

# How Ideas Become Products

How does a company like Sulzer compete successfully on the market for more than 180 years? A culture of innovation, advanced technical and technological expertise along with a consistent market orientation of the products are the prerequisites for success. It is also important to understand the wishes of the customers. The following insights into divisional development at Sulzer reveal how ideas and products are born.

The founding father of Sulzer, Johann Jakob Sulzer (1806 – 1883), already realized that the combination of product innovation and the market acceptance of a product is an essential factor for success. „If a business is to be successful, an untiring genius must be present for the technology, and no less for the mercantile direction.“ Being innovative – and offering innovative products – is of high importance to Sulzer. The company registered 31 patents in 2016, and it invested CHF 71.4 million globally in research and development. This corresponds to 2.5% of total sales.

## Innovation in various industries

Innovative solutions are the basis for Sulzer products. Technological progress is important but is not the only contributor to success in the market. In today's volatile market environment, customers focus on costs and suppliers must meet their expectations. Three of Sulzer's technical and development managers report on how Sulzer creates innovative solutions and products. Group Communications spoke to Ralf Gerdes from the Pumps Equipment division, Felix Moser from the Chemtech division, and Paul Jutzi from the Applicator Systems division.

### Pump development at Pumps Equipment

There are two different types of pump products. On the one hand, there are the standardized pumps that Sulzer delivers directly from the warehouse. These include drainage pumps, wastewater pumps, and pumps for general industrial applications. On the other hand, Sulzer also delivers many pumps that are designed, developed, and manufactured for specific projects. These are, above all pumps, for the oil and gas production, for power plants, and for major water projects, where Sulzer offers various product lines. However, there is a basic common technology development as basis for all product developments. The solutions that arise are then integrated into all pump models and product lines.

### Split tasks for cost optimization

“In our basic development process, we introduce new technologies and materials, and we engineer new hydraulic or design solutions for pumps. This knowledge is passed on to the local development centers, and, in this way, becomes integrated into the development of all Sulzer pumps worldwide,” explains Ralf Gerdes.

“We have several local development centers spread all over the world. They are specialized in different fields of application and different product classes. The development center in Finland, for example, is specialized in products for the pulp and paper industry. In Portland OR, USA, our engineers develop vertical pumps for power plants and the oil and gas industry. We ensure advanced and uniform technology through centralization. All the locations benefit from this expertise.”

### Sulzer's contribution to sustainability

Many engineers contribute to the innovations at Sulzer: more than 200 people work in product development and more than 400 in engineering; numerous products and pumps are released to the market every year. Megatrends such as urbanization, resource scarcity, or air pollution play a key role in the development of new products. Sulzer also contributes to the global reduction in energy needs. Gerdes had the following to say about sustainability: “Lowering energy consumption reduces the operating costs of our customers and



Ralf Gerdes studied mechanical engineering at the Technical University, Braunschweig, Germany, with a specialization in turbomachinery. He subsequently did his doctoral studies in the field of mechanics. During his professional career, he has held several positions in the fields of steam turbine technology and business. Dr. Ralf Gerdes joined the Pumps Equipment division of the Sulzer Group in 2006. After various roles in the development and operations area, he took over the management of the Global Technology department in 2014.

1 Ralf Gerdes, Head Global Technology in the Pumps Equipment division.

protects the environment. With optimized hydraulics and drive technology, we can increase the efficiency of each pump and thereby lower its energy consumption. We invest heavily in the development of the hydraulics, and we are proud to offer our customers highly efficient, cutting-edge products.”

#### Optimization of hydraulics

To improve the pump hydraulics, the company works closely with customers and universities as well as development and research facilities all over the world. The fundamentals for design calculations are received through detailed research and measurements and are verified with the latest methods and tests. Customer feedback is an important step in improving all aspects of the products. Gerdes explains: “Through research, we have gained knowledge that will enable us to better predict flow and vibrations of the pump. This reduces downtime and increases the lifetime of a pump, especially when it is used over a wide operating range.”

#### Formula 1 as a model

The reliability of any Sulzer pump is not only based on experience values and calculations. The operational reliability of the pumps is also checked by thorough testing on internal development test beds. Gerdes explains: “For customer-specific large pumps, we apply a technology that is also used by Formula 1 car manufacturers. The airflow behavior of a model racing car is measured in a wind tunnel. The outer contours and thereby the driving behavior of the cars are then optimized. We do the same thing — but inside the pump and with water. The pumps are manufactured at a smaller scale, and the flow conditions inside the pump are measured. The results are used to improve the design and to validate the CFD calculations (computational fluid dynamics). To produce these small pump models, we use components that are manufactured using 3D printing, just like in Formula 1. This allows us to reduce testing and development times to the benefit of our customers.”

#### Pioneering pump innovation

Market analyses by the business development department can be decisive when following new paths. Identifying market niches may lead to an expansion of the product range or to new products. For example, modern seawater desalination plants work according to the principle of reverse osmosis. Salt water is pressed through a membrane under high pressure. Through this process, the salt is separated from the water. Sulzer offers optimal solutions for all the pump processes in these desalination plants.

In the field of renewable energy, Sulzer develops pumps for geothermal applications and solar power plants. Before the market introduction of biofuels, Sulzer carried out extensive tests with customers.

Recognizing trends and making the right decisions is vital for the innovation of a company. “A major challenge for development was the multiphase subsea pump, which we developed cooperatively with customers. It will be delivered to the end customers this year. (see STR 2/2016). The special feature of this pump is the extremely high delivery capacity, which means that boosting is not necessary. This pump is also maintenance-free, thanks to a motor with magnetic bearings. Magnetic bearings arose from the basic development process, and we are now investigating the implementation of these technologies in other products,” says Gerdes.

2 Sulzer's development principles are similar to those of Formula 1 car manufacturers.



## From the idea to the product at Chemtech

The separation, reaction, and mixing technology of Chemtech is mainly used in the key oil and gas market as well as in the chemical industry. Chemtech manufactures, as one of its main products, structured packing, which is used, for example, for the separation of crude oil in refineries.

The development of structured packing, originally simply called “Sulzer Packing” by experts, dates back to the 1960s. “A dissertation at the Swiss Federal Institute of Technology (ETH) in Zurich, sponsored by Sulzer, played an important part in this. The static mixer is based on the same basic structure and was developed in parallel,” explains Felix Moser. “These two products formed — so to speak — the basis for today’s Chemtech division.”

## Working with universities

Cooperation with international universities and technical colleges is very important at Chemtech. Felix Moser describes: “We frequently carry out research projects together with universities, and we are currently working on a joint project with the ETH in Zurich, Switzerland. A second project in Switzerland with the Zurich University of Applied Sciences (ZHAW) as well as the Swiss Federal Institute of Materials Testing (EMPA) is in preparation. We are working with the Technical University (TU) Berlin in the field of oil-water separation. We reported on a special wash tank process for the CLOV-FPSO project in STR 2/2016. For that project, TU Berlin supported us in optimizing the wash tank distributor. This optimization was supported by our own computational fluid dynamics study (CFD) to understand the influence of FPSO motion on the tank and separation process.”

## R&D serves the customers

Within the framework of the research and development (R&D) at Chemtech, we carry out empirical tests and product tests in our own pilot plants. They serve as a sound basis for the later design of the products and the process calculations. This allows Sulzer to design the products reliably, according to their application, and to provide process guarantees. Neutral institutions confirm our measurements. One of these institutions is Fractionation Research Inc. (FRI) in Stillwater, OK, USA, a non-profit research consortium that is financed exclusively through memberships. Independent measurements are also carried out within the context of the Separation Technology Research (STAR) program, a joint industrial project affiliated to the Southwest Research Institute® (SwRI®) in San Antonio, TX, USA.

Moser explains: “Separation columns are always calculated, designed, and constructed for specific

cases. The customer-specific design of our products depends on the substances to be separated, the necessary purity, and various other requirements of the customer process. We have application specialists who are familiar with the various process areas working around the world. They contribute their experience to the design of the products. More than 30 people work to improve our products in research and development departments at various locations in several countries, and we operate a large development laboratory in Switzerland (Fig. 3). Numerous columns are available there, such as distillation columns, absorption columns, and air-water simulators. In our product development, we often work at the interface between mechanical and chemical engineering. That makes the work very challenging but also enormously exciting.”

## Success thanks to innovation

“We are not only the leader in separation technology with structured packings, random packings, and separating trays. More than 80% of the acrylic acid produced globally is purified with crystallizers from Sulzer. Acrylic acid is the basic product for the production of superabsorbers, which are used, among other things, in baby diapers and sanitary pads. High market share is our benchmark for the success of a product. It shows us that the price/performance ratio is right and that the market appreciates our products,” Moser adds. “Even before new process and process technologies become established in the market, we check whether our products can be used without changes or whether they need modifications. Sulzer is proud to have developed a process for the production of polylactic acid (PLA) together with a customer. PLA is a biopolymer in two senses. It is produced from renewable resources — from organic raw materials — and is biodegradable.

Following the successes of the pilot plant trials in Winterthur and Pfäffikon and the first smaller production plants, we are now building a plant for the production of 75 000 tons of PLA a year."

#### Continuous process development

Sulzer has also expanded the range of its technologies and the palette of innovative ideas by acquiring new companies. Chemtech is traditionally established in the downstream sector of the oil and gas business, i.e., in the refineries and the downstream industries. Moser explains: "With the integration of the Ascom company in Arnhem, Netherlands, into the Chemtech division, we have widened the focus of our development activities, in particular, into the area of oil and gas production, which is also referred to as *upstream*. At the same location in Arnhem, with ProLabNL B.V., Sulzer operates an independent test facility with installations that make it possible to carry out trials under real oil and gas field conditions. We also use these customer trial installations for development purposes."

#### The courage for creative thinking

"We are constantly reviewing the use of new — and sometimes unconventional — solutions so that our customers can benefit from them. In doing this, we aim, among other things, to improve the quality of our



3 Pilot installation in the development laboratory in Winterthur, Switzerland.



Felix Moser joined the Sulzer Group in 1984 after studying process engineering at the ETH Zurich. He was initially involved in the development of heat pumps and refrigeration plants. He has worked in various technical and management functions for the last 32 years at Sulzer, including being Technology Manager in the areas of Mass

Transfer Technology and Mixing and Reaction Technology at Sulzer Chemtech. He has been responsible for Technology Management and Intellectual Property at Sulzer Chemtech since 2010. In July 2016, he took over the role as R&D director for Separation Technology.

4 Felix Moser, Director R&D and Technology Management in the Chemtech division.

products, to save energy or space, or to optimize the processes. The static mixer that is used in the recondensation process for liquid gas, for example, is an innovative and significantly space-saving solution (see page 16). Lateral thinkers with know-how and experience are needed to come up with new ideas. It also needs the strength, perseverance, and patience to develop marketable products from these ideas," stresses Moser.

#### Innovation management at Chemtech

There are many different sources for new product ideas. Any of our employees can enter new ideas onto an electronic platform. This collection of ideas is regularly assessed, and relevant inputs are implemented. Our service organization — Tower Field Services — installs and services our products. Important suggestions for improvement arise from this. Directly on the system, the technicians can see exactly where things go wrong in practice and where improvements are necessary. Every customer request for a new application or for the implementation of a process idea flows into the development. That way, we are always able to correctly align our products to the market and to continually improve them," continues Moser.

"It is said that the developers are the rock stars of the industry. They may not stand in the spotlight, but their work is essential for market success. How well a product sells is ultimately dependent on the smart ideas that the developers have integrated into the products."



5 The previous mixer and the new, shorter T-mixer for dental applications.

## Innovative products of the Applicator Systems division

The products of the Applicator Systems division (APS) are used in a wide variety of markets: construction, industrial production, automotive and aircraft construction, healthcare, and cosmetics. The APS division's product range is vast and offers innovative packaging and application solutions. When customers apply two-component materials, they also benefit from the integrated mixing technology. This technology is used, for example, with industrial adhesives, dental cements, or impression materials — for the precise mixing and targeted application of reactive materials.

### Development of products, procedures, and processes

APS starts its development activity for application systems with a detailed analysis of the respective application, in which the needs of the user of such a system are clarified in detail. The Head of Technology and Innovation at APS, Paul Jutzi, explains: “Our innovations and product developments take the needs of end users into account. The precise analysis of the working steps and the handling allows our development engineers to crystallize the difficulties and the potential for improvement in the application. This allows them to develop suitable solutions. For example, it sometimes takes an excessive amount of force when using a mixer. Space is sometimes limited. In other cases, the brush applicator is too stiff and feels uncomfortable on the human skin.”

From the very start of new developments, a team of market specialists and engineers is involved to provide very different points of view and to generate ideas. The division APS works closely with end users in this phase. During the analysis, the complete life cycle of the packaging is scrutinized and optimized. Here, the most important points are the production of the application system, the filling procedure, the product presentation, the supply chain, the handling during product use, and the disposal.

### Sophisticated application solutions

A good application system influences purchasing decisions. Thus, it is important to invest in the development of sophisticated application systems. More than 80 people around the world are involved in the development and industrialization of new packaging solutions, mixing technologies, and application systems at Sulzer APS.

“We are active in a wide range of areas, and we need to know the respective application case very well. Our packaging solutions are used in the fields of adhesives, coatings, and cosmetics, as well as in the healthcare and dental sector. There is a group of innovation engineers who develop technological principles, new mixing technologies, and concepts that can be applied in all fields of application. In addition, we have development engineers who particularly focus on specific solutions for one industrial sector. This division of tasks leads to the rapid implementation of innovations in all areas while taking specific market needs into account.”

### Savings through innovative handling

Simplification of handling saves time, and, as everyone knows, time is money. That is why Sulzer is the market leader in the dental sector. Two-component materials are mixed in the right proportions and then applied simultaneously. Dentists appreciate — in addition to the time-savings compared to hand mixing — the improvement in quality from the exact mixing ratio. Colored markings on the mixers and packaging allow dentists to rapidly differentiate the contents and/or the application, and they avoid confusion during application. Jutzi explains, “We cannot carry out our development behind closed doors. In order

6 Sharkskin was the inspiration for a new surface structure.



to develop in a targeted manner, our engineers must know the problems experienced by the users. We find these out through direct interchange with our customers and end users. In the dental market, for example, we work with selected dentists who bring us new ideas and provide us with feedback on existing or newly developed products. To better reach areas that are difficult to access in the oral cavity or the root area of a tooth, we developed a mixer with flexible, bendable application tips. This innovation, called Colibri mixer, was developed based on the idea of a dentist.

### Time-saving for the industry

Sulzer cartridge and dispenser solutions are used in numerous areas of the industry: for chemical anchors, coatings, or the application of adhesive or sealing compounds. The application and mixing quality are enormously important in adhesive applications in the industrial sector to ensure that the adhesive bonds will be long lasting and safe. "Our packaging and dispensing solutions are used in, among other areas, construction, transportation, shipbuilding, and aircraft industries to make processes more efficient. To ensure that the right application systems are chosen for the many different applications, our salespeople, and technical service technologists are available to assist customers. At the same time, we gain an overview of the market needs and can further optimize our products," adds Jutzi.

### Sustainability in single-use applications

Every gram of plastic material that can be saved in packaging without affecting functionality is critical for sustainability. A savings of one gram for a single package may not seem like much. However, with annual quantities of, for example, several hundred million mixers, it translates into a total saving of several hundred tons of plastic raw material. "Sulzer is committed to developing application systems that can cut down on the amount of waste generated, whether by lowering the amount of residual material or by reducing the packaging," continues Jutzi proudly. "One of our latest developments, which has been very well received by our end users, is the new mixer geometry in the T-Mixer. It reduces the material loss by 30% to 40% compared with previous mixers (Fig. 5)."

### Creative inputs from universities

Sulzer makes use of the knowledge and resources of universities. Jutzi tells us more: "We are working



Paul Jutzi, born in 1962, studied mechanical engineering at the ETH Zurich. He joined Mixpac in 2002, which was acquired by Sulzer in 2007. In addition to managing the dispenser production in Rotkreuz, Switzerland, he has also led various development projects in the field of two-component delivery systems. He has been managing Technology and Toolmaking at Sulzer Mixpac since 2008. Since January 1, 2017, he has been in charge of Technology and Innovation in the APS division.

7 Paul Jutzi, Director Technology and Innovation in the Applicator Systems division.

cooperatively with several universities in Switzerland. In our branch in Haag, Switzerland, we support students from the fields of plastic injection molding and process engineering time and again. They carry out research work for APS. Working jointly with Technical University of Northwest Switzerland (FHNW), we have developed a remarkable solution to reduce the force required in pressing out cartridges. Inspired by the field of bionics, we have changed the surface structure of a component so that the friction force can be reduced by 30%. That means the end users can more easily dispense material from our cartridges (Fig. 6)."

### Ideas for new application areas

One of Sulzer's strategic goals is to expand the areas of application for APS solutions — primarily in the healthcare sector. The development teams are generating new and exciting solutions for this sector. The versatile MIXPAC™ Barrel System even won the CPhI Pharma Award 2015 for the "best innovation in packaging." Sulzer strongly emphasizes performing detailed product tests before the market launch. "We thoroughly test the handling and performance of the product in our laboratories. Along with customers and end users, we develop our products continuously further. We are grateful for all feedback, and we benefit from the improvement suggestions from our customers and also our employees." Jutzi adds, smiling: "We were, for example, encouraged to study how to improve cosmetics packaging to ensure better detection of cosmetic utensils in women's handbags. We are now investigating how we can accomplish this."

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