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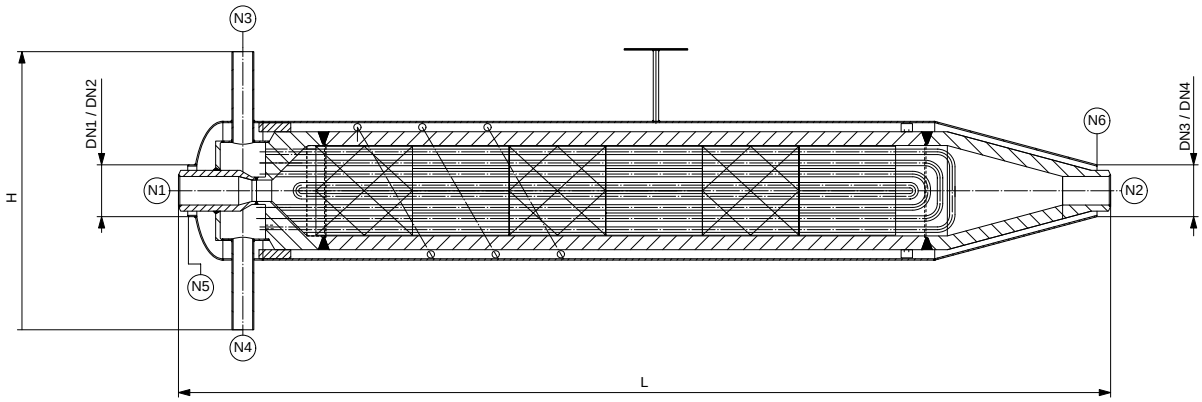
CSE-XR® Mixer Heat-Exchanger for highly viscous

Polymer Melts

There is an increasing need for heat exchangers to heat or to cool polymer-melts and Polymer solutions. Due to the high operating pressure and the high operating temperature however removable devices are often very complex and expensive. With its outstanding performance, the novel CSE-XR® Mixer Heat-Exchanger can be built as a non removable, gap-reduced or even as a gap-free device.



Index	Description	DN	PN
N1	Polymer Inlet	90	<500
N2	Polymer Outlet	90	<500
N3	HTM In for multi tube	40	<40
N4	HTM Out for multi tube	40	<40
N5	HTM In for jacket	100	<40
N6	HTM Out for jacket	100	<40

Fig. 1 and Tab. 1: CSE-XR® Heat-Exchanger

Introduction

The high mixing performance and the excellent self-cleaning efficiency of the CSE-XR® Mixer Heat-Exchanger are described in details in the Fluitec Technical Documentations No. 11.101 and No. 11.103. The knowledge gained by practical experiments and CFD-calculations could be confirmed in recent years by many industrial applications.

Technical Features

The technical features of the CSE-XR® Mixer Heat-Exchanger can be summarized as follows:

- the high heat-transfer performance in combination with the large internal area allow the construction of very compact heat-exchangers
- mixing performance is controlled, defined and very strong. The temperature profile is effectively equilibrated
- the narrow residence time distribution leads to a very good self-cleaning efficiency
- the low shear rates allows a gentle treatment of the product
- the plug flow, the low shear rates and the well equilibrated temperature profile reduce depolymerisation and cracking of temperature sensitive polymers
- pressure drop and energy consumption are low
- cleaning is performed while operating by simultaneous heating-up and flushing of mantle and multi tube
- the heat exchanger can be designed for a nominal pressure of up to 500 bar
- the heat exchanger can be welded direct into the process line. Due to the preparation of the welding points, it has no welding seams
- the tubes surfaces are fine polished and of Ra < 1.6 mm

CSE-XR® Mixing Elements

CSE-XR® mixing elements are of the same construction as the CSE-X mixing elements. Investigations at the University of Applied Sciences Zurich, Winterthur, made clear, that the multi tubes increase the mixing performance.
Concerns regarding the self cleaning efficiency often rise up due to the many mixing elements and

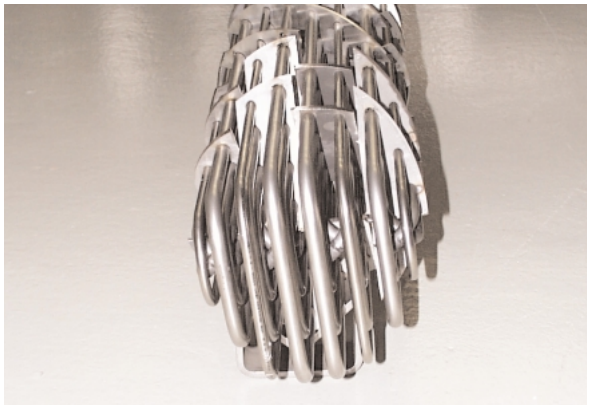


Fig. 2 Multi tube with CSE-XR® mixing elements

and the many axial tubes. CFD calculations, however, showed, that the laminar flow at the wall is much more critical, that the flow through a static mixing element (Fig. 3 and Fig. 4).

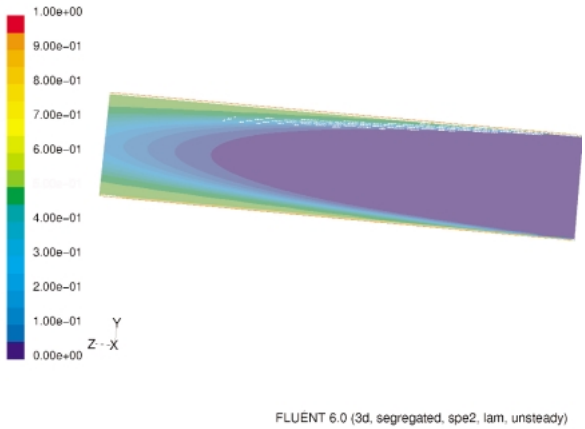


Fig. 3: CFD calculations of the flow regime in an empty tube after a Dirac pulse. The typical parabolic flow profile with a thick stationary film at the wall, as it is known from literature, is well visible.

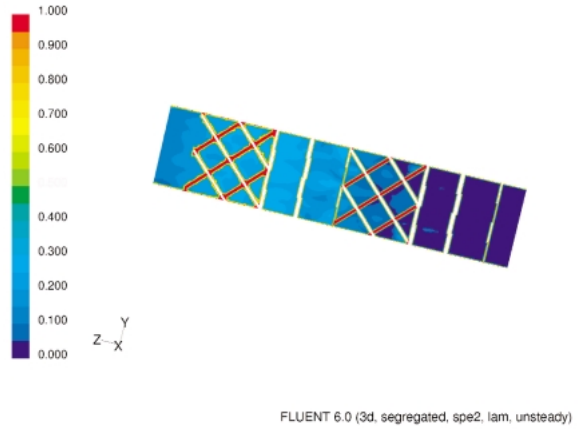


Fig. 4 Dirac pulse in 4 CSE-XR mixing elements. The mixing elements generate a good plug flow.

The CFD-calculations of Fig. 3 ended up with the result that 1% of the particles have a 10-time longer residence time than the fastest particles. The laminar parabolic flow is the main reason for depolymerising reactions and cracking of temperature sensitive polymers. The CSE-XR® produces a much narrower residence time distribution. Practical applications proved, that a change in colour is accomplished completely after flushing with only 2 to 3 volumes of the heat exchanger. The self-cleaning efficiency is even more improved, when heating up the heat exchanger. It is therefore recommended to heat up the bundle and the shell. If long sections of empty tubes are existent in a production plant. the use of the non-removable Mixer Heat-Exchanger is possible without problems.

Fig. 5: CSE-XR® Polymer cooler for PET-melts

Examples of Applications

- Cooling and homogenisation of the temperature profile between the polycondensation- and the spinning-unit of a polyester production plant improves the product quality and allows a higher through-put.
- The viscosity in a extrusion unit is adjusted by cooling and heating, thus allowing the production under optimised operating parameters. An example is the improved sliceability of a granulation unit, due to increased viscosity of the polymer.
- Uncontrolled foaming of thermoplastic polystyrene- or polyethylene-foams can be inhibited by cooling the melt. The result is an increased product quality and a higher through-put rate.
- CSE-XR® coolers are used to compound additives and to cool polymer melts in coating processes of textiles. A variation of temperature of max. +/- 1°C at the outlet of the cooler ensures highest product quality. A constant film thickness also avoids degassing effects. The improved covering power improves quality and throughput rates.

Fig. 5: CSE-XR® Polymer cooler