

Perfect mixing with minimal pressure drop

The new static mixer

Sulzer Chemtech is the technology and global market leader in the static mixing and reaction technology sector. In this sector, fluids and gases are mixed by fixed elements in a pipe or channel. Sulzer has been refining the principle of static mixing for 40 years now. Today, static mixing is an established process in a very wide range of market segments, such as refineries, oil and gas, chemical industry, polymer production, and food technology. For years now, the SMX™ static mixer developed by Sulzer has held a leading position when it comes to mixing viscous fluids. Thanks to innovation and continuous further development, the new generation of the SMX static mixer is more compact and offers customers outstanding mixing performance with only half the pressure drop.

With thick and laminar flowing fluids—so-called viscous fluids—the mixing effect is produced through the formation and redistribution of layers. While very simple mixer structures are usually used for thin fluids—so-called low-viscosity

fluids—and also for gases, mixing viscous fluids is very challenging; only special mixer structures produce a sufficient mixing effect. In applications of this type, the SMX™ static mixer developed by Sulzer has occupied a leading position for years now. The SMX mixer can be

used for fluids with varying grades of viscosity. It is also possible to mix low-viscosity additives into highly viscous fluids and to create fine dispersions of insoluble components. The mixer has also proven itself for reactions with a narrow residence time spectrum.



Refinery with mass transfer columns to extract raw materials—among other things for the plastics industry.

Still, might it be possible to develop an even better mixer? A mixer that is even shorter and more compact and one that produces a better mixing effect with less pressure drop?

The path to the perfect mixer

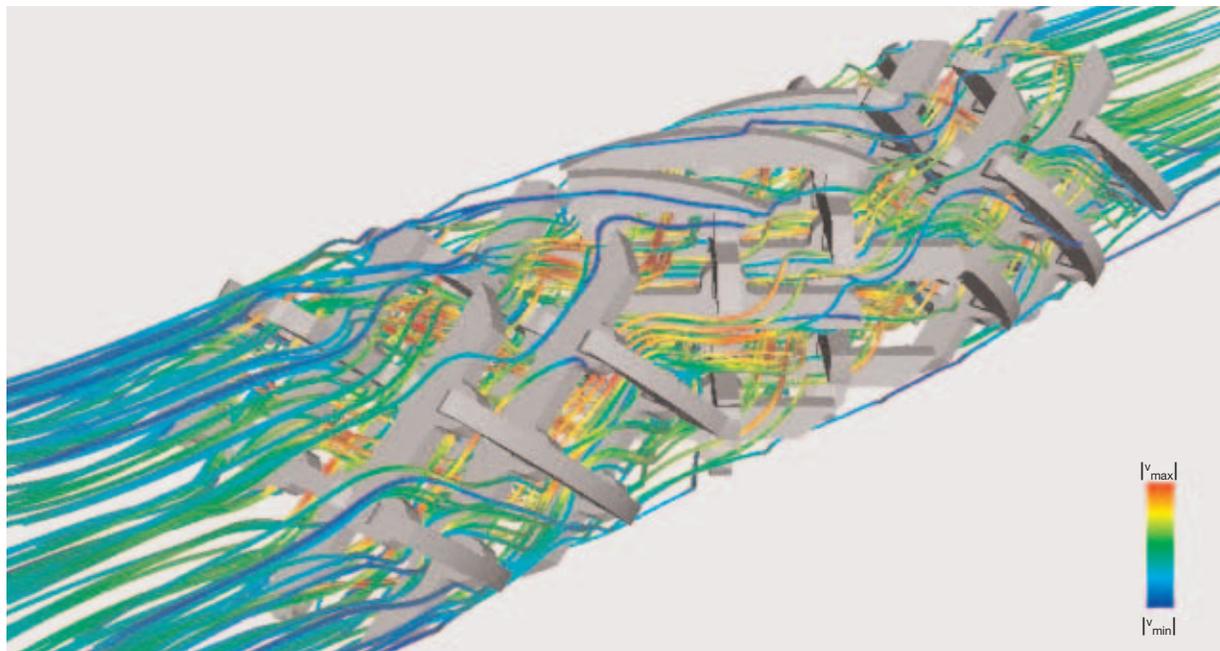
Through the years, there have been numerous unsuccessful attempts to optimize the SMX static mixer. Increasingly, it was questioned whether it was even possible to further improve the mixer. In cooperation with Sulzer Innotec, the existing SMX mixer was studied with all of its degrees of freedom. Using computational fluid dynamics (CFD), parameters such as bar width, angle, thickness, spacing, and combinations thereof were varied and their influences analyzed [1]. In the past, the only way to carry out such

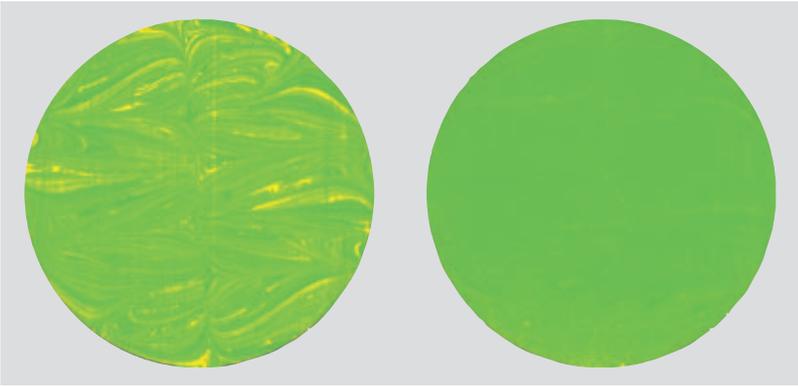
development projects was with time-consuming and expensively built prototypes in countless lab tests. Now the new, automated CFD simulation method makes it possible to analyze and evaluate numerous variants systematically [2]. The results of the simulation astounded even long-time experts in the field. It turned out that, with certain configurations, changing the distance between the crossed bars reduces pressure drop by half—with no reduction in mixing performance. This analysis was followed by additional tests with various measuring techniques, for example, the laser-based LIF (laser-induced fluorescence) method that confirmed these results. Very good results were also obtained with dispersion tasks and with mixing of fluids with widely varying viscosities.

Economic aspects of manufacturing

In addition to optimization of the mixer structure, manufacturing was also a challenge. It quickly became apparent that it would not be cost effective to transfer conventional manufacturing process for the SMX mixer to the new SMX™ plus mixer. For this reason, various alternative manufacturing processes were evaluated and analyzed with regard to feasibility and efficiency. The focus was not only on the manufacturing costs per se, but also on factors such as mechanical stability and suitability for decentralized production. It was also clear that a uniform global standard should be introduced as a basis for later global sourcing. Brazing the modular bars for large nominal widths and special casting processes for small nominal

[1] Innovative breakthrough thanks to systematic analysis of variables through automated CFD simulations.





2 SMX™ plus static mixer: comparable mixing performance with half of the pressure drop in comparison with the SMX mixer; concentration distributions after eight and ten mixing elements respectively (dosing ratio 1:1, viscosity ratio 1:1).

widths were considered as methods of manufacturing. Here, two appealing methods were found that evidence two clear advantages over the present-day manufacturing process: increased stability and lower cost.

More compact and less expensive

The new SMX plus mixer, for which an application for a patent has been filed, offers substantial advantages over competing mixers. It can be made much shorter and more compact for a specified maximum allowable pressure drop. Besides very short residence times and minimal space requirements,

this also leads to much lower investment costs. The strongly reduced pressure drop, however, can also be used directly. Viscous fluids, for example, can be mixed much more gently thanks to extremely low shear rates, which is especially advantageous with sensitive products such as polymers. Moreover, the lower pressure drop means lower anticipated investment and operating costs for the pump. Thanks to the optimized manufacturing process, the SMX plus static mixer is also suitable for applications with high pressure drops and can be offered at affordable prices.

The new standard

The SMX plus mixer had its official market launch at the end of 2008. Now many mixers are in operation—to the complete satisfaction of the customers. The SMX plus static mixer is the new standard when it comes to mixing viscous fluids in laminar flows. It defines the benchmark against which the competition will have to measure itself in the future.

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3 SMX™ plus static mixer: minimal pressure drop thanks to an innovative open structure.



4 SMX™ plus static mixer with housing and removable mixing element.

