



INNOVATION THROUGH  
MICROFLUIDIZER® PROCESSOR  
HIGH-SHEAR  
FLUID PROCESSING TECHNOLOGY

— NANOEMULSIONS  
— NANODISPERSIONS  
— CELL DISRUPTIONS  
— NANO/MICROENCAPSULATION  
— DEAGGLOMERATION

 **Microfluidics**

## INNOVATE WITH US™

Take advantage of nanotechnology and innovate with us. Uniformly-sized nanoparticles are a common denominator among our customers' many breakthrough (and often patented) high-performance products. Since our founding in 1983 we have enabled our customers to develop new and innovative products, new intellectual property, and new revenue streams. Those customers have improved their existing products and created products that were not previously possible, by getting from "Can this be done?" to "Here's how this can be done."

We serve a global customer base of several thousand companies in the pharmaceutical, biotechnology, chemical, cosmetics, food and beverage and other industries, as well as researchers at many of the top universities worldwide. By providing industry-leading Microfluidizer® high-shear fluid processors and unparalleled applications expertise, we help them to capture competitive and economic advantages in their formulation and manufacturing of numerous materials and products, many to the nano-scale size. From laboratory to pilot and full-scale manufacturing, our customers are able to achieve the smallest particles, tightest particle size distribution and high process efficiency for their liposome, emulsion, dispersion, encapsulation, suspension, deagglomeration and cell rupturing applications.

### THE MICROFLUIDICS DIFFERENCE: TECHNOLOGY

- **Outperforms alternatives** – Produces smallest particle size and narrowest particle size distribution
- **Ease of scaleup** – Cuts time to market through rapid transition from lab to production with no basic change in product formulation or process design
- **Efficient processes** – Typically requires less processing due to highest shear force in the industry
- **Reproducible results** – Delivers a highly repeatable procedure, resulting in consistently uniform product of high quality
- **Breadth of product line** – Offers best fit for your needs, including the industry's widest selection of lab units

### THE MICROFLUIDICS DIFFERENCE: COMPANY

- **Applications expertise** - Unparalleled applications expertise developed through several decades of experience with thousands of companies and hands-on work with a wide variety of customer formulations each year at the Microfluidics Technology Center
- **Enabling customer success** – Via process consultation and other services as you consider and after you invest in a Microfluidizer processor
- **Global presence** - Ability to serve your operations worldwide

Leading companies worldwide rely on Microfluidics to help them solve their toughest formulation challenges. Who owns a Microfluidizer processor?

- 4 of the top 5 chemical companies
- 8 of the top 10 biotech companies
- 17 of the top 20 pharmaceutical companies

## CUSTOMERS

Abbott Laboratories	DuPont	Merck
Air Products	Eastman Kodak	Monsanto
Allergan	Eli Lilly	Nalco
Amylin Pharmaceuticals	Exxon	Novartis
Armstrong	GAF	Pfizer
Avon	General Electric	Polaroid
BASF	General Motors	PPG Industries
Baxter	Georgia-Pacific	Procter & Gamble
Beckman Industries	Gerber	Quaker (PepsiCo)
Becton, Dickinson	Gillette	Rohm and Haas
Bristol-Myers Squibb	Goodyear	Sanofi Aventis
British Petroleum	GSK	Schering-Plough
Campbell Soup	Helene Curtis	Sherwin-Williams
Celanese	Hercules	W.R. Grace
Chevron	Hershey Foods	Xerox
Church & Dwight	International Flavors and Fragrances (IFF)	
The Clorox Company	Johnson & Johnson	
ConAgra Foods	Kimberly-Clark	
Conoco-Phillips	Land O'Lakes	
Corning	Martin Marietta	
Del Monte	McCormick	
Dow		

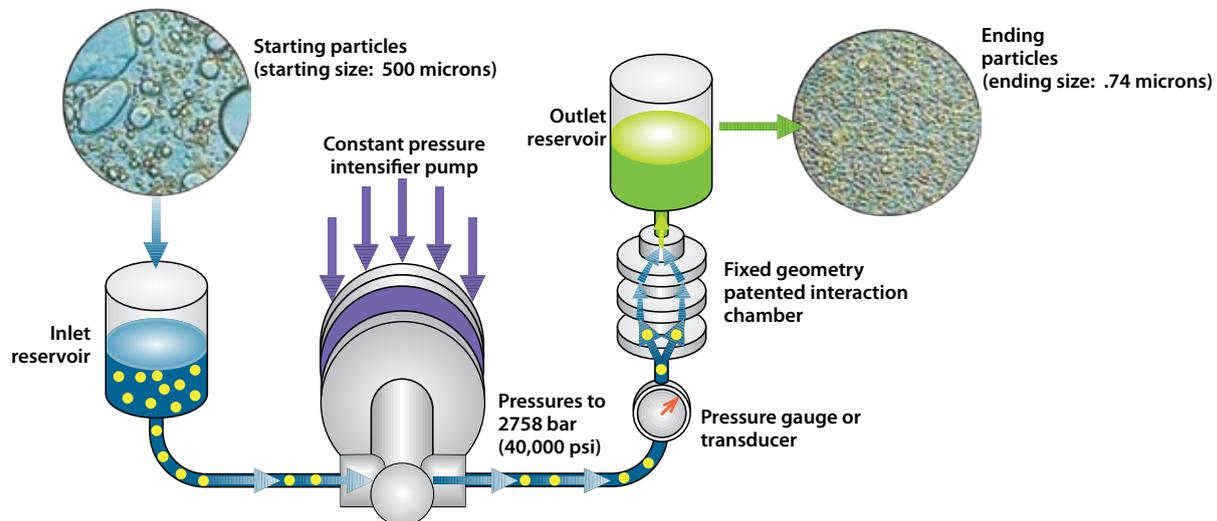
“The overall satisfaction which we experienced with our laboratory model Microfluidizer processor eliminated the need to consider other equipment when it was time to scale up to production capabilities. In our application of E. coli cell disruption, we achieve a rupture rate in the 90% range with just two passes.”

— Amylin Pharmaceuticals

## THE MICROFLUIDIZER PROCESSOR DISTINCTION

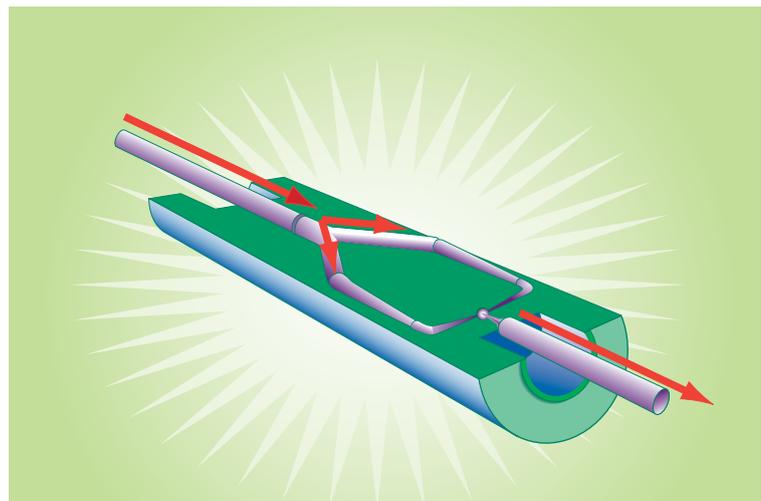
Innovative Microfluidizer processor technology revolutionized fluids processing with its fixed geometry (no moving parts) interaction chamber. Within the interaction chamber, highly-pressurized liquid product streams travel at high velocities through precisely defined microchannels producing high-shear forces. Unlike alternate processing technologies, our technology exposes 100% of your product to the same processing conditions, all the time, every time. As a result, your formulations will be consistent and reproducible, and they will scale readily from laboratory to production. The Microfluidizer processor's efficiency enables you to meet your processing objectives with fewer passes than alternatives.

## THE MICROFLUIDIZER PROCESSOR FLOW DIAGRAM



## CUTAWAY VIEW OF AN INTERACTION CHAMBER

*The intensifier pump drives the product through precisely defined fixed-geometry microchannels within the interaction chamber. As a result, the product stream accelerates to high velocities, creating shear rates within the product stream that are orders of magnitude greater than any other conventional means. All of the product experiences the same processing conditions, producing the desired results, including uniform particle and droplet size reduction (often submicron), deagglomeration and high yield cell disruption.*





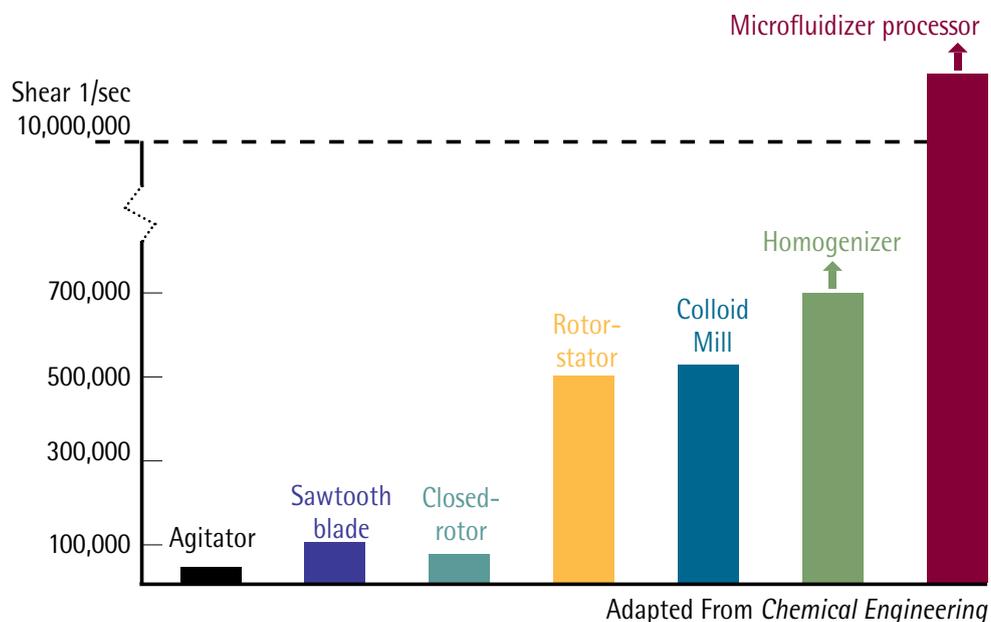
Microfluidizer processor technology improves a diverse array of potentially challenging applications, including:

- Nanoemulsions
- High solids dispersions
- Cell disruption (up to a 99% rupture rate)
- Nano/microencapsulation (e.g., polymers, liposomes, emulsions)
- Deagglomeration

Our product line offers you:

- Widest selection of lab units
- Extensive product range ensuring ease of scaleup from lab to production
- Processors that can be used in pharmaceutical lab and production environments (including 21 CFR Part 11 where needed)
- Processors suitable for cGMP environments
- Pressure ranges from 17-2760 bar (250 to 40,000 psi)
- Flow rates from 100 ml/min to 68 lpm (18 gpm)
- Steam-in-place (SIP) and ultra-clean-in-place (UCIP)
- Batch or continuous flow
- CE, ATEX and XP compliance

### Shear Forces of Various Processes





## CUSTOMER SUCCESS

To ensure our customers' success, we offer a variety of services and support both before and after you invest in a Microfluidizer processor. Our several decades of experience with thousands of customers, and our hands-on work with a wide range of customer formulations each year at our Microfluidics Technology Center, provide unparalleled applications expertise that enables us to better serve you.

## SUPPORT

Our customer service team can answer questions about your order, help you purchase spare parts, and if needed connect you with our field service engineers.

## SERVICES

### *As you consider a Microfluidizer processor*

#### **Microfluidics Technology Center**

Wondering if a Microfluidizer processor would successfully address your formulation challenge? Our complimentary processing of an initial sample for qualified prospects shows you how our equipment will improve your formulation. Just tell us what process benefits you want to achieve, and provide a sample that we can run through the Microfluidics Technology Center. We will analyze the results, provide you with a written report (including particle size and distribution) that indicates how a Microfluidizer processor would address your formulation challenge, and refer you to the Microfluidizer processor model best suited to your particular application.

#### **On-site demonstrations**

Learn more about Microfluidizer processors through a demonstration and discussion for you and your colleagues, held at your facility.

#### **Regional seminars**

We periodically host regional seminars for prospective customers who would like to learn more about Microfluidizer processors and see one in use. To participate, please call us or fill out the "Contact Us" form on our website.

#### **Purchase options**

To maximize your flexibility and accommodate varied financial situations, we offer attractive rental and leasing terms with fees applied toward a subsequent purchase.

### *After you invest in a Microfluidizer processor*

#### ***We help you innovate by sharing technology and process expertise***

#### **Process consulting**

Need help developing your processes for nanomaterial production or optimizing them as you scale up from the lab to pilots and production? Our highly-trained technical staff members have advised many customers and provide consulting services ranging from proof of concept, to optimization and scaleup.

#### **Customized in-house seminars and training**

As technologies and applications continue to evolve, so do your opportunities and challenges. Our technical staff members stay current on a wide range of nanotechnology and other topics, and use that expertise in delivering customized in-house seminars and training.

#### ***We ensure your successful ongoing use of your Microfluidizer processor***

#### **Testing**

Our engineering department can provide factory and onsite acceptance testing and IQ/OQ (documentation and execution).

#### **Start-up and maintenance training**

Prefer to learn about new equipment through hands-on assistance? Our capable field service engineers can deliver one to three days of start-up and maintenance training.

#### **Parts and technical service**

Our experienced field service engineers and customer service representatives help you obtain parts and technical service when needed.

#### **Preventive maintenance contracts**

Preventive maintenance of your Microfluidizer processor ensures its longevity and optimizes its performance. Many of our customers prefer the ease of pre-arranging annual preventive maintenance for their Microfluidizer processors through single- or multiple-year contracts. A preventive maintenance visit to your site by a skilled field service engineer includes processor inspection, replacement of designated parts, a performance test, a written report of processor condition and recommendations, and brief training in various processor procedures.

## OUR CUSTOMERS' INDUSTRIES AND APPLICATIONS

Our customers include the leading innovators in diverse industries ranging from those described below to emerging segments where nanotechnology is a differentiator, such as carbon nanotubes, fuel cells, photovoltaics and biofuels.

### Pharmaceutical

By significantly reducing the particle size of active pharmaceutical ingredients, Microfluidics' high-shear fluid processors can assist in the creation of formulations for drug delivery with improved bioavailability. Drugs are more stable, can be efficiently administered and have a longer shelf life. In addition, these uniformly small particles may enable formulations to be filter-sterilized.

Applications include nanoemulsions, nanodispersions, liposomes, nano/microencapsulation; cancer therapeutics, anesthetics, antibiotics, steroids, vaccines, vaccine adjuvants, artificial blood, controlled-release drugs, ointments, vitamins; injectables, inhalables, parenterals, transdermals

### Biotechnology

Microfluidizer processors provide an ideal solution for cell disruption due to more effective cell breakage and higher disruption efficiencies than any other means. Microfluidizer processors are tough on cells and gentle on proteins, and produce repeatable results.

Applications include yeast, mold, E.coli, penicillium, algae, meningococcal cells, mammalian tissue, bacteria, fungi, insect cells

### Chemical

Microfluidizer processors reduce particle size to a submicron level to create stable emulsions or suspensions. As droplet size decreases and particles are more uniformly dispersed, the effectiveness of high-performance materials increases. Microfluidics' high-shear fluid processors can also be used to achieve high color strength and gloss, and to reduce the amount of volatile organic compounds by increasing water content. Narrow size distribution of nanoparticles, achieved by using Microfluidics' high-shear fluid processors, prevent the clogging of tiny inkjet nozzles. High formulation stability and a longer shelf life are also achieved.

Applications include nanoemulsions, nanodispersions, nano/microencapsulation, wax emulsions; inkjet inks, conductive inks, carbon nanotubes, toners, polymers, electrodes for fuel cells and batteries, catalysts, nanoclays, cellulose with nanofibrils, nanoceramics, high-performance coatings, metal nanoparticles, pigments, electronic materials, adhesives, preservatives, rheological agents, lubricants

### Cosmetics

Microfluidizer processors are used to create stable nanoemulsions and nanosuspensions. Through uniform micro- and nanoencapsulation of the active ingredients in liposomes and emulsions, lotions and creams will deliver benefits to specific sites at controlled and predictable rates.

Applications include nanoemulsions, liposomes, wax emulsions, nanodispersions, nano/microencapsulation; facial creams, makeups, mascaras, lipsticks, sunscreens, fragrances, encapsulation of actives (oxygen carriers, peptides, proteins, vitamins)

### Food and beverage; nutraceuticals

Microfluidizer processors improve the color, texture and taste of foods by producing highly-concentrated emulsions. They also contribute to key advancements in nutraceuticals by processing liposomes to enable the slow release of nutrients that can be more easily ingested.

Applications include flavor and color emulsions, high fiber soy products, nutraceuticals, fat substitutes, low-fat products, cream liqueurs, starch dispersions



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