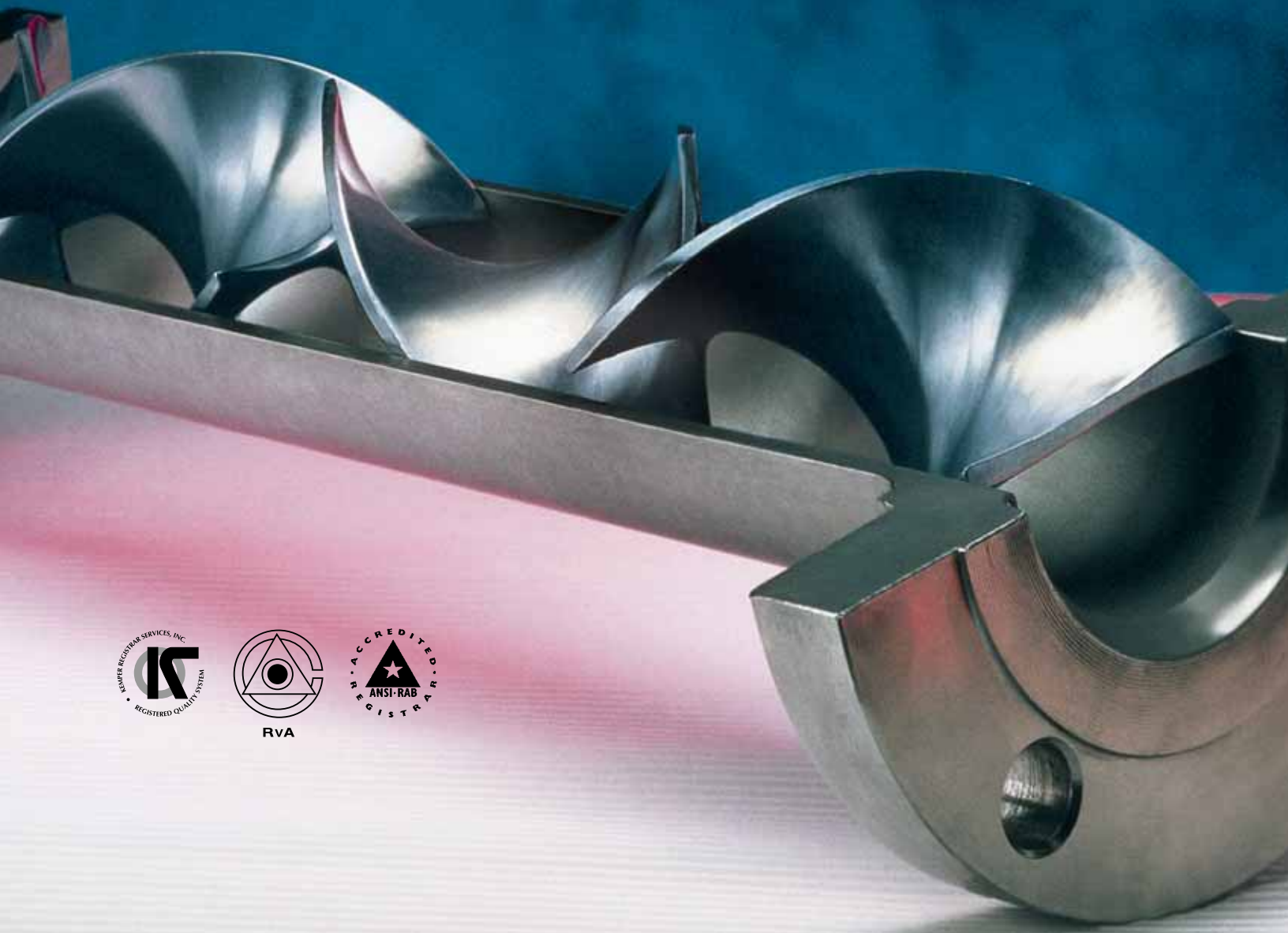
Kenics

Static Mixing Technology



KEMPER REGISTRAR SERVICES, INC. REGISTERED QUALITY SYSTEM

RvA

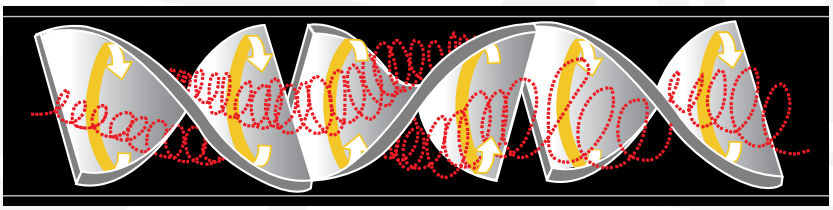
ACCREDITED REGISTRAR ANSI-RAB

Product Innovation

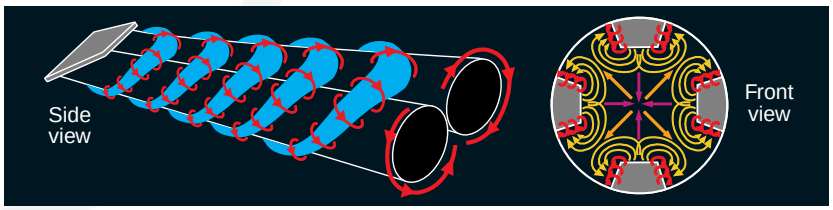
For over 30 years, in thousands of installations worldwide, Kenics® Static Mixers have set the standard for in-line mixing and heat transfer performance. Chemineer incorporates advanced technology into every Kenics Mixer to give you reliable, uninterrupted performance that you can depend on for the long term. The result: maximum operating efficiency and overall cost savings.

Principles of Operation

In the KM Static Mixer, a patented helical mixing element directs the flow of material radially toward the pipe walls and back to the center. Additional velocity reversal and flow division result from combining alternating right- and left-hand elements, increasing mixing efficiency. All material is continuously and completely mixed, eliminating radial gradients in temperature, velocity and material composition.



KM Static Mixer



HEV Static Mixer

In the HEV Static Mixer, the patented tab geometry maximizes the conversion of turbulent energy into efficient mixing. The HEV produces complete stream uniformity through controlled vortex structures generated by the mixing elements.

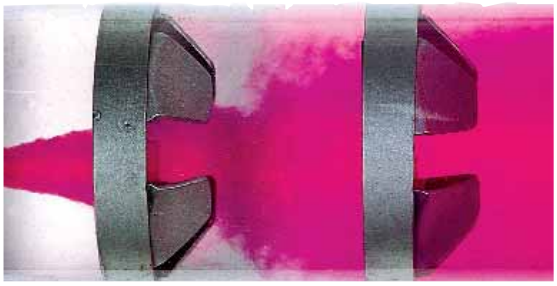
The element geometry takes advantage of the naturally occurring vortices induced by the element edges.

These mixing principles result in an applications technology that can be easily reproduced and reliably scaled. Numerous independent studies have shown Kenics Static Mixers maximize mixing efficiency—without the wasted energy and material blockage typically found in more restrictive motionless mixers.

Mixing Applications

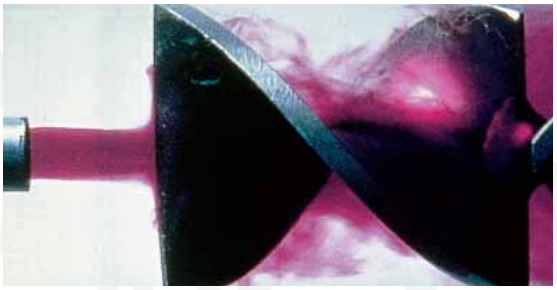
Turbulent Blending HEV Static Mixer

Each tab of the HEV Static Mixer generates a pair of streamwise counter-rotating vortices that produce vigorous cross-stream mixing and rapid uniformity.



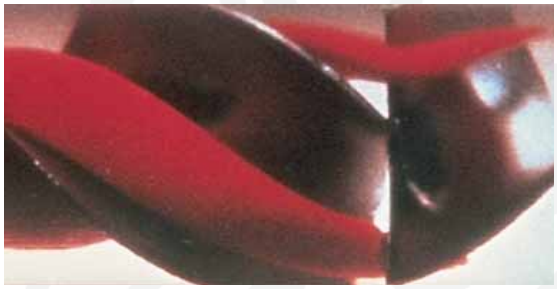
Turbulent Blending KM Static Mixer

The KM Static Mixer produces rapid mixing by inducing circular patterns that reverse direction at each element intersection.



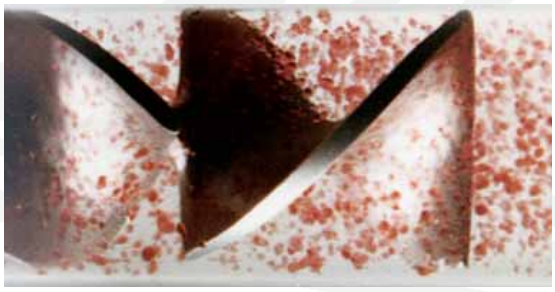
Laminar Blending KM Static Mixer

The alternating helical elements of the KM Static Mixer continually divide, stretch and reorient the flow stream to produce complete mixing with minimum pressure drop.



Liquid/Liquid Dispersion

The uniform turbulent shear field of the KM Mixer quickly disperses immiscible liquids and produces a narrow drop size distribution.



Gas/Liquid Dispersion

Gases can be incorporated into turbulent liquids using the KM Static Mixer. Mass transfer rates are dramatically enhanced to maximize absorption or reaction.

Kenics Mixers provide precise blending and dispersion of all flowable materials, with no moving parts, by redirecting the flow patterns present in the open pipe. Many applications in the chemical, refining, polymer, food, pulp and paper, water and wastewater treatment and other major processing industries have shown significant improvements in processing speed, control and cost savings using Kenics Mixers. These high-efficiency mixers also handle other critical processes such as:

Heating/Cooling

Kenics Mixers dramatically boost heat transfer rates over those typically found in open pipe under both laminar and turbulent flow conditions.

Residence Time Control

By eliminating the parabolic velocity profile characteristic of laminar flow in open pipes, the helical element of Kenics Mixers promotes plug flow in continuous processes.

Temperature Uniformity

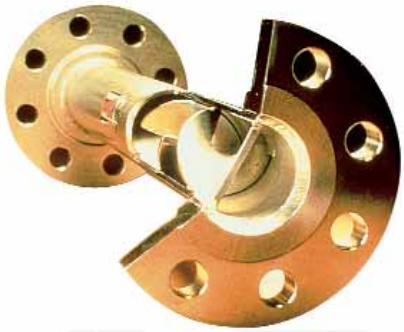
The radial mixing action of the KM elements rapidly eliminates temperature gradients, reducing fouling and thermal degradation.

KM Series Static Mixers

Kenics KM Series Static Mixers feature a patented helical mixing element which produces complete radial mixing and flow division for any combination of liquids, gases, or solids.

Adapts to any piping system

Mixer dimensions match all standard pipe sizes. Mixer housings feature plain, threaded, weld prep or flanged ends for easy installation. Flange styles include raised face slip-ons, weld neck, lap joint, ring joint and Grayloc-type hubs in all standard pressure ratings. Mixers are available in carbon steel, 304SS, 304LSS, 316SS, 316LSS, Alloy 20 Cb-3, Titanium, Monel 400, Nickel 200, Inconel, Hastelloy C-276, Hastelloy B-2, FRP, PVC, CPVC, PTFE, Kynar, PVDF, Tantalum, Zirconium and other high alloys.



Fixed Element — KMS

- Used for laminar, transitional, and turbulent flow applications; suitable for most blending or dispersion problems involving liquids or gases
- Mixing elements are attached to the housing wall

Removable Element — KMR

- Used for laminar, transitional, and turbulent flow applications where periodic cleaning or inspection is required; suitable for most blending or dispersion problems involving liquids or gases
- Mixing elements are easily removed from housing

Element Assembly — KMA

- Mixing elements are inserted in the customer's existing housing
- Precisely controlled to assure proper fit and ease of installation in any standard or custom pipe size

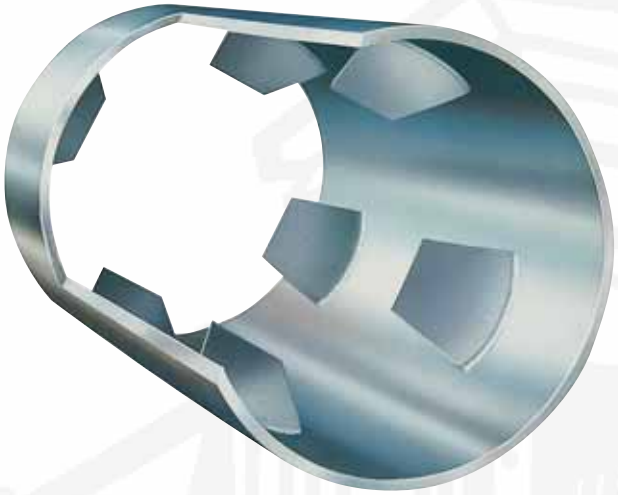
Edge-Sealed Element — KME

- Used for maximum heat transfer, polymer reactors, certain fibrous applications, and mixing liquids with wide viscosity ratios
- Mixing element edges are furnace-brazed to the housing wall eliminating dead areas
- Continuous joining of elements to the housing eliminates wall clearance to maximize heat conduction and minimize thermal degradation or fouling
- Available with internal surface finishes down to 8 microinches

Construction options include:

- ASME/B31.3 certification and testing
- Design pressures to over 10,000 psi
- Jackets, nozzles, fittings
- Complete custom fabrication
- Diameters to over 8 feet

HEV
Static Mixers



HEV high-efficiency static mixers handle all turbulent-flow mixing applications regardless of line size or shape. Mixing is accomplished by controlled vortex structures generated by the patented low-profile tab geometry. This provides uniform blending while limiting mixer length to less than 1-1/2 pipe diameters. Complete mixing is achieved with pressure losses 75% less than conventional static mixers.

Typical applications for the HEV include all low-viscosity liquid-liquid blending processes, as well as gas-gas mixing. The HEV is ideal for processes where pressure loss and length are critical.

HEV Static Mixer features include:

- Lowest pressure drop available
- Unlimited sizes and shapes
- Shortest possible mixer length
- Easy retrofit to existing lines
- Available in all metals and alloys, FRP, PVC, PFA, and epoxy-coated steel

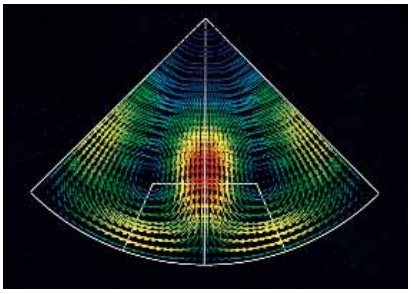
HEV static mixers provide installation flexibility and can be configured to square, rectangular or 3-sided ducts. They are adaptable to open channels typically found in water treatment systems.

Technology Development

From bench to production, Kenics Static Mixers provide you with the mixer performance to match your process needs. Your guaranteed satisfaction is the result of the advanced technologies we use to analyze and solve your mixing problems.

Research Lab

Thorough understanding of fundamental fluid mechanics principles is a necessary starting point for developing effective mixing equipment. In our state-of-the-art test lab, we use the latest technology to evaluate mixer concepts and generate the next evolution of equipment to handle your most difficult mixing challenges.

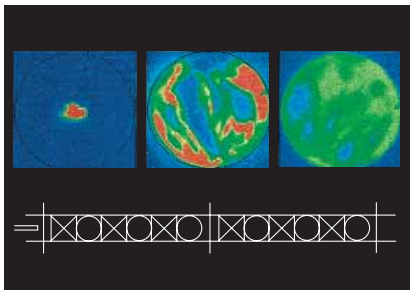


Computational Fluid Mixing (CFM)

CFM analysis of the flow field is used to confirm and optimize the operating characteristics of mixing elements.

Digital Particle Image Velocimetry (DPIV)

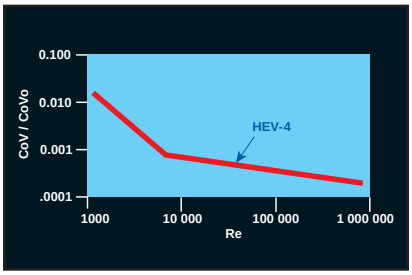
DPIV, a laser-based analytical tool used to validate computer mixing models, has the capability of measuring the entire fluid velocity field almost instantaneously. This makes it possible to study large-scale, time-dependent phenomena responsible for much of the mixing process.



Laser Induced Fluorescence (LIF)

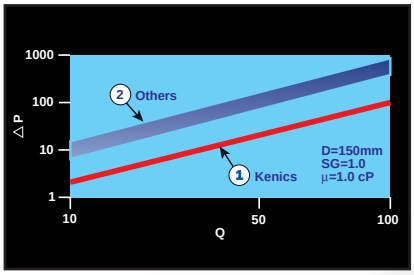
LIF is a computer-controlled data acquisition technique used to determine mixing uniformity. Because LIF allows you to “see” what is taking place inside the flow field, geometry parameters can be evaluated to optimize process performance.

TECHNOLOGY APPLICATION



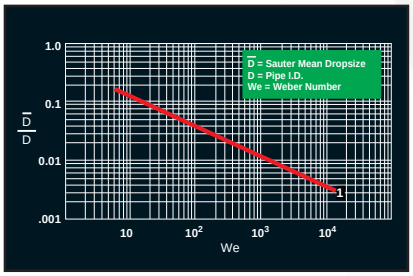
Mixing Uniformity

By analyzing the inlet stream conditions, final mixture quality can be predicted for all Kenics Mixer designs.



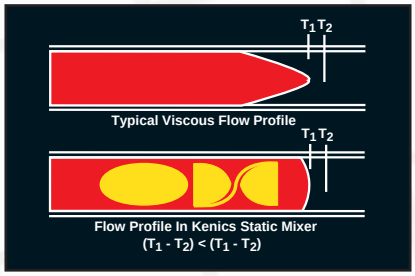
Pressure Drop

The pressure drop through Kenics Static Mixers is the lowest in the industry resulting in reduced operating costs and increased process capacity.



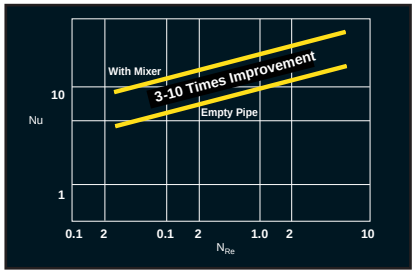
Drop Size Prediction

Accurate drop size prediction allows optimization of mass transfer controlled processes while avoiding problems with downstream separation equipment.



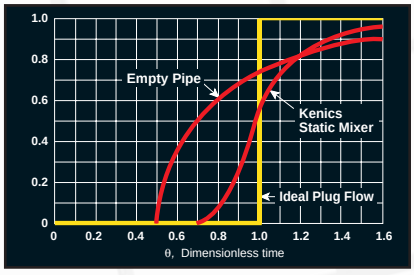
Temperature Uniformity

Kenics Mixers eliminate hot or cold spots typical of flow in open pipes. Improved thermal uniformity optimizes process performance.



Heat Transfer

Exclusive edge-sealed mixing elements give Kenics Heat Exchangers transfer rates up to 10 times greater than open tubes.



Reactor Engineering

By interrupting the parabolic velocity profile characteristic of open pipe, Kenics Static Mixers produce residence time distributions approaching plug flow.

Guaranteed Mixing Uniformity

The standard technique used for measuring the degree of mixing in pipe flow is the coefficient of variation, CoV. The coefficient of variation is the ratio of the standard deviation of component concentration to its mean concentration. The coefficient of variation achieved at the mixer discharge is dependent on the inlet coefficient of variation $(CoV)_o$. The initial coefficient of variation is defined as:

$$(CoV)_o = \left[\frac{1-V_a}{V_a}\right]^{1/2}$$

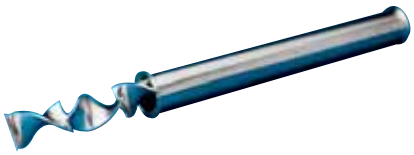
where V_a is the volume fraction of the stream added. To allow plotting against geometrical factors such as element style, as well as Reynolds number, a normalized coefficient of variation is defined as:

$$\frac{CoV}{(CoV)_o}$$

The correlations Chemineer has developed through fundamental research, as well as years of operating experience, allow us to accurately predict mixer performance and offer you *100% guaranteed results.*

Special Purpose Products

In addition to our standard static mixer line, Chemineer manufactures a range of products designed to meet your specialized process requirements.



Sanitary Mixers

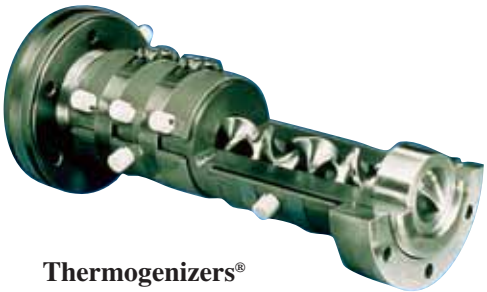
- Polished internal and external surfaces
- Removable element assemblies for fast, easy cleaning
- Fitted with tri-clamp-style ferrules
- Available in five diameters from 1/2" to 4"
- 316L construction materials
- Meet 3A standards
- Request Bulletin 820

Pilot Plant Heat Exchangers

- Standard off-the-shelf design for immediate shipment
- Direct scale-up with 100% process warranty
- All stainless steel construction
- Can be used in pilot plants or slip streams to full-scale process

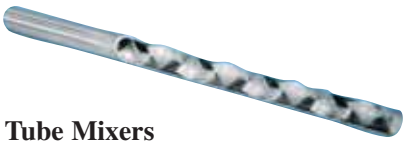
Heat Exchangers

- Used for process applications, including polymers, plastics, adhesives, hydrocarbon processing, and food industries
- Effective for both heating and cooling of viscous fluids
- Three-to-ten times greater transfer rates than empty tubes
- Boosts heat transfer with minimal flow disruption
- Custom fabrication to ASME/TEMA standards
- Request Bulletin 808



Thermogenizers®

- Delivers uniformly mixed melt for extrusion applications
- Offers improved gauge control
- No radial temperature gradients
- Reduced color concentrate usage by improving mixture uniformity
- One-piece design for easy installation and cleaning
- Request Bulletin 806



Tube Mixers

- Used for applications with low flow rates in full-scale and pilot plant operations
- Exclusive edge-sealed mixing elements attached to housing wall
- Plain ends accommodate a wide variety of common fittings
- Standard 22-gauge 316SS housings available in diameters from 3/16" to 1/2"

Tubular Reactors

- Continuous plug flow performance
- Single or multi-tube construction
- Continuous solution phase reactions and polymerizations
- High heat transfer rates with low pressure drop

No matter what your process needs or system considerations, Kenics Static Mixers can handle your mixing requirements.

Customer Service & Support

Commitment to Quality

We manufacture Kenics Static Mixers and Heat Exchangers in our ISO 9001 certified facility in North Andover, Massachusetts. ISO certification allows us to offer customers 100% guaranteed quality products, and represents our ongoing commitment to customer satisfaction.

Computerized Process Optimization

CEDS® (Chemineer Expert Design System) is a comprehensive computer program developed by Chemineer that interprets process design data and selects only those mixers that it has verified for process and mechanical design integrity. Chemineer field engineers use this technology via laptop computers to provide you with immediate design alternatives.

Sharing Our Technology

Our Applications Specialists are ready to bring the latest static mixing technology right to your front door. Your process and development engineers are introduced to mixing principles for blending, dispersion, heat transfer and reactor design allowing them to optimize plant operating performance. Contact your local Chemineer Sales Engineer to arrange an in-house seminar.

Factory Services and Field Engineering

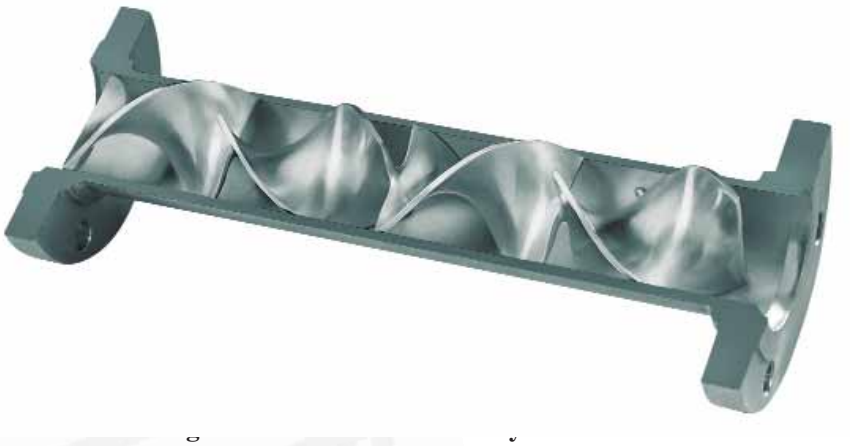
Every Kenics Static Mixer is backed by product and application engineering, a fully equipped mixing laboratory, and complete in-house manufacturing and quality control. Our process engineers combine hands-on experience with fundamental technology to provide you with optimal, cost-effective mixer performance.

Worldwide Distribution

Kenics Static Mixers are marketed globally through locations in the United States, Canada, England, Mexico, Brazil, India, Singapore, China and Taiwan. Kenics worldwide distribution is ready to serve your mixing needs . . . anywhere . . . anytime.

Product Applications

Kenics Mixers are used in numerous industries for a variety of blending, dispersion, heat transfer and residence time control applications.



Typical Applications

Agricultural Chemicals
- Fertilizer and pesticide preparation
- Gas/liquid dispersion
- Dilution of feed concentrates

Chemicals
- Chlorination and oxidation
- Organic/aqueous dispersions
- Dilution of acids and bases

Cosmetics
- Heating slurries and pastes
- Additive blending
- Dispersion of oils

Energy
- Chemical addition for enhanced oil recovery
- Injection of geothermal steam
- Preheating coal/oil slurries
- NOX/SOX control

Foods
- Blending food constituents
- Washing fats and oils with acid
- Heating and cooling sugar solutions
- Starch slurry cooking

Pharmaceuticals
- Nutrient blending
- pH control
- Sterilization

- Starch conversion
- Chemical addition
- Mud dilution
- Steam injection

Minerals Processing
- Metals recovery by solvent extraction
- Chemical addition and pH control
- Oxidation and bleaching

OEM
- Adhesive and epoxy dispensing systems
- Adhesives heating
- Monitoring and sampling systems

Paints & Resins
- Dilution of TiO_2 slurries
- Coloring and tinting
- Solvent blending

Petrochemical & Refining
- Blending gaseous reactants
- Washing hydrocarbon streams
- Gas scrubbing
- Lube oil blending
- Crude oil sampling

- Blending reactants & catalysts
- Thermal homogenization
- Plug flow finishing reactors
- Preheating polymers prior to devolatization

Pulp & Paper
- Stock dilution and consistency control
- Chemical and coatings preparation
- pH control
- Pulp bleaching

Rubber Processing
- Blending latex compounds
- Adding pre-polymers and activators
- Heating and cooling adhesives

Textiles
- Blending additives
- Eliminating thermal gradients
- Heating and cooling polymers
- Achieving uniform heat history

Water & Waste Treatment
- Polymer dilution
- pH control
- Chemical addition and flash mixing
- Disinfection and aeration

Tel: 978-687-0101 **Kenics Fax-Back Process Analysis Form** FAX: 978-687-8500

B800

Name_____ Title_____
Address_____ Phone_____
City_____ FAX_____
State/Zip_____ E-Mail_____

Process Description: **Mixing or Dispersion**

Date_____ Items_____ of_____
Item ref. _____

	Units	Stream 1	Stream 2	Stream 3	Mixture
Component Name					
Flow Rate					
Density					
Viscosity					
Temperature					
Pressure					
Liquid/Gas/Solids					

Process Requirement: ☐ Blending ☐ Dispersion ☐ Reaction ☐ Residence Time

Components Miscible: ☐ Yes ☐ No Interfacial Tension:_____
Required Droplet/Bubble Size:_____ Allowable Pressure Drop:_____

Process Description: **Heating/Cooling**

	Specific Gravity	T, in	T, out	Viscosity	Sp. Heat	Thermal Cond.	Flow Rate
Process Fluid							
Heating/Cooling Fluid							

Allowable Pressure Drop: Jacket_____ Tube_____

Mechanical Design

Material of Construction:_____ Existing Line Size:_____
End Connections: ☐ Plain ☐ THD ☐ Flanged Type:_____ Class:_____
Design Temperature:_____ Design Pressure:_____
Other Process Details/Special Requirements:_____

Commercial Requirements:

Pricing: ☐ Budgetary ☐ Immediate Purchase
Delivery Requirement:_____

Response needed by: ☐ Today ☐ Tomorrow ☐ One Week ☐ Other_____

Comments:_____

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A Unit of Robbins & Myers, Inc.

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Symbol of Mixing Excellence

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Singapore
Taipei, Taiwan