"Trial and error" belongs to yesterday
More exact definitions due to CFD simulation

The creation of reproducible mixing ratios plays a role not only in modern industrial 2 component adhesive applications for the automotive industry, aerospace and electronics but also in medical technology, which requires application systems for mixing, metering and applying two or more components. How the current game of chance when mixing components can be replaced by reliable, reproducible results in the future is being demonstrated by the Swiss company Sulzer Mixpac AG by using computational fluid dynamics (CFD) for the calculation.

Manufacturers of multicomponent compounds, particularly in the medical sector, can have the optimal mixing ratio calculated exactly and can thereby also determine the optimal application system for their multicomponent materials. They thus save themselves protracted and expensive tests, or the high consumption of disposable application systems, in order to find a suitable application system.

Sulzer Mixpac AG, a subsidiary of the internationally established Sulzer Group, has its business in the development, production and distribution of mixing, metering and application systems based in the Swiss Rhine Valley. The company is the global leader in two-component mixing systems, which are used, for example, in the processing of viscous materials in orthopedics, vascular surgery, wound care or in the dental sector. In its product development, Sulzer Mixpac benefits from the know-how of its parent company, which, with a total of more than 17,000 employees, is a leading pump manufacturer and has over 175 years of experience in the area of the flow behavior of materials.

"The overall spectrum of products offered by the Sulzer Group allows us to expand our own service portfolio," says Dietmar Salzgeber, who is responsible for medical products at Sulzer Mixpac. This is possible due to "our secure roof", as Mr. Salzgeber calls it, referring to the intensive promotion of innovation as well as financial backing by the Group.
CFD revolutionizes mixing systems for reproducible results

The close interconnection between the product and the service in medical technology increases the demands placed on the materials used. These materials determine whether the end user will be able to optimally perform his/her service for the treatment of the patient. It is therefore necessary to know precisely the composition and the behavior of the various components and to adapt the design of the mixer in individual cases. To improve the application of the respective compounds for persons in the medical profession, as well as to improve the quality of the devices, Sulzer is relying on what is a completely new calculation system in medical technology.

CFD simulation (Computational Fluid Dynamics), has to date been commonly used in the automotive and aerospace sectors in particular, but is still largely unknown in medical technology. Due to many years of research, Sulzer Mixpac has a wealth of experience in this area and offers its know-how to its customers through the development of innovative products. It is the only company worldwide to use the technology for multicomponent mixtures used in medical technology.

CFD simulations are used particularly for optimizing existing products or in the development of new products by the manufacturers of multicomponent compounds for end users such as dentists or dental technicians. The challenge in mixing several materials is to obtain reliable information as to how an homogeneous compound is created from them, which can be reproduced at any time. This a requirement that medical technicians are faced with, for example when making dental imprints.

Dietmar Salzgeber explains: „The ‘trial and error’ method has prevailed to date, which means that dentists, medical technicians or providers of compounds mix the respective components by hand. It is often only after a large number of tests that providers know whether and how two components react with one another – why and what chemical reactions are behind this remain a secret. On the one hand, this way of doing things never produces the same result twice – it is particularly hard to determine the mixing quality for components of a similar color. On the other hand, the time-to-market for new product developments is many times longer and is more cost intensive.

CFD allows you to not only find out the optimal mixing ratios and to therefore guarantee efficient and reproducible mixing results, but it also enables you to considerably shorten the entire development process.” Shorter time-to-market and greater reliability of the mixing result due to the optimal application system therefore provide a valuable competitive advantage for manufacturers of 2-component materials.

A and B in the right place at the right time

The objective of the simulation is to achieve an optimal mixing ratio for multiple components. Factors such as viscosity, pressure conditions, density or surface tension have an effect on the circulation of a substance.

Based on the mixing geometry and the material properties of the components, the experts at Sulzer Mixpac simulate the best possible application system to generate a high mixing quality or homogeneity. The CFD simulations can be used to calculate the optimal dwell time for a substance in the mixer. For example, the dwell time cannot be too long to ensure that the components do not already react before leaving the mixer. It would also be counterproductive, for example, if the pressure to be applied to squeeze the compound out of the mixer was so high that it exceeded the manual strength of the user. Computational fluid dynamics can also be used to ensure that two substances meet each other at the right time, i.e. that they are in the mixer for the same amount of time.
Know-how and experience make it possible

As it is primarily viscous materials that are used in medical technology, Sulzer Mixpac is focusing on the flow behavior of highly viscous substances. The components move in a laminar fashion, i.e. in layers without visible turbulence. If Sulzer receives data from its customers regarding the material properties, the engineers can start the calculation straightaway. If the customer does not have these properties, such as the viscosity curves (rheology), available, Sulzer offers to determine them for the customer.

„In our application laboratories, we conduct material tests for our customers for the selection of the product configuration,” says Dietmar Salzgeber. The simulations are carried out in a data center specifically set up for this purpose comprising a cluster with over 200 high-performance processors. When a calculation shows the optimal result there, the next step is the „real“ mixing of the components. Comparison images show that the simulations are a very good match with the mixing ratios actually measured. The rule here is: The more precise the boundary conditions of the calculation, the more precise the result.

Thanks to the experience of the corporate Group, Sulzer Mixpac is able to position itself in the CFD sector for multicomponent mixing systems through the targeted use of know-how. The advantage for customers is obvious: they reduce their time-to-market and save costs by cutting down on the consumption of disposable application systems for test purposes. „We are already looking forward to presenting our new offering at the COMPAMED trade fair at Düsseldorf, this November. Because our competitive advantage also means a competitive advantage for our customers. Customized mixing and application solutions for chemical formulations can be calculated and provided in substantially shorter time, “ says Mr. Salzgeber in conclusion.

Internal use: Test passed

„To date we have used CFD simulations primarily internally for, among other things, the development of our T-mixer, a completely new mixing technology, which produces a significantly better result for certain components. Our original reason for incorporating CFD was to optimize the development of our mixing systems. Our new customer can also benefit from this straightaway,” explains Mr. Salzgeber.

The company tests all component mixing systems, also in the way that they will be used later by the customer. „An enormous amount of disposable mixers are wasted until a perfect mixing ratio is achieved. In times of increasing environmental awareness and rising commodity prices, this means that mixers and materials are wasted unnecessarily – and with no guarantee of a qualitative result,“ Mr. Salzgeber goes on to explain.

Figure 4: T-Mixer with newly developed mixing technology