Digital Particle Image Velocimetry

Chemineer utilizes a Digital Particle Image Velocimetry (DPIV) system in our Research and Development Laboratory to ensure that the latest technology is used in developing and sizing your agitators.

What is DPIV?

DPIV is a measuring technique that provides flow visualization and quantitative measurement of a velocity field. Two sequential digitized images are taken of a fluid seeded with small particles, also called markers. The particles may be solids in gases or liquids, gaseous bubbles in liquids, or liquid droplets in gases.

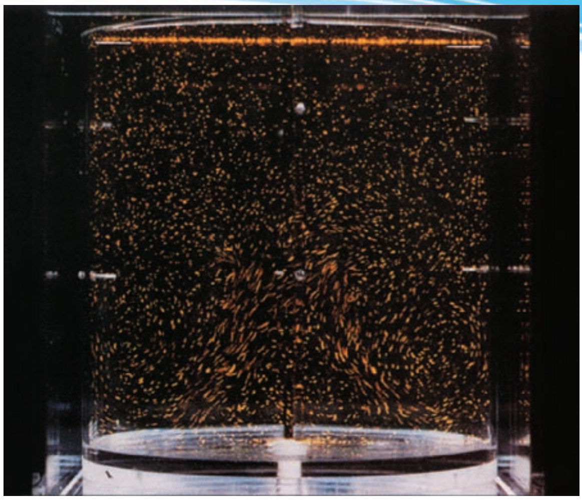
Chemineer's DPIV system uses an Argon-Ion laser light sheet to illuminate fluorescent, neutrally buoyant particles, a CCD camera to capture the images, an advanced timing system and a computer with image board to freeze and digitize the images. This digitized information is automatically analyzed by advanced software that performs the cross-correlation analysis of the two views and extracts the velocity vector field from the data.

Advantages of Using DPIV

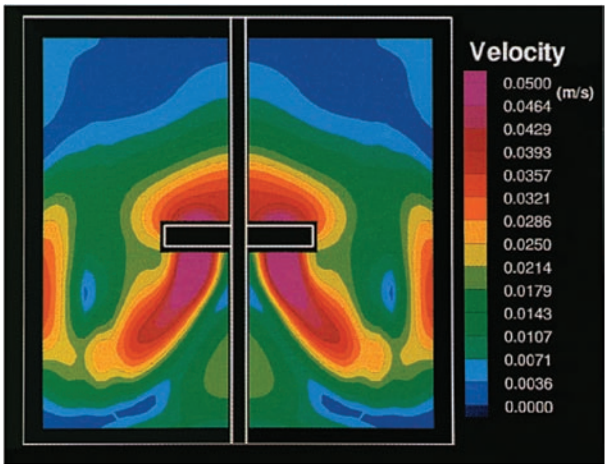
Accuracy, speed and efficiency are just some of the benefits of DPIV. This technology has the capability of measuring the entire fluid velocity field in a tank almost instantaneously. This makes it possible to study large-scale, time-dependent phenomena in the tank, which are responsible for much of the mixing process. In contrast, point measurement techniques such as Laser Doppler Velocimetry and hot wire anemometry can only measure the liquid velocity at one location at a time.

Computational Fluid Mixing (CFM) is another technique used extensively at Chemineer to study agitated vessels and static mixers (Chemineer Bulletin 750). Various mathematical models used by the CFM software must be validated to ensure the accuracy of the results. DPIV analyses provide that validation with actual experimental data and, if necessary, DPIV test data can be used to further improve CFM models so the predictions have an even higher degree of accuracy.

DPIV helps us better understand the flow phenomena occurring in mixing tanks. As a result, we can better design agitation equipment for your specific application. Providing the most efficient equipment for your process can result in both cost and energy savings for you.

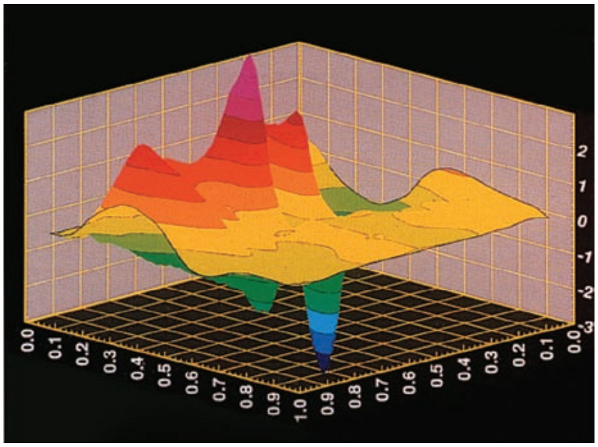


The picture on the right shows the motion of fluorescent particles illuminated by a sheet of Argon-Ion laser light. The particles (60 micrometers) are small and neutrally buoyant, so they follow the liquid flow. The tank is equipped with a pitched-blade turbine. The particle motion is filmed with a CCD camera. The velocity field is then extracted from the digitized images using cross-correlation software.



The image to the left shows the result of a series of full flow field measurements using DPIV. The color shows the local, time-averaged velocity. Fast-moving regions are colored red and slow-moving regions are colored blue. The pitched-blade turbine creates a mixed axial/radial flow pattern. The highest velocities are found at the impeller blade tip. The velocities at the liquid surface are an order of magnitude lower.

The measured velocity field (above) can be used to calculate other flow field information, such as shear stress, stream function, vorticity, etc. The graph on the right shows a vorticity field calculated from the DPIV data. Positive peaks in the vorticity function show regions of strong counterclockwise circulation. The liquid circulates clockwise in regions with a negative vorticity.



Chemineer Prochem Kenics Greerco

Chemineer, Inc.
5870 Poe Avenue
Dayton, Ohio 45414
Telephone: (937) 454-3200
Email: chemineer@nov.com

Chemineer, Ltd.
7 Cranmer Road, West Meadows
Derby DE21 6XT, England
Telephone: 44-1-332-546700
Email: chemineeruk@nov.com

Chemineer China
Room 2006, Modern Plaza
369 Xianxia Road
Shanghai 200335 China
Telephone: 86-21-61240001
Email: chemineercn@nov.com

Chemineer, Inc.
125 Flagship Drive
North Andover, MA 01845
Telephone: (978) 687-0101
Email: navinfo@nov.com

www.kenics.com
www.greercomixers.com

Chemineer International Sales Offices:
Brazil
Mexico
Singapore

Bulletin 755

1-800-643-0641 • www.chemineer.com

NOV Mono

Printed in U.S.A. 913