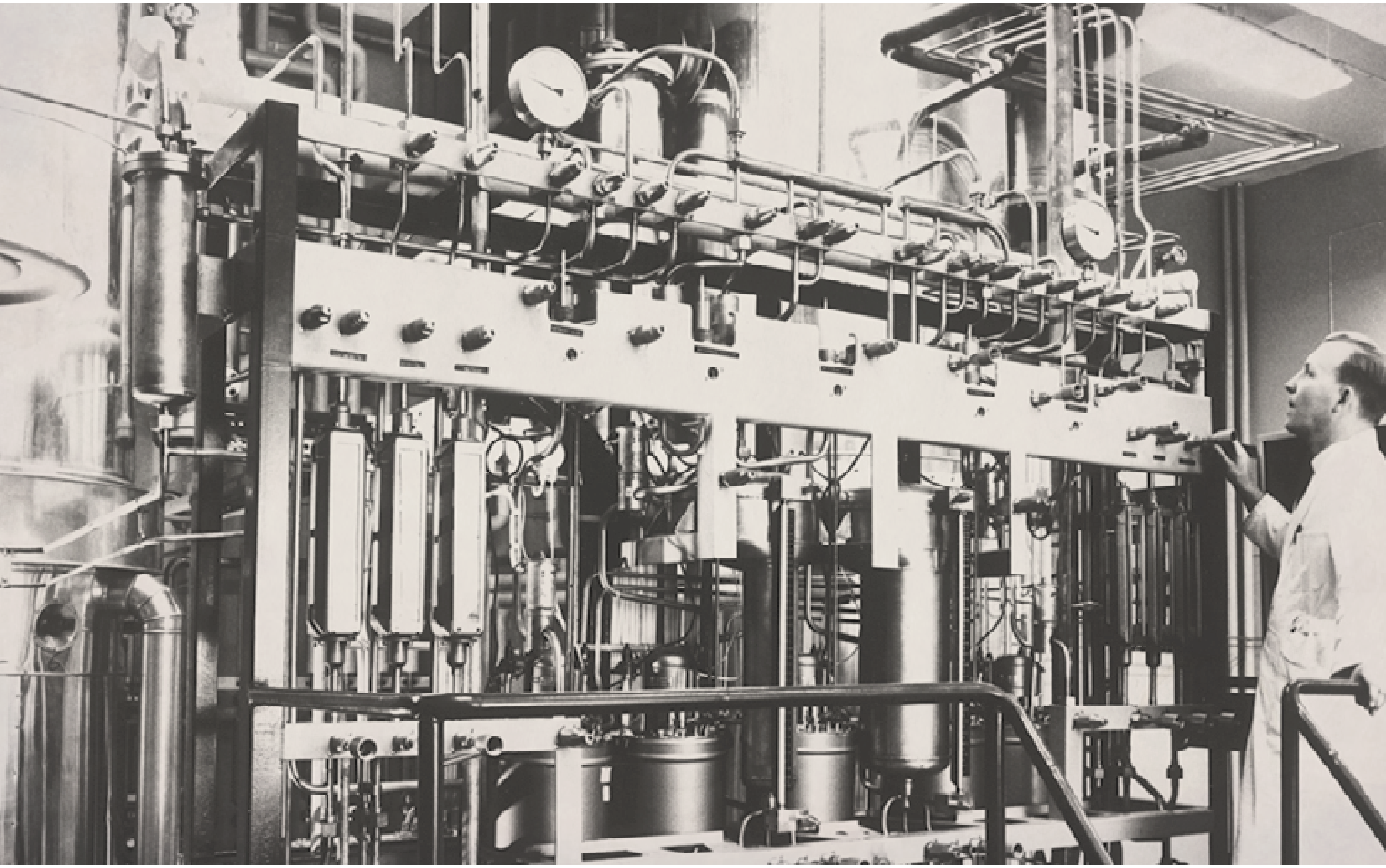
Chemical process technology for the industry since 1946

Nuclear fission, discovered in 1938, opened up access to an energy source of previously unknown dimensions. After its disastrous military use, the focus shifted to civilian nuclear technology. This was why, as early as 1946, Sulzer focused its development activities on the production and upgrading of heavy water (D_2O), which was needed for the first natural uranium reactors. Sulzer thus laid the foundation for today's Chemtech division.



The conventional process for D_2O production at that time was the rectification of water. In 1951, Sulzer decided to license the rectification apparatus of one Professor Kuhn from Basel. The Kuhn column proved unsuitable for industrial-scale separation, but over the course of numerous experiments, Sulzer gained sound knowledge in the field of distillation processes.

New ideas from the process technology laboratory

New people, new insights – the hiring of Max Huber in 1957 brought a new approach to the company. As head of the laboratory for process technology, he uncovered the weaknesses of the Kuhn column (Fig. 1). His ideas led to the invention of the first Sulzer structured packing, with a regular structure made of folded metal wire gauze for installation into the column.

In contrast to mechanical engineering, process engineering focuses on tailor-made customer solutions. The design of the plants is always customer-specific. Column size, internal types, separating trays, material specification — all this is adapted to the chemical components to be processed and the throughput quantities specified. Sulzer set up a special laboratory (Fig. 2) for distillation in 1958. In addition to the separation of isotopes, the lab used the new columns to research and test the separation of substances from the chemical industry and refinery, and then extrapolated the findings to industrial standards.

Fig. 1 Rectification apparatus (Kuhn column) from Sulzer.

Fig. 2 Vacuum pilot column in the laboratory.

The founding of the Chemtech division in 1989

In 1989, Sulzer brought together all process technology activities into one unit. The Chemtech division was born, encompassing distillation, mixing, reaction and separation technology, as well as crystallization. The separation and mixing processes proved to be particularly successful and continue to shape the face of Chemtech to this day.

From the very beginning, Chemtech has pursued three objectives in the development of customer-specific processes: low pressure drop in the process, high efficiency and scalability. These requirements have led to the invention and continuous improvement of Sulzer's structured packings. The segmented design (Fig. 3) of these packings was an intelligent solution that allowed the packings to be used in columns of any diameter.

Fig. 3 Installation of segmented structured packings in a column.

The market launch of gauze packing in 1964

Building on their experience with the Kuhn column, Sulzer engineers first developed a packing with a regular structure from self-wetting wire gauze. A number of tests were carried out to assess and optimize various geometric arrangements. In 1964, the product was presented to the experts for the first time at Achema, the world's largest trade fair for chemical engineering, process engineering, and biotechnology. The first delivery was provided for a batch column with a diameter of 300 mm and a height of 9 m for the separation of fragrances, and the next column was for the separation of xylenols. The column already had a diameter of 900 mm. These packings were also used for heavy water columns. Sulzer gauze packings (Fig. 4) are still used for the distillation of temperature-sensitive materials such as perfume bases.

Mellapak™ for greater separating efficiency since 1976

The manufacturing of wire gauze is complex. In their search for an efficient and cost-effective solution, the use of thin metal sheets has been tested. Thanks to their special patented surface, good wetting of the sheets was achieved (Fig. 5). Sulzer introduced this new packing under the name Mellapak™ 250.Y at Achema in 1976. The first large orders were placed for a tall oil column in 1977 and a year later for a styrene column.

The Mellapak structured packing can be used as a revamp solution for existing columns. When customers replace separating trays or random packings with this packing in existing columns, they can either increase throughput or drastically reduce energy consumption. This explains their continued success on the market. Sulzer has continuously expanded the application area, on the one hand by varying the packing geometry, and on the other by using new materials such as plastics, ceramics and carbon fibers.

Another important application is air separation. The individual air components are separated from each other by low-temperature rectification to obtain nitrogen (N_2), oxygen (O_2) and noble gases. Packing types with a high separating efficiency are used here. The structured packings make air separation more economical because the considerable reduction in column volume allows the size of the cooled shell around the columns (cold box) to be reduced, and less cooling capacity is required.

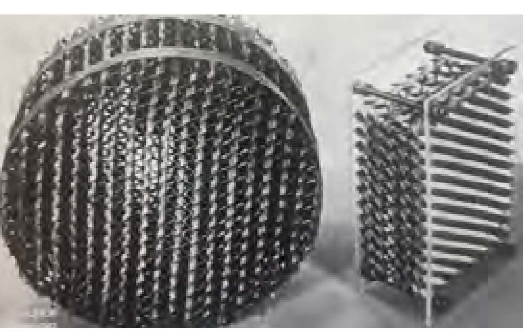


Fig. 4 The first generation of Sulzer gauze packing BX.

Fig. 5 Made of sheet metal with a special surface structure — Mellapak packing.

Fig. 6 Process installation for heavy water production in 1960.

A new generation of packing — MellapakPlus™

Detailed measurement of liquid holdup over the full height of a packed bed using gamma scanning showed an increased holdup at the interface of the packing layers. This phenomenon limiting the capacity could be confirmed with CFD calculations. By modifying this interface, the structure of the packing could be optimized in such a way that capacity could be increased by 20–30% with the same efficiency. This packing type was called MellapakPlus (Fig. 7) which quickly conquered the market in 1999.

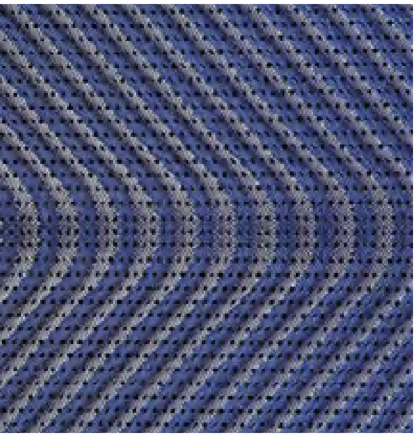


Fig. 7
MellapakPlus™ — the high-performance packing of Sulzer.

The MellapakPlus high-performance packing was specifically tested and optimized for new applications. The development of the absorption packing MellapakCC™, a packing type adapted for use in CO_2 separation (gas scrubbing), is worth mentioning.

Separating trays for further growth

The structured packings are particularly suitable for vacuum rectification due to their low pressure drop. For applications with normal or high pressure, separating trays are usually preferred. In 1987, Sulzer bought Metawa Tray in Tiel, the Netherlands, to better position itself in the market for separating trays. This company manufactured conventional separating trays and proprietary high-performance trays for Shell. This was followed in 1999 by the acquisition of Nutter in Tulsa, US, which had two tray types in its product range: one with fixed valves and the other with movable valves (Fig. 8). Based on this technology, Sulzer developed its own high-performance tray in the following years. The result is the VGPlus™ tray, which has proven itself on the market since 2004 and was further improved in 2012 with the special movable valve UFM™.

Fig. 8
Separating tray with movable valves.

Random packings in perfection

More than 100 years ago, distillation columns were mainly equipped with separating trays or random packings. With the acquisition of Nutter, Sulzer expanded its product range to include its own random packing, the Nutter Ring™. Sulzer's process engineering know-how and knowledge of materials was also incorporated into the further development of these products. The new Sulzer random packing NeXRing™ is a mechanically extremely stable, high-capacity ring of the fourth generation and was launched in 2015.

Mixing instead of separating

At the beginning of the 1970s, experiments on the propagation of gases in structured packings revealed remarkably good cross-mixing. This led to the idea of using the structure as the basis for a static mixer (Fig. 9). As early as 1973, the SME mixer (now the SMV™ static mixer) was presented to customers at Achema. The field of application is very large, from mixing liquids with large differences in viscosity (Fig. 10) to mixing gases (Fig. 11).

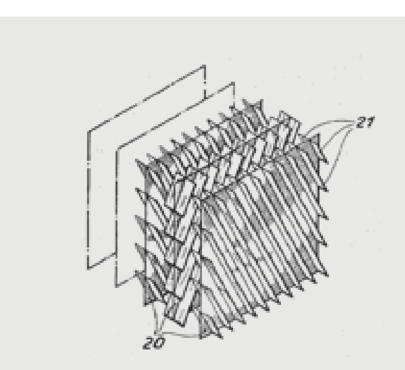


Fig. 9 Patent application for static mixing in 1972.

Fig. 10 Test of the SMV mixer in the lab.

Fig. 11 Installation of the SMV mixer for flue gas.

In 1975, Sulzer acquired a license from Bayer for the BKM, a static mixer for viscous liquids. This mixer is successfully marketed by Sulzer under the name SMX™. Another proven product is the Sulzer SMR™ mixing reactor. It was licensed from Höchst in 1985. This is a tubular bundle system built in the form of an SMX structure. An important application for the SMR mixing reactor is the polymerization reaction for the production of plastics such as polystyrene or polylactide (PLA). Sulzer subsequently developed other, similar products: the SMI™ static mixer for turbulent flows (1996), the very compact CompaX™ mixer for admixture of additives (2004), and the Contour™ gas mixer for flue gas cleaning systems (2007).

Further milestones in separation and mixing are:

- In 1982, Sulzer began using crystallization as a separation equipment after acquiring MWB Buchs in Switzerland.
- In 1996, the first two-component Quadro mixer was launched by Sulzer and laid the foundation for the later establishment of a new Sulzer division (Applicator Systems) in 2017.
- Since 2000, thanks to a license agreement, Sulzer has been able to manufacture and distribute products developed by the Shell Corporation.
- In 2007, Sulzer acquired part of the business of the UK company Knitmesh and has since offered separators and mist eliminators.
- The integration of Kühni in Allschwil, Switzerland, in 2009 brought additional products and equipment for thermal process engineering into the product portfolio.
- Since 2010, most process technology tests have been carried out at the customer test center in Allschwil.
- Sulzer's distillation technology supports sustainable energy production where microbes are used to produce biofuels. After intensive process tests in Allschwil the steel producer ArcelorMittal ordered in 2018 Sulzer equipment for the production of biofuels out of carbon-monoxide-rich gas.

Plastics technology and bioplastics

Sulzer acquired the German company Aixfotec in 2014. Its plants for the production of foamable polymer granules and for the foaming of polymers are well-established in the market. The product portfolio for foamed products (Fig. 12) is expanding steadily and now comprises expandable polyethylene terephthalate (XPET).

Sulzer had the foresight to develop a production process for bioplastic polylactide (PLA, Fig. 13) and installed a process plant in the market already in 2010. The world's largest PLA plant was installed in 2018 and uses Sulzer's technology. Sulzer sells complete polymer systems for the production of PLA (Fig. 14), or only the key equipment as required. Sulzer continues to focus on the development of further bio-based polymer technologies, which represents an important contribution to the protection of our environment.

Fig. 12 Rolls for fascia training – produced with Sulzer's patented process for foamed polymers.

Fig. 13 Biodegradable bioplastic polylactic acid (PLA).

Fig. 14 Installed in 2010 — production plant for bioplastics.

Main milestones in Chemtech's history

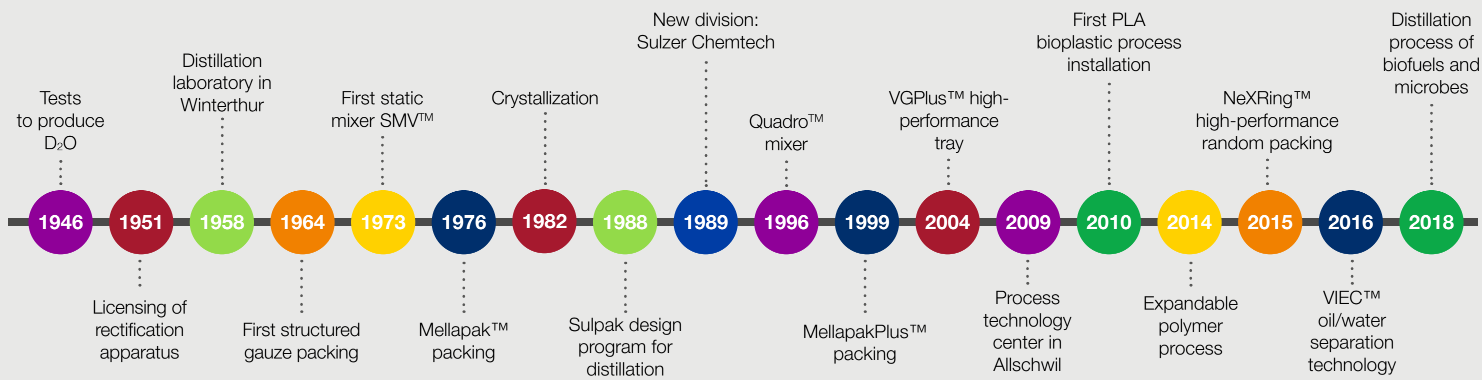


Fig. 15 Important milestones of the history of Chemtech.

A Danish company developed a novel conversion process for recycling mixed plastic waste and uses Sulzer's distillation technology as an important part of the depolymerization process.

Closer to the source

Since the integration of the Dutch companies Ascom and ProLabNL in 2014, a large test center for separation technologies revolving around crude oil, water, sand and associated natural gas has been available to Sulzer customers. This allows customers to benefit from extensive technology expertise in the processing of petroleum flows near the production site. This technology is particularly important in offshore and subsea applications for the elimination of water, sludge and sand. VIEC™ technology, acquired in 2016, is used to separate difficult-to-separate oil/water mixtures using electric fields, expanding Sulzer's offering in this area.

Calculation basis for developments

At Sulzer, product development is based on two main pillars: computational fluid dynamics (CFD) calculations and tests in the company's own laboratories, including the validation of CFD calculations. For customer-specific projects, CFD simulations are used to calculate the flow dynamics of gases or liquids in order to optimize the design of the systems and save energy.

Digitalization to serve customers

Sulzer made its first digital design program, Sulpak, available to customers as early as 1988. Today, this knowledge is contained in the SULCOL™ calculation program. The program is available to Sulzer customers for the design of separation columns and is based on years of experience from the process engineering laboratory, combined with theoretical knowledge gained from cooperation with leading universities and scientists.

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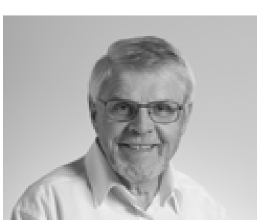

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