

Kenics™

Static Mixer Technology



NOV

Product Innovation

Since 1965, in thousands of installations worldwide, Kenics static mixers have set the standard for inline mixing and heat transfer performance. The Mixing Technologies Group of NOV incorporates advanced technology into every static 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.

In the HEV and UltraTab™ static mixers, the element geometry maximizes the conversion of turbulent energy into efficient mixing. The static mixers produce 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.

In the KMX-V, this static mixer utilizes cross-stream mixing and flow splitting to achieve a very rapid blend. This mixer is ideal for laminar flow and high viscosity ratio blending.

These mixing principles result in an application 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.



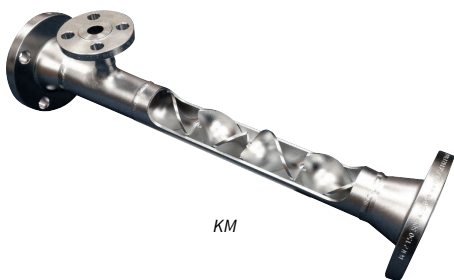
Thermogenizers



UltraTab



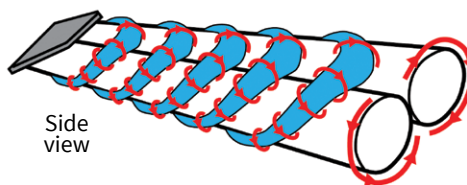
KMX-V



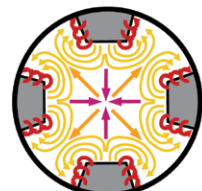
KM



HEV

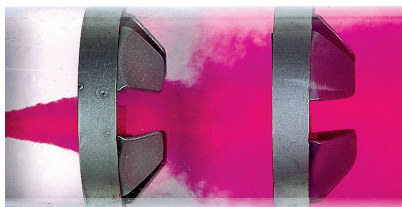


Side view



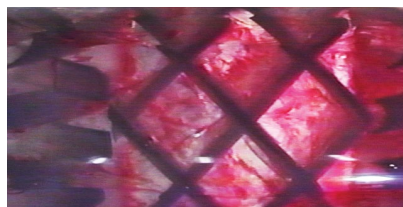
Front view

Mixing Applications



Turbulent Blending **HEV and UltraTab**

Each tab of the HEV generates a pair of streamwise counter rotating vortices, while the UltraTab, with upstream injector, provides rapid incorporation of additives. Both mixers produce vigorous cross-stream mixing and rapid uniformity.



Laminar Blending **KMX-V**

The intersecting blades of the KMX-V create cross-stream mixing and flow splitting to achieve rapid mixing even in the most demanding applications such as those with extreme viscosity and volume ratios.



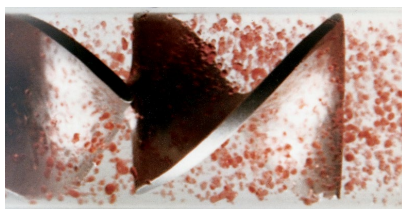
Laminar Blending **KM**

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



Turbulent Blending **KM**

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



Liquid/Liquid Dispersion

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



Gas/Liquid Dispersion

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

Our static mixers provide precise blending and dispersion of all flowable materials, without utilizing moving parts. Mixing is achieved by redirecting the flow patterns already present in empty pipe. Kenics static mixers are currently being used in numerous processing applications, in order to reduce overall cost and significantly improve efficiency, speed and control. They can be found in a wide range of markets including chemicals, refining, polymers, food, pulp and paper, and water and wastewater treatment. These high efficiency mixers also handle other critical processes, such as:

Heating/Cooling

Kenics static 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 static 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 Static Mixers

KM 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

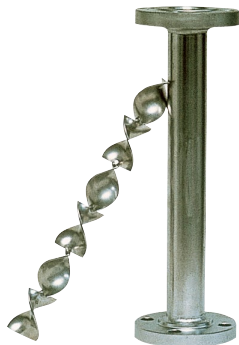
Mixer dimensions match all standard pipe sizes. Mixer housings feature plain, threaded, weld prep or flanged ends for easy installation. Flange styles

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.



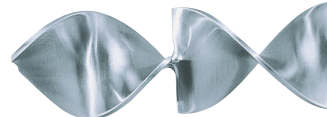
Fixed Element—KMS

- 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

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

UltraTab Static Mixers

The UltraTab provides rapid mixing in circular pipe turbulent flow applications. The integral injector allows upstream injection of additives to produce a 0.05 CoV (coefficient of variation) in as little as two pipe diameters downstream from the exit of the mixer. This upstream injector ensures that the highest energy dissipation zone is not missed. The compact tab design minimizes the length required for mixing and optimizes piping layout.

Typical applications include pH Control, Chlorination, Chemical Dosing/Flash Mixing, Disinfection, and Polymer Blending in Water Treatment Applications. Additional applications include Desalination Processes, Chemical Processing, and any low viscosity blending processes.

UltraTab Static Mixer Features

- Available in carbon steel, stainless steel, coated carbon/316ss and FRP materials
- Multi-injection ports available
- Spool piece with flanged or weld prep ends
- Element extension for lower CoV requirements
- Sizes range from 2" to 60" +



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 drop and length are critical.

HEV Static Mixer Features

- Lowest pressure drop available
- Unlimited sizes and shapes
- Short mixer length
- Easy retrofit to existing lines
- Available in all metals and alloys, FRP, PVC, PFA, and epoxy coated steel
- Low cost, wafer design is available for installation between flanges

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.

KMX-V Static Mixers



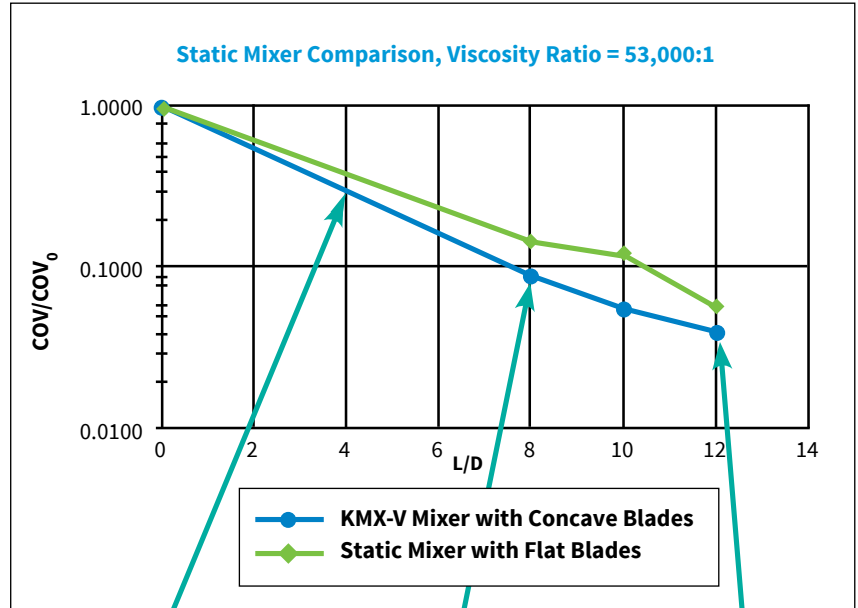
The KMX-V is the choice for demanding mixing applications, such as those involving fluids with extreme viscosity or volumetric ratios. The common limiting factor in static mixer design is the allowable mixer length and the patented element design offers a short length and the most efficient mixing performance.

Exclusive Mixing Principle

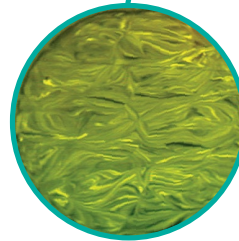
The KMX-V utilizes cross-stream mixing and flow splitting to achieve very rapid blending. Each element is approximately one pipe diameter in length and consists of multiple intersecting blades, which generate fluid layers as the mixture flows downstream.

KMX-V Static Mixer Features

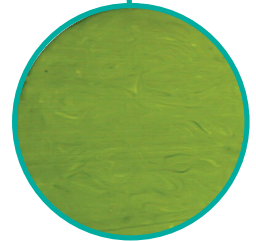
- Superior mixing performance
- Laminar flow and high-low viscosity mixing
- Cost effective solution
- Short length
- Standard diameters up to 24"



KMX-V-4



KMX-V-8



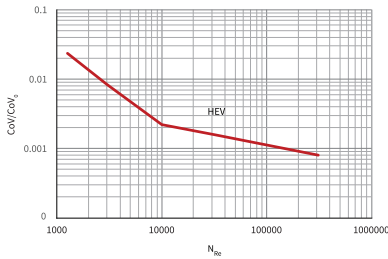
KMX-V-12

Laser induced fluorescence (LIF) images showing cross-sectional uniformity



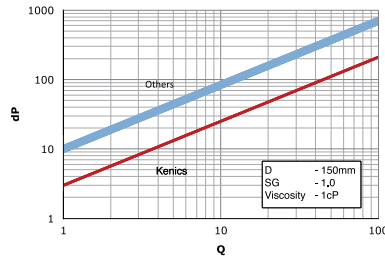
Low viscosity additives are driven along the trough of each blade and abruptly sheared by strong cross-stream velocity gradients as they pass around the upstream surface

Technology Application



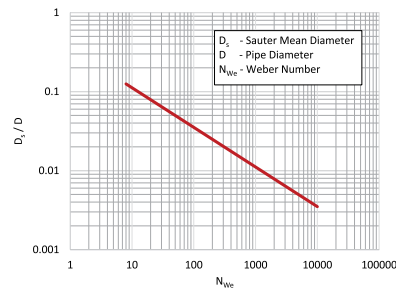
Mixing Uniformity

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



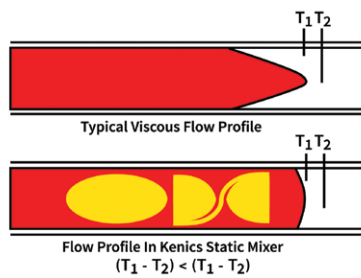
Pressure Drop

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



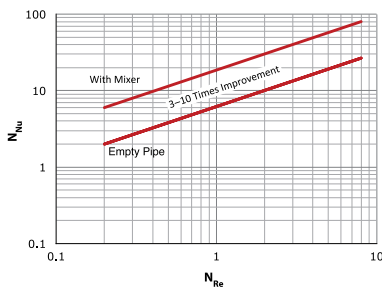
Droplet Size Prediction

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



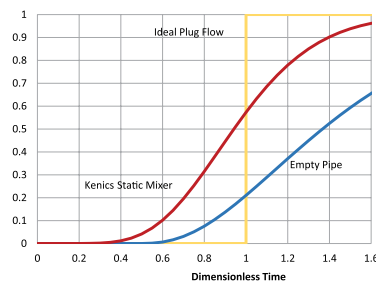
Temperature Uniformity

Kenics static 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 static mixer heat transfer rates 3 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)₀. The initial coefficient of variation is defined as:

$$(\text{CoV})_0 = \left[\frac{1 - V_a}{V_a} \right]^{1/2}$$

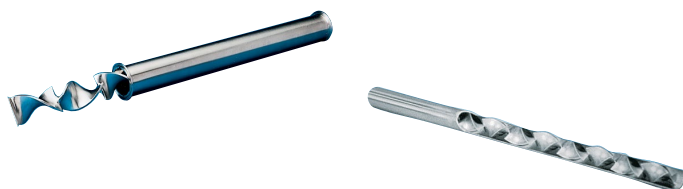
where V_a is the volume fraction of the stream added. To allow plotting against geometrical factors such as element style, as well as Reynolds number, a normalized coefficient of variation is defined as:

$$\frac{\text{CoV}}{(\text{CoV})_0}$$

The correlations we have 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, we manufacture 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 0.5" to 4"
- 316L construction materials
- 3A certified design/construction
- BPE option available
- CIP models available



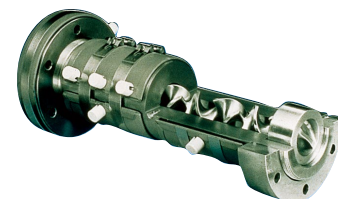
Tube Mixers

- 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 0.1875" to 0.5"



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
- Designed and constructed to ASME Pressure Vessel Code; Section VIII, Div 1
- TEMA standards used for manufacturing and assembly techniques
- Chinese boiler and pressure vessel license



Thermogenizers

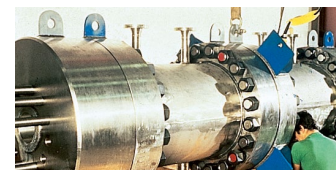
- Delivers uniformly mixed melt for extrusion applications
- Offers improved gauge control
- No radial temperature gradients
- Reduced color concentrate usage by improving mixture uniformity
- One piece design for easy installation and cleaning

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



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



Tubular Reactors

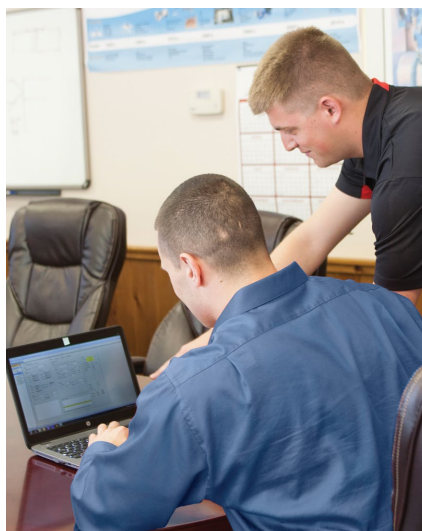
- Continuous plug flow performance
- Single or multi-tube construction
- Continuous solution phase reactions and polymerizations
- High heat transfer rates with low pressure drop

Service and Support



Commitment to Quality

We manufacture Kenics static mixers at our Dayton, Ohio facility and heat exchangers at our facility in Harvey, Louisiana. Our UK facility is ISO certified and can provide CE markings on our products allowing 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 Mixing Technologies that interprets process design data and selects only those mixers that it has verified for process and mechanical design integrity specific to your application. Mixing Technologies application engineers use this technology to provide you with immediate design solutions.



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.



Sharing Our Technology

Our team is 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 representative to arrange an in house seminar.

Worldwide Distribution

Kenics static mixers are marketed globally through locations in the United States, United Kingdom, Mexico, Singapore, Austria and China. Kenics worldwide distribution is ready to serve your mixing needs... anywhere... anytime.

Product Applications

Kenics static 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

Grain Processing

- 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 TiO₂ Slurries
- Coloring and Tinting
- Solvent Blending
- Petrochemical & Refining
- Blending Gaseous Reactants
- Washing Hydrocarbon Streams
- Gas Scrubbing
- Lube Oil Blending
- Crude Oil Sampling

Polymers & Plastics

- Blending Reactants & Catalysts
- Thermal Homogenization
- Plug Flow Finishing Reactors
- Preheating Polymers Prior to Devolatilization

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





With experienced, customer focused engineers, our Kenics products satisfy a wide range of mixing applications worldwide



Quality is designed and built into every Kenics product to ensure performance and long service life



The versatility of Kenics static mixers allows customers to design around existing pipe layout



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