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mixing + reaction solutions

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HD-CSE mixer nozzle for homogeneous melts for

Injection Moulding

A improved homogeneity of a polymer melt results in most cases in reduced production costs and in a significantly higher quality of the injection moulding-workpiece. Improved form-filling behaviour, reduced clouds and stains of colours, decreased cycle times and a uniform distribution of temperature and dye are the results of the excellent mixing performance of the HD-CSE mixing nozzle. The HD-CSE mixing nozzle has been especially developed for injection moulding processes. Its typical features is the low pressure drop at a high mixing efficiency.

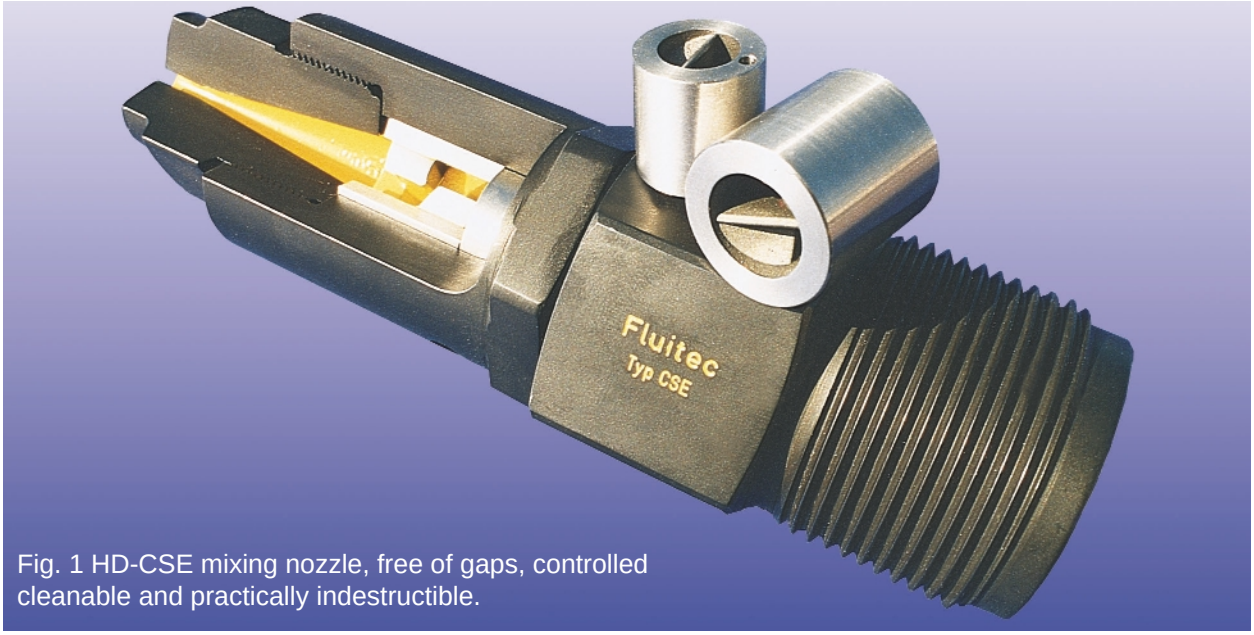


Fig. 1 HD-CSE mixing nozzle, free of gaps, controlled cleanable and practically indestructible.

Function

The HD-CSE mixing nozzle is mainly used for the processing of thermoplasts in injection moulding processes. Its design and construction is unique and well proved in industry for many years. Each mixing element divides the crossectional area in two channels, which are reduced to the half area and expanded again. Inflow and outflow of the channels are rotated by 90°. The flow guiding surface area of the mixers is geometrically defined and convave. The high mixing efficiency of the CSE-mixer is mainly based on two effects: the exponential stratification and the local gradients of the speed of the liquid layers. These effects lead to a continuous mixing at a minimal necessary mixer length.

The typical HD-CSE mixing nozzle consists of 4 corrosion resistant sleeves, each containing 8 gap-free mixing elements. The sleeves are manufactured as a single piece and practically indestructible. The high quality of fabrication ensures the 100% absence of gaps, thus allowing the problem-free processing of polymer melts.

Homogenisation of the temperature

Polymers are very bad conductors of heat. Investigations in extruder plants showed that significant gradients in temperature of up to +/- 20°C are not uncommon. This fact is the reason for deviations in measures and causes thereby often a high rejection rate especially of technical parts.

High gradients of temperature also stand for high cycle times, since the cooling time is a function of the temperature peaks in the melt. A reduction of the cycle time allows thereby a clear

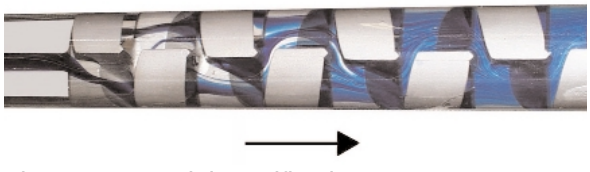


Fig. 2 exponential stratification

economisation of the cost of operation. In numerous applications, the HD-CSE mixing nozzle has proved that it generates a homogenous polymer melt at a comparable low pressure drop.

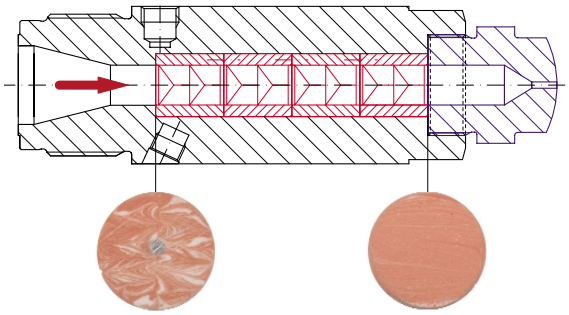


Fig. 3 Schematic illustration of the improved homogeneity of a two parts HD-CSE mixing nozzle. Epoxy cut to the left/right: inflow/outflow

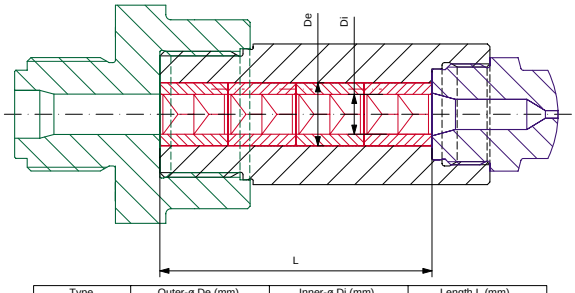
Reduction of costs for dye

An improved homogeneity of the polymer melt allows the production of parts with a more luscious colour, what is easily recognisable often even by the naked eye. The use of the HD-CSE mixing nozzle makes the reduction of dye of up to 30% possible while keeping the intensity and the quality of the colours constant. The saved costs of operation (by only this fact) can be calculated as follows:

Model of calculation:
Costs = price of dye [Euro/kg] x weight of the part of mould [kg] x numbers of parts [-] x weight ratio of dye [%]

Example of calculation:
Typical prices of master batches are in the range of 2.- to max. 30.- Euro/kg. Assuming a price of 5.- Euro/kg, a weight of 0.45 kg per part of mould, the production of 20'000 pieces and a weight ratio of 3% of a master batch of dye, the described reduction of 30% leads to a new demand of 2.1% of master batch.

Cost analysis:
Costs of dye without mixing nozzle: 1'350.- Euro
Costs of dye with mixing nozzle: 945.- Euro
Reduction of costs: 405.- Euro
This realistic example makes clear that a HD-CSE mixing nozzle is amortised in a very short time.



Type	Outer-ø De (mm)	Inner-ø Di (mm)	Length L (mm)
HD-CSE De =12	22 +0 / -0.1	12.0 +/-0.1	88 +/-0.2
HD-CSE De =16	25 +0 / -0.1	15.8 +/-0.1	108 +/-0.2

Fig. 4 Three parts HD-CSE mixing nozzle

Reduction of stains, clouds and striae

The application of CSE-mixing nozzles reduces significantly the possibility of stains, clouds and striaes in parts of mould even if they are of a crystal clear polymer. In combination with the mixing performance of the screws in the extruder, not more than 4 HD-CSE mixing elements are normally necessary. For extremely difficult mixing tasks, however, a mixing nozzle containing 5 to 6 elements could be required. Recapitulating the mentioned facts, the following improvements can be expected by using a HD-CSE mixing nozzle:

- reduced costs for dye
- reduced cycle times
- homogeneous distribution of colour
- prevention of stains and clouds
- homogeneous flow of melt
- extended fields of application
- reduced rate of rejection (also of older moulding machines)
- improved geometrically accuracy
- improved product quality also with regenerates

Evaluation of the appropriate mixer type

The ideal dimension of the mixing nozzle required can be evaluated by using Fig. 5. It is easily recognisable that the HD-CSE mixing element is capable to cover a very wide range of through-put rates. The additional pressure required by the use of a mixing nozzle is 50 to 200 bar. For very tough material and/or very short injection times, the use of the corresponding viscosity curve is strongly recommended.
Compared to the mostly used and well known x-type mixers (CSE-X), the pressure drop of the HD-CSE mixing nozzle is reduced by a factor of 5 to 6. This is the reason why this mixing nozzle covers such a wide range of application: 90% of all applications can be covered with only two dimensions.

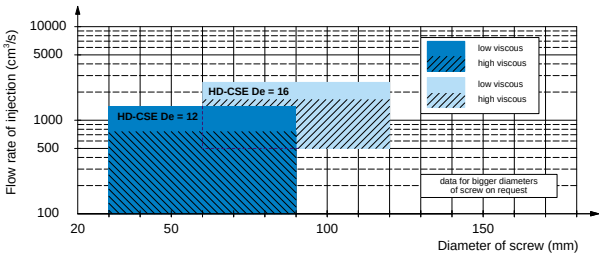


Fig. 5 Chart for the evaluation of the appropriate size of the mixing nozzle

Cleaning

If changing the polymer, the content of a mixing nozzle is ejected within a very short time. It is known from experiences that 2 to 3 volumes of the mixer are necessary. The nozzle is self cleaning. If removed from the housing, the mixer can be easily disjoint. After cleaning in a thermal fluidised-bed or in a vacuum chamber, the mixers can be visually checked to 100%.