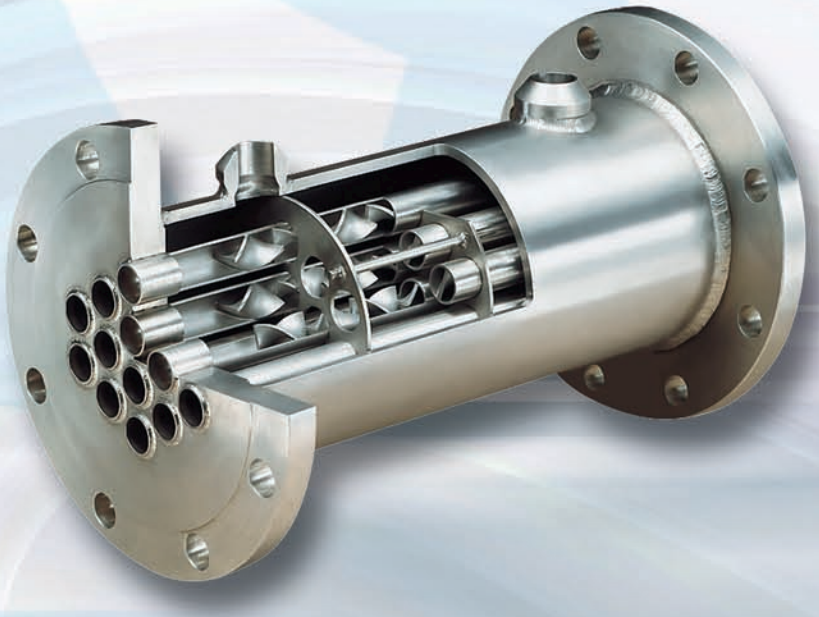
ENTORNO INDUSTRIAL

Kenics

High Viscosity

Heat Exchangers

For Hard-to-Handle Fluids

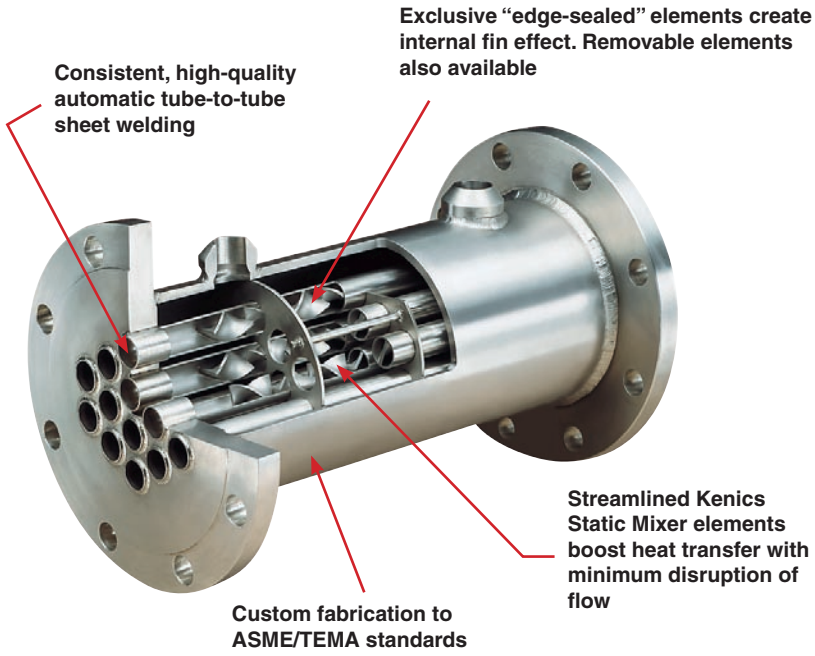


Kenics Heat Exchangers—Custom Built to Save Space, Energy and Time

Kenics Heat Exchangers, equipped with streamlined Kenics Static Mixer elements, are the most efficient heat exchangers available today. These high performance thermal units offer maximum transfer rates even with highly viscous, difficult-to-process materials.

Used for a wide range of process applications, including those in the polymer, plastic, pulp and paper and food industries. Kenics Heat Exchangers use highly-efficient static mixer elements that require less space, less energy and less time to process than standard designs.

Kenics Static Mixer technology exclusively offers the highest available heat transfer coefficients for fast, uniform heat transfer. In addition, full technical support is provided from design to manufacturing for meeting even the most stringent applications.



Efficient Heat Exchange Design

Heat exchangers are commonly made of conventional straight empty tubes. The laminar build-up on the tube walls from the process fluid inhibits and creates inefficiencies in the heat transfer process.

Kenics Heat Exchangers solve these inefficiencies with state-of-the-art static mixer technology. By using static mixer elements in each heat exchanger tube, film build-up on the inside walls is greatly reduced. Process fluid is continuously pushed from the center of each tube to the wall and back to the center, eliminating thermal gradients and boosting the inside film coefficient.

Kenics Static Mixer elements produce a more uniform, consistent transfer process, with three to seven times greater heat transfer rates than empty tubes alone. Other characteristics include:

- Mixer elements create self-cleaning, wiping action
- Fouling is minimized
- Surface renewal at tube wall reduces chance of thermal degradation
- Plug flow characteristics produce uniform heat history
- Temperature gradients are blended out
- Viscous materials can cool to near freezing point

When the Kenics Static Mixer elements are bonded to the tube walls via furnace brazing, the enhanced surface area and internal fin effect augments the mixing action. Transfer rates are increased dramatically. Removable elements are also available for applications requiring periodic cleaning during product change-overs.

With either design, a Kenics Heat Exchanger will be smaller than a conventional heat exchanger to handle the same job.

Thermal Performance Comparison

Kenics Static Mixer Heat Exchangers are more effective than conventional empty tubes by a substantial margin. Consider the following example:

Problem: Cool 5,000 lbs/hr of a polymer with thermal conductivity (.09 BTU/Ft - Hr -°F), specific heat (.36 BTU/# - °F) and average viscosity (60,000 cps) from 356° to 104° using cooling water at 75° F.

	Conventional Empty Tube	Kenics Static Mixer Heat Exchanger
Shell Diameter	29"	18"
Tube Length	192"	30"
Surface Area	1600 ft^2	160 ft^2
Transfer Coefficient	3 BTU/FT - Hr - °F	30 BTU/FT - Hr - °F

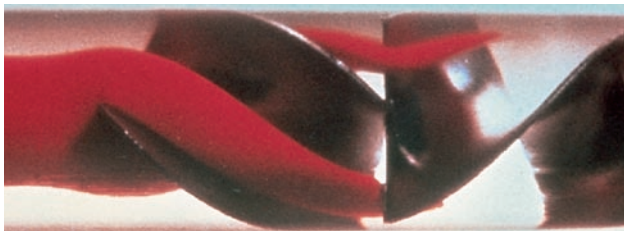
Static Mixing Element Technology

The Kenics Static Mixer Heat Exchanger consists of a continuous string of static mixer elements within each heat exchanger tube. Static mixing is an inline mixing and processing technology with no moving parts, requiring no external power and no maintenance.

A unique, non-moving mixing element with a patented helical form directs the flow of material radially toward the pipe walls and back to the element, regardless of velocity. By combining alternating right and left hand elements, additional actions of momentum reversal and flow division contribute to the mixing efficiency.

Rotational motion and turbulence are generated in an inherently predictable way to provide the required process result. Thus, all processed material is continuously and completely intermixed to eliminate radial gradients in temperature, velocity and material composition.

Kenics Static Mixer technology produces homogeneous mixing, blending, and dispersion in any flow regime in a short length of pipe. By utilizing these mixing characteristics, Kenics Heat Exchangers provide predictable, controlled mixing, and the most efficient form of thermal transfer available.



Advanced Engineering and Fabrication

As the leaders in static mixing technology, our trained professionals analyze your specific process requirements and utilize advanced computer technology to design solutions for your heat exchange needs. Highly skilled engineers provide full technical support, including computer process simulation techniques, to develop a custom heat exchanger that matches specific requirements.

Demanding quality testing procedures ensure mechanical integrity and strict adherence to industry standards. An ASME code-certified vessel shop, located at the facility in North Andover, Massachusetts, serves as the manufacturing base for Kenics Heat Exchanger operations.

As custom-built, individually crafted units, Kenics Static Mixer Heat Exchangers are built to stringent ASME and TEMA codes, requiring the use of efficient, state-of-the-art equipment in both manufacturing and design operations. Often large and complex, these units require considerable welding and metal joining. Using the most advanced welding techniques and equipment available, fabrication specialists produce a smooth, uniform weld at each tube end.

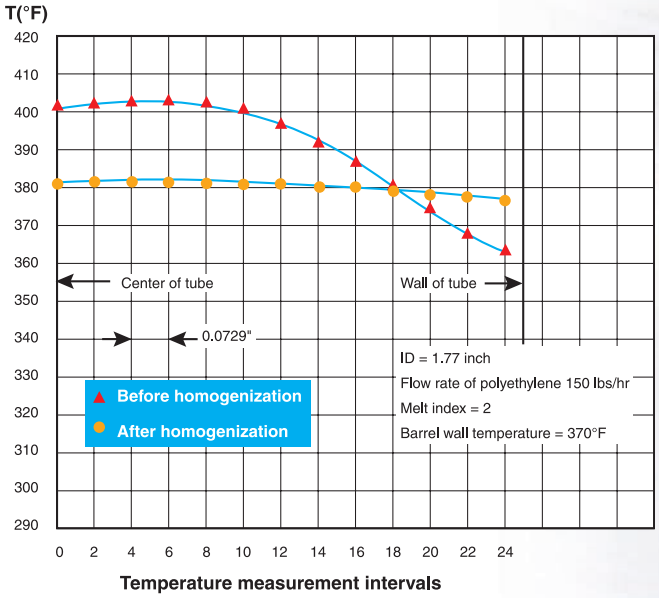
Computer Aided Design (CAD) is an integral part of the development, manufacturing and quality process which produces Kenics Heat Exchangers. With CAD-based Finite Element Analysis programs, engineers create models of complex static mixer elements. From the resulting pressure and thermal load information, they accurately predict structural design and heat transfer performance for use in developing the most reliable and efficient heat exchanger possible.

Applications	
Polymers	styrenics, ethylenes, polyesters, nylons, silicones, adhesives and sealants, de-volitization
Plastics	extruded foam
Foods	chocolates, dairy products, salad dressing, sugar syrups and corn syrup
Energy	Coal-oil mixtures, power alcohol, petrochemicals and fuel oil
Pulp and Paper	black liquor, tall oils and kraft soaps
Miscellaneous	asphalts, slurries, agri-chemicals, rubber sealants, paint and waste treatment

Performance Benefits

Kenics Heat Exchangers range from single jacketed units to large, multi-tube designs, consisting of over 3,000 individual tubes and approaching 2-1/2 linear miles of static mixer elements. Yet, because of the increased efficiency of the internal mixing elements, a Kenics Heat Exchanger will be smaller than a conventional heat exchanger used to handle the same job. Features include:

- Design pressures to 10,000 psi
- Construction from all metals and alloys
- Special connections and fittings
- X-ray, hydro, dye penetrant and halogen testing ASME/ TEMA compliance
- **Heating Viscous Fluids without Degradation**—The mixing action of the Kenics Static Mixer element constantly moves the process material away from the tube wall. This surface renewal eliminates scorching and thermal degradation.
- **Cooling Viscous Materials without Freezing**—By minimizing the laminar sublayer next to the tube wall, the Kenics Static Mixer Heat Exchanger can cool materials to near their freezing temperatures without plugging the tubes. Transfer coefficients equivalent to scraped-surface units are generated without the problems associated with moving parts.



Temperature measurement intervals

Radial temperature profiles before and after homogenization. The apparent viscosity of polyethylene used in this test was 11,000 poises. A homogeneous melt stream was obtained using a Kenics Static Mixer of six elements. It was found that thermal homogenization in the Kenics Static Mixer is independent of the initial radial temperature profiles and the size of the unit. A radial thermal gradient reduction from 100°F to less than l°F was obtained in a PVC cast film production. In general, the unit delivers a polymer melt stream with less than a 3°F radial temperature gradient.

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