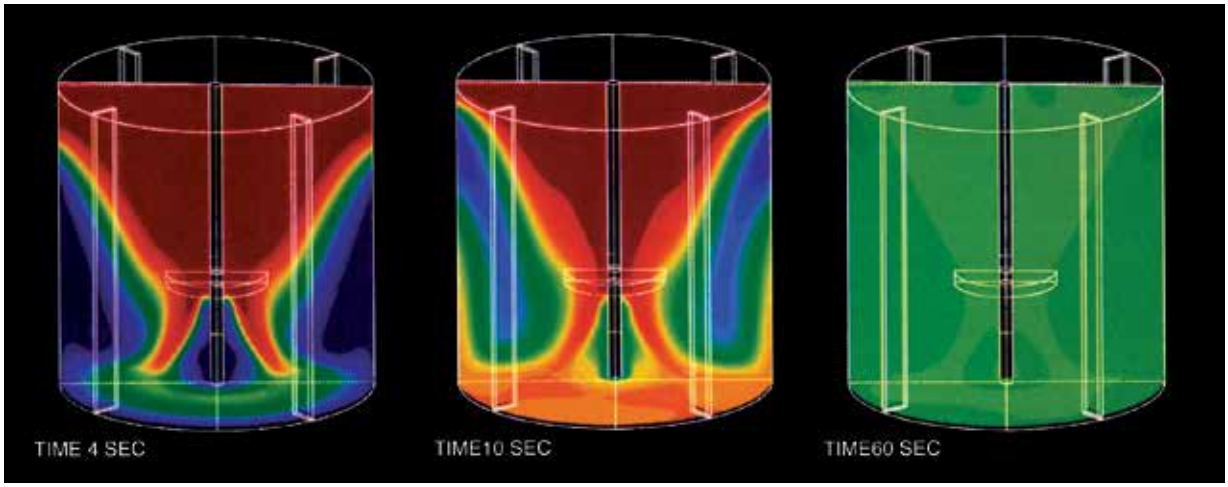
Chemineer

Computational Fluid Mixing (CFM)



Computational Fluid Mixing (CFM) is a powerful tool that is used to mathematically model fluid flows of different agitator/impeller designs in mixing tanks. Other valuable analyses include the mixing and reaction rates of chemicals and heat transfer. The CFM example above illustrates predicted agitated blend times.

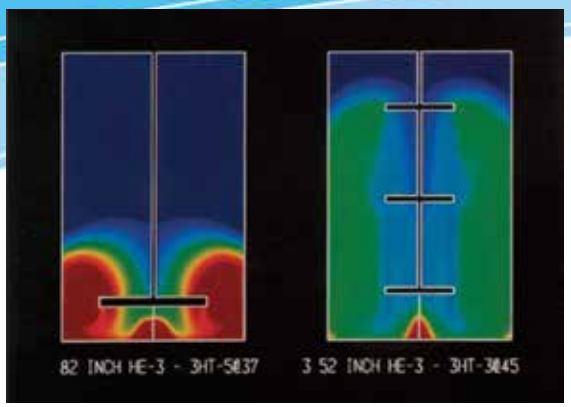
Mixing of single and multi-phase fluids in stirred tank reactors is a common operation in many industries. Understanding the fluid flow in these tanks is critical for equipment design, scale-up, process control, and economic factors. CFM models allow you to see what is taking place in the mixing vessel. The results enable an engineer to select the best agitator design to obtain the desired process performance.

Flow patterns in stirred tanks are complex and CFM modeling can be a time-consuming process. A CFM expert may need as long as 3 days to define all of the equations and run the program. To streamline this process, Chemineer developed a software interface program called AgFlow. AgFlow greatly reduces the time and technical expertise required to perform a CFM analysis. When AgDesign, a program from Chemineer's Expert Design System (CEDS™), is used to determine your agitator needs, a CFM model is easy to generate. AgFlow extracts the necessary data from the AgDesign file and automatically creates the mathematical model for the Fluent™ solver. Fluent then performs the flow pattern calculations and generates graphics output. Chemineer engineers can obtain a two-dimensional CFM analysis in as little as 10 minutes, and 3·D analysis in 3 to 4 hours of computer time, all without having to be CFM experts.

If your application is gas dispersion or solids suspension, we can perform CFM analysis on your process using our proprietary software Ghost! (Gas Hold-up Simulation Tool). Ghost! was originally developed at Delft University of Technology in the Netherlands and has been further enhanced by Chemineer CFM experts. For gas dispersion applications Ghost! will calculate color coded maps of the distribution of the gas, the local bubble size and the local mass transfer coefficients. These maps can be used to compare alternative agitator designs and to optimize your process. The accuracy achieved is impossible to capture with purely experimentally based design procedures.

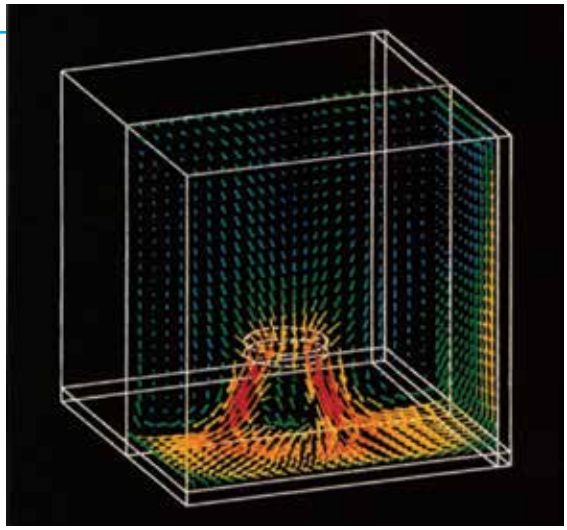
These analytical capabilities are not limited to just cylindrical stirred tanks. Rectangular and side-entering agitated tanks as well as turbulent and laminar flow static mixers can all be successfully evaluated using our CFM technology.

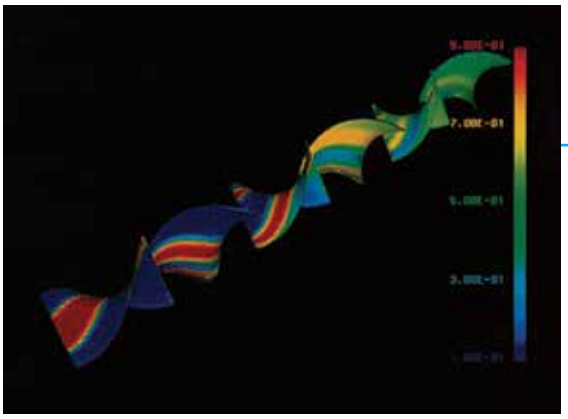
Our CFM models receive extensive validation using advanced experimental techniques. Chemineer is the first in the industry to use laser based Particle Image Velocimetry (PIV) for mixing analysis. The unique data obtained with PIV further improves our modeling capabilities and provides you with the most accurate design for your agitation needs.



This photograph shows a color coded map of the local solids concentration in two industrial reactors. Regions with high solids concentrations are colored red and low solids concentrations are colored blue. Maps like these can be used to compare different impeller systems and to optimize your agitator design. In this example, the reactor on the left is equipped with only one impeller drawing 5 HP. All of the solids are concentrated in the lower part of the tank. The reactor on the right, however, is equipped with three impellers but is only drawing 3 HP The three-impeller design indicates a much more homogeneous distribution of solids in the tank. Chemineer can perform CFM analysis on your blending, solids suspension, or gas dispersion process problem and provide you with the optimum design solution.

The graph shows the flow pattern in a rectangular tank equipped with a top-entering impeller. Such reactor configurations are common in a variety of industries and can frequently be found in paint production, paper pulp chests, and in water and wastewater treatment plants. The flow pattern is shown by means of velocity vectors. The vectors point in the direction of the liquid flow, at the point where they originate. The length of the arrows is proportional to the liquid velocity. The high-efficiency impeller (Chemineer HE-3 impeller) generates an axial jet that sweeps the tank bottom. The strong circulation flow pattern ensures thorough mixing of the tank contents. We can provide CFM analysis on your application based on your specific tank parameters and agitator installation, including top, bottom, and side-entering designs.





Chemineer's Kenics static mixers are used extensively for inline mixing of viscous materials such as polymers, paint, food, etc. This graph shows the mixing of two chemicals, red and blue, in a static mixer containing six helical elements. The color of the mixture is plotted on the surface of the mixer elements, showing how the mixing progresses as the fluids move through the pipe. This calculation was performed in cooperation with Cray Research on a Cray YMP-C90™ supercomputer. CFM analysis is available on static mixer and heat exchanger requirements.

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