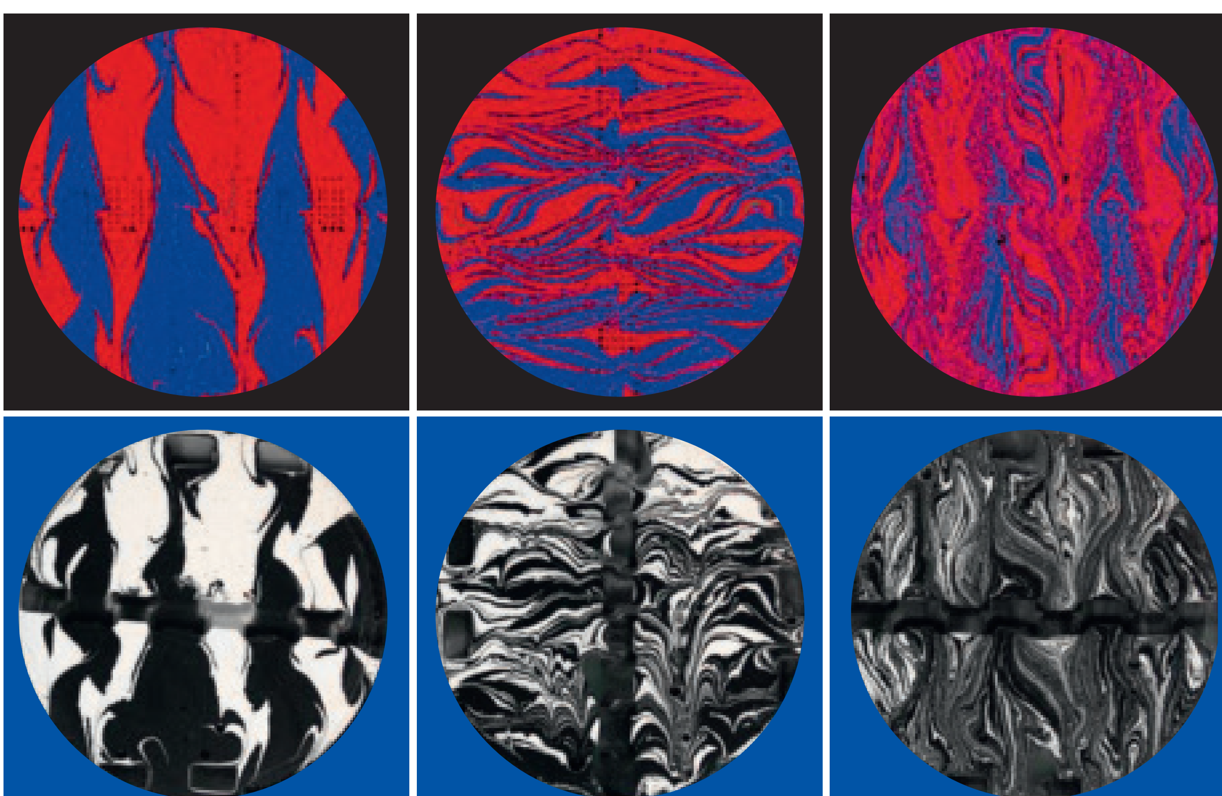
Reproducible mixing results thanks to simulation

Calculation instead of trial

Sulzer is making use of a completely new calculation system for mixtures in medical technology. Medical technicians face the daily challenge of reproducibly mixing a homogenous mass from several substances—for example, when making dental impressions. Until now, users and manufacturers of mixtures have had little information about the behavior of the various components in the mixer, so that many mixing trials have been necessary. Sulzer's new approach facilitates the determination of the optimal mixing ratio and the selection of a suitable dispenser.

CFD simulations (computational fluid dynamics) have so far been used commonly, above all, in the automotive and aviation industries, but are still largely unknown in medical technology. Thanks to many years of research, Sulzer Mixpac has a great deal of experience in this field and wants to make its expertise in the development of innovative products available to its customers. Sulzer is the only company in the world that applies CFD technology for multicomponent mixtures in medical technology. These CFD simulations are mainly used in the optimization or development of multicomponent mixtures for use by dentists.

The results of the CFD simulation (top) correspond well with the mixing trials (bottom: section through the hardened epoxy resin).



All the components at the right place at the right time

The goal of the simulation is to achieve an optimal mixing ratio of a number of components. Factors such as viscosity, pressure, density, and surface tension affect the flow of a substance. The experts at Sulzer Mixpac simulate the mixing process based on the mixing geometry and the material properties of the components. In this way, they can find the dispenser that produces the best mixture and homogeneity. Furthermore, the optimal holding time for a substance in the mixer can be calculated with the CFD simulation. This should not be too long—to ensure that the components do not already react with each other before leaving the mixer. The pressure that must be applied to press the mixture out of the mixer should also not exceed the hand strength of the user. The simulation ensures that the two materials come into contact in the mixer at the right time and remain in the mixer for the same period of time.

Because medical technology predominantly uses viscous materials, Sulzer Mixpac largely focuses on the flow behavior of highly viscous substances. The components thereby move in a laminar way—that is, in layers—without visible turbulence. When Sulzer receives data on the material properties of a substance from the customers, the engineers can start calculations directly. If the customer does not have information on the properties of the materials, such as the viscosity curves (rheology), Sulzer is able to determine these.

Modern research center

Sulzer carries out material tests and simulations for its customers in its in-house application laboratories. A specially equipped computer center consisting of a cluster of more than 200 high-performance processors is available for the simulations. If the calculations deliver the desired results, the next step is the real mixing of the components. Comparison images demonstrate that the simulations correspond well with the mixing ratios that are actually measured. The following applies here: the more accurate the boundary conditions of the calculation are, the more accurate the result will be.

Customers benefit from the simulation method in two ways: they save time through a shorter time to market as well as costs through the reduced consumption of disposable mixers for test purposes. With the introduction of this new offer, Sulzer Mixpac can position itself as the technology leader in the field of CFD for multicomponent mixing systems.

Dietmar Salzgeber is responsible for medical technology products at Sulzer Mixpac. He discusses the expanded range of offers for customers.

Why does the medical technology industry need high-tech simulations?

Until now, this industry has mainly used trial-and-error methods. This means that dentists, medical technicians, or the providers of compounds have carried out mixing trials by hand. In many cases, the users only know whether and how two components react to one another after a large number of tests—and the chemical reactions behind it remain a mystery. Exactly the same result seldom arises twice with this approach. It is often very difficult to determine the mixing quality—in particular with components of similar colors. In addition, the time to market is very long and cost-intensive for new product development.

Mixing trials by hand sounds like a lot of waste …

Indeed. Until a perfect mixing ratio has been found, there is an enormous and unnecessary loss of disposable mixers and material. This is inacceptable in times of increasing environmental awareness and rising raw material prices.

What is the advantage of computational flow simulation?

Optimal mixing ratios can be determined with the help of CFD simulations, and efficient and reproducible mixing results are guaranteed. The entire development process can be significantly shortened.

How did you come up with the idea of using CFD methods?

We had previously primarily used CFD simulations internally to optimize the development of our mixing systems. Flow simulations help us to develop completely new mixing technologies, such as the MIXPAC™ T-mixer. The idea thereby arose that our customers could also benefit from this method.

How have you been able to implement the idea?

We have benefitted from the expertise of the Sulzer corporation, which has more than 175 years of experience in the field of the flow behavior of substances. Through the intensive promotion of innovation and the financial support of the corporation, we have been able to expand our own service portfolio at Sulzer Mixpac with such attractive offers as CFD simulations for customers.

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