered a broad platform to follow the entire life cycle of a packaging unit, from the raw material stage and processing through to disposal of the packaging material or potential re–use.

ULTRAPURE PROCESSING

The global market for the purification of air, gases and liquids in high–technology industries has rapidly grown. The smallest amount of unwanted matter –

whether it is in the form of particulate matter, stray chemical molecules, metal ions, or biofilm – can contaminate a production run, and cost thousands, if not millions, of dollars in lost revenue.

In the electronics industry – which can be considered the standard bearer for purity – acceptable levels of particulate contamination for chemicals and materials have been reduced from parts per million (ppm) just a few years ago, to parts per billion (ppb) cleanliness today. And, the trend now is toward limiting certain contaminants, such as metals, to parts–per–trillion (ppt) concentrations in the chemicals that are used to produce semiconductors.

Production of pharmaceuticals and biotechnology–derived products for human consumption is also being retooled to meet increasingly strict regulatory standards for purity. One of the latest initiatives of U.S. Food and Drug Administration (FDA; Washington, D.C.), for example, is the development of guidelines for sterile drugs that are produced by aseptic processing. According to a draft concept published in September 2002, there are basic differences between conventional "terminal sterilization" methods, and "aseptic processing", which involves more variables.

Terminal sterilization usually involves filling and sealing product containers under the conditions of a high–quality environment; in most cases, the product, container and closure have acceptably low rates of biological contaminants, but they can not be considered to be sterile.

In aseptic processing, however, the drug product, container and closure are subjected to separate sterilization processes, and are then brought together. Because no further processing is used to sterilize the product once it is in its final container, it is critical that containers be filled and sealed in an environment of extremely high quality and sterility. The current Good Manufacturing Practices (cGMP), set FDA, and similar global standards set by the International Organization for Standardization (ISO; Geneva), will continue to guide the design of high–purity equipment. Suppliers of sanitary and high–purity equipment must meet these guidelines as they strive to make product and design improvements that ensure maximum cleanliness, process flexibility and system compatability.

Clean–in–place capabilities

Increasingly, clean–in–place (CIP) is the technology that distinguishes conventional chemical process equipment from that used for sanitary or ultrapure manufacturing. CIP equipment can be cleaned and sterilized automatically in place, and is designed so that no dismantling or disassembling of the system is required. Originally designed for applications in the food and dairy industry, CIP systems are now mandated by many companies in the pharmaceutical, biotechnology and semiconductor sectors.

CIP is typically achieved by pumping a cleaning solution through a piping network, so that it flows across all internal equipment surfaces. In addition, spray devices are used to clean vessels, reactors and other process equipment.

In addition to eliminating the need to dismantle and reassemble system components every time cleaning is required between batches, CIP capabilities allow the system operator to carefully control cleanliness. For example, automated CIP systems monitor and control parameters, reduce operator exposure to products, and permit the use of cleaners that may be more aggressive than those used when operator intervention is required.

While CIP components and systems often are more expensive than conventional alternatives, for many high–purity process operators, there is no choice but to use CIP, to meet their challenging requirements for product and process cleanliness.

Building in process flexibility

Multi–functional equipment designs that incorporate several unit operations in a single system are making steady inroads for the production and handling of delicate, temperature–sensitive processes. Some systems, for example, combine drying operations with other operations, such as filtration and mixing.

In general, the trend in drying is away from convection drying systems that use direct heat, and toward conduction drying, whereby heat is applied indirectly. An increasing popular choice for indirect heating is vacuum drying. That's because it allows products to be gently dried in less time and at lower temperatures. High–purity processors are also leaning toward vacuum dryers that conserve energy and allow solvents to be recovered for reuse.

For example, vacuum–operated conical mixer dryers from Krauss–Maffei Kunststofftechnik GmbH (München, Germany) are equipped with a bottom–drive mixing screw that simultaneously mixes and homogenizes product while it is being dried. Most of the product moisture or mother liquid is removed during batch centrifugation, which precedes the drying step.

Meanwhile, by combining filtration and drying, filter–dryer systems separate solids from liquids, and discharge them as free–flowing powders. One direct benefit of such a systems is this: Because separation and drying occur inside of a single, sealed vessel, product purity and process containment can be maximized.

For example, 3V Cogeim, Group (Bergamo, Italy) markets the FPP series of filter dryers. FPP feature the patented Xtract 1, which facilitates the complete removal and discharge of the heel from the filter dryer. This design eliminates any possible breach of containment, or the need for operator intervention to recover residual product.

At Charles Thompson Ltd. (CT; Mexborough, U.K.), filter dryers can be equipped with a multipurpose double–mechanical seal that permits the seal to operate as either a drying–running system or as a conventional wet–seal system with Thermosyphon cooling – that is, cooling obtained by quencher liquid. In addition to indirect drying of product via vessel walls, the filter plate and the heated agitator, CT filter dryers also offer the option for microwave drying. Microwaves can reduce drying time by as much as 50% for certain products.

In recent years, the dominance of mechanically sealed high–purity mixers has been challenged by the introduction of products using magnetically coupled agitators, which have the advantage of hermetic sealing. Such systems use no rotary seals, which reduces maintenance requirements, and eliminate the need for packings or lubrication, both of which can introduce impurities during system operation.

As these designes have evolved, some of the problems associated with the earliest generation of magnetically coupled mixers have been eliminated. For example, one shortcoming of conventional magnetically coupled mixers is their cleanability, due to the restricted flow of cleaning fluids through the small openings in the outer rotor head.

To meet the validation requirements for CIP capabilities, some magnetic mixer models are equipped with an open mixer head that can be completely flushed. One particular enhancement for improved cleanability in magnetic–drive mixers comes from Lightnin (Rochester, N.Y.), through its Hyper–Flow bearings. Compared with traditional sleeve bearings, Hyper–Flow bearings have fewer contact points, so they result in reduced particulate generation, permitting easier and more thorough cleaning.

Glass–lined systems protect product purity

Glass–lined reactor systems are widely used in most bulk–pharmaceutical facilities. They are favored for their resistance to both corrosion and contaminant buildup, as well as for their relatively low cost, compared to other, more–exotic materials. Increasingly, makers of glass–lined steel reactors are outfitting their systems with linings made of conductive glass, enamel and plastics materials to accommodate a wider range of fluids. Vessel accessories, such as glass–lined baffles and flanges, have also been improved. Typically, baffles are suspended from nozzles in the top of glass–lined vessels. However, DeDietrich Process Systems (Zinswiller, France) has designed a reactor in which the baffles are attached to the sidewalls. This configuration provides better mixing and frees up nozzles, according to the company. Pfaudler, a division of Robbins & Myers, Inc. (Cleveland, Ohio) makes glass–lined vessels with concave baffles, which are designed to provide increased turbulence.

Meanwhile, Eisenwerke Fried. Wilh. Düker AG & Co. (Laufach, Germany) has reduced the collar radii of stub flanges used in its glass–lined reactors by 50%. This modification reduces dead volume and is said to make cleaning easier. And currently under development by the company is a loose flange, which would allow connection to be made by simply twisting the parts together, without any bolts.

Ensuring purity during fluid flow

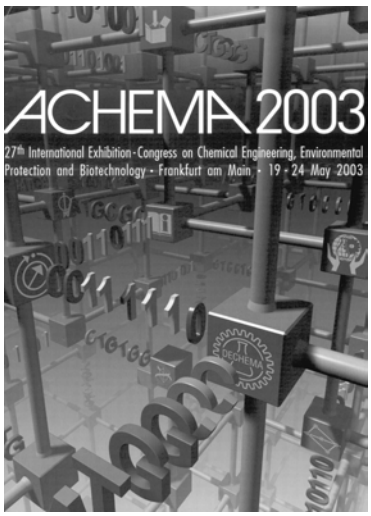
High–purity tubing must carry sensitive product feed streams into a plant, protect feedstock purity between reactors and vessels at various processing steps during manufacture, and deliver uncontaminated finished product for packaging and shipping.

Contamination control is a constant challenge as high–purity fluids are transported through process plants, for even deionized, ultrapure water systems will support microbial biofilms with significant cell densities after only a few weeks of service. The problem is further complicated by small inner diameters of some tubing, which make such tubing difficult to clean. Increasingly, it is essential that tubing material used for ultrapure or pristine processing operations be able to withstand cleaning and sterilization using CIP and steam–in–place (SIP) protocols.

In pharmaceutical applications, for example, variations in flow or poorly planned piping slopes or bends can create either stagnant areas where contaminants can concentrate, or areas of turbulence, which can strip biofilm buildup from tubing walls and carry it into large production vessels. Especially for chip fabrication, tubing systems must be carefully designed to prevent turbulence while transporting caustic or hazardous liquids under extremely high temperatures and pressures.

Installed tubing material must also be readily repairable or easily replaceable, in the event that a section break or changes in the manufacturing process require that a feed stream or process line be rerouted. Adding to these challenges, tubing material used for ultrapure processes must be compatible with tubing materials used elsewhere in the plant, to allow for cost–effective modification of process systems.

Plastics are often specified for critical fluid–handling applications for the tubing that is used to transport chemicals and water for semiconductor fabrication and rinsing. For application that may involve exposure to corrosive process chemicals and cleaning fluids, fluoropolymers offer the best overall performance. Some, such as perfluoroalkoxy (PFA) and polytrafluoroethylene (PTFE) are fully fluorinated; others, including polyvinylidine fluoride (PVDF) and ethylene chlorotrifluoroethylene (ECTFE), are only partially fluorinated. Major suppliers of plastic fluid handling systems include Georg Fischer AG (Schaffhausen, Switzerland) Saint–Gobain Performance Plastics (Charney, France), and Entegris, Inc. (Chaska, Minn).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