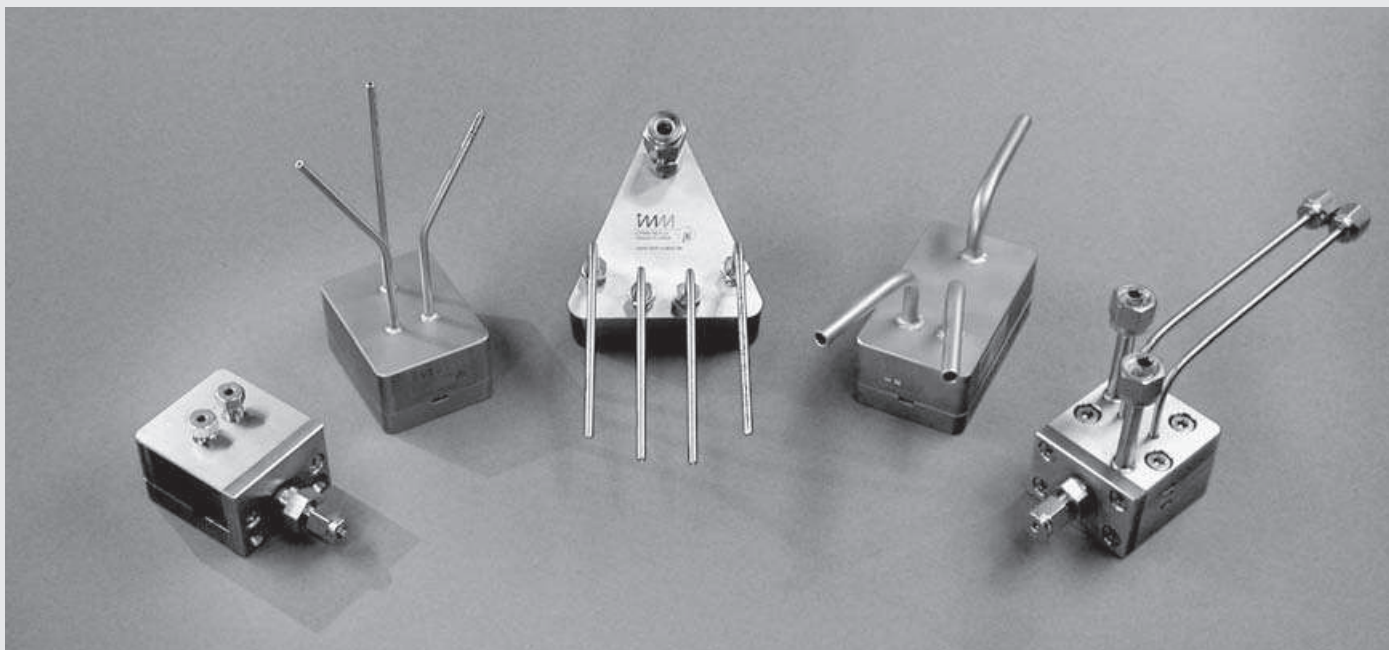


CATERPILLAR MICROMIXER

CPMM-V1.2 GROUP CLASS-R150, -R300, -R600, -R1200, -R2400

46

03



CPMM group class

Principle

The Caterpillar Micromixers are particularly suitable for applications where fast mixing at higher throughput is desired, providing highest performance for l/l-mixing as well as for g/l- or l/l-dispersing. As they consist of a structured single channel, these devices may also be used successfully if precipitation occurs during the reaction or if fine slurries shall be processed.

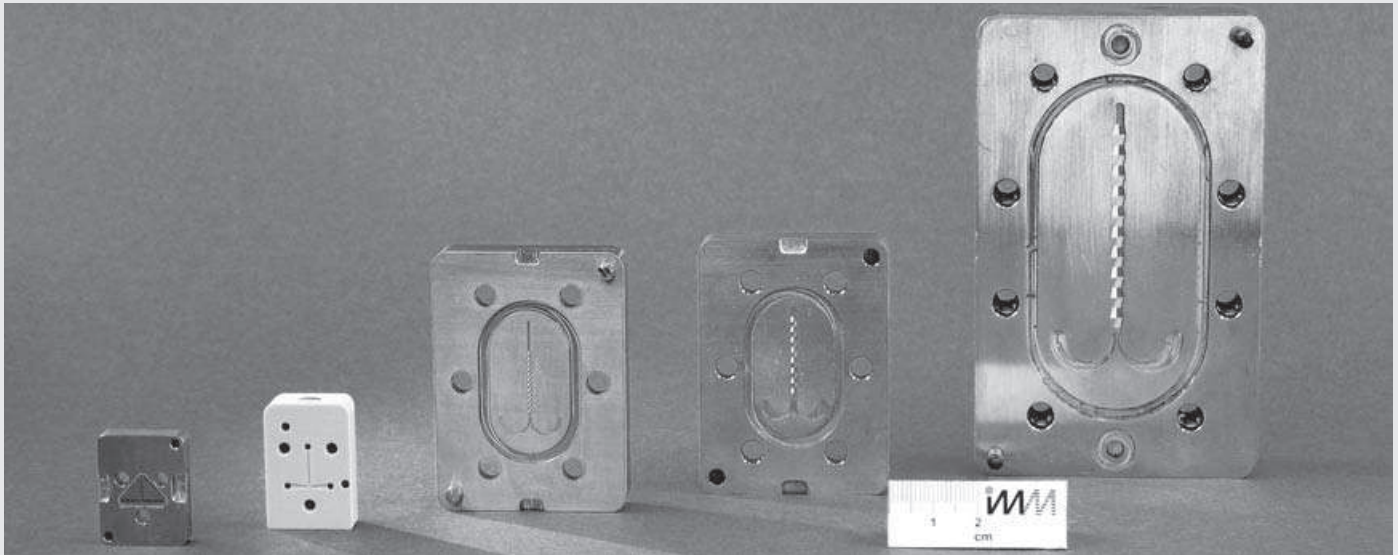
The higher flowrates enable production scales of a few up to about 100 tons per year with all the advantages of our micro mixers, such as mixing quality, availability of different housing materials and safety gains.

The Caterpillar Micromixer has internal bas-relief structures which induce recirculation flows transverse to the flow direction which result in efficient chaotic mixing. At very low Re numbers, e.g. for viscous flows at low flow rates, the mixing mechanism may change and a near-multilamellae type flow pattern arises which uses diffusion mixing in thin layers, in a split-and-recombine fashion.

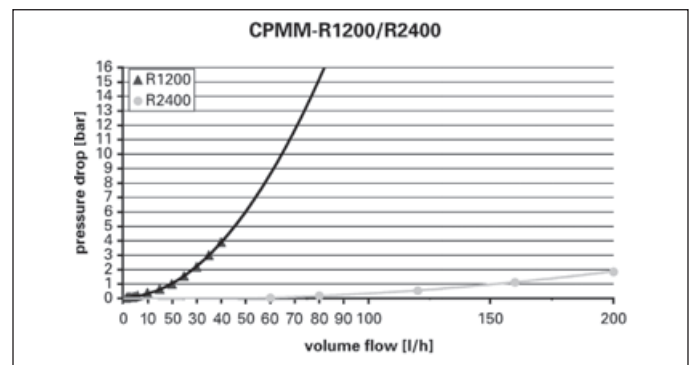
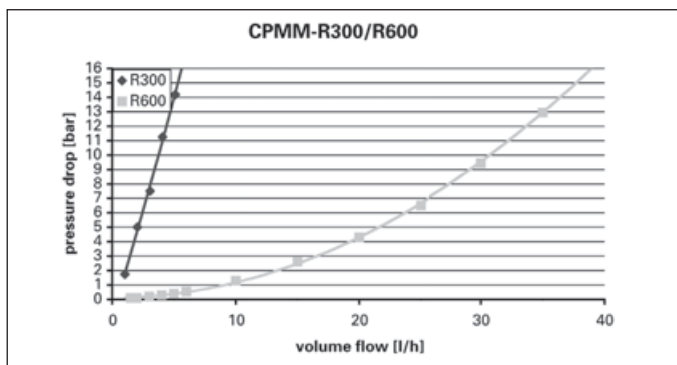


Simulated "real" flow profiles at high flow rates in Caterpillar Micromixers

Single Caterpillar Micromixers



CPMM sizes, from left: R150, R300, R600, R1200, R2400

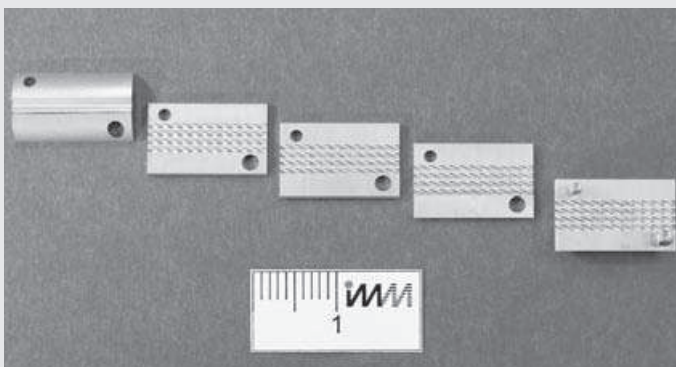


Caterpillar Micromixer Arrays & Stacks

Research Topics at IMM

In the context of IMM's efforts in the continuous advancement of our components for production purposes two prototypes of numbered-up versions of the CPMM-R600/12 mixer have been realized recently. They combine the unique properties of the Caterpillar Micromixers and their less clogging-sensitive structures with the aim to process higher throughputs. In the STACK-10x-CPMM-R600/12 ten caterpillar structures on plates are stacked and brazed

together allowing high pressure applications. This mixer has been successfully tested for a dispersion step with a throughput of up to 600 kg/h. In the ARRAY-16x-CPMM-R600/12 the caterpillar structures are arranged in a different manner requiring also a new feed distribution system but decreasing pressure drop. Development here has been accompanied by modelling works to learn and understand fluidic behaviour, mixing, and fluid equidistribution when numbering up.

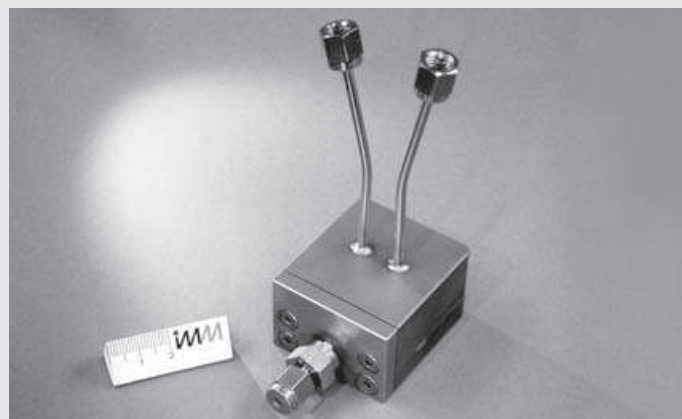


CATERPILLAR MICROMIXER

CPMM-V1.2 GROUP CLASS-R150, -R300, -R600, -R1200, -R2400

48

Single Caterpillar Micromixers with straight outlet



CPMM with a straight outlet



CPMM with a straight outlet made of PP

The Caterpillar Micromixers with straight outlet are particularly suitable for applications where fast mixing is desired though precipitation occurs during the reaction or if fine slurries shall be processed. Due to the construction principle only 30 bar system pressure can be applied, nonetheless enabling production of slurries containing up to some 100 kg per year of fine powders. These mixers consist of a single structured mixer channel with an adapted outlet.

As the emerging reaction fluid is not forced to leave the mixer via the 90° elbow flow configuration and in addition the rectangular mixer geometry is smoothly adapted to the round shape outlet tube, eddies can be prevented in this region and therefore fouling is diminished or even prevented. This effect can further be promoted by the application of suitable special housing materials as e.g. PTFE.

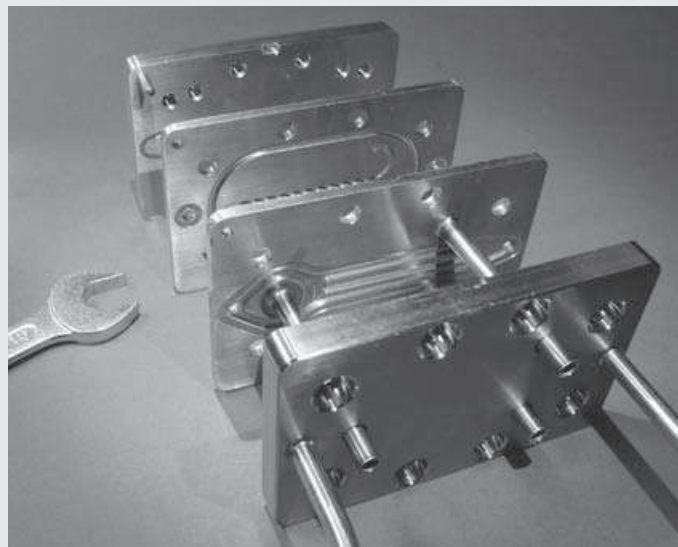
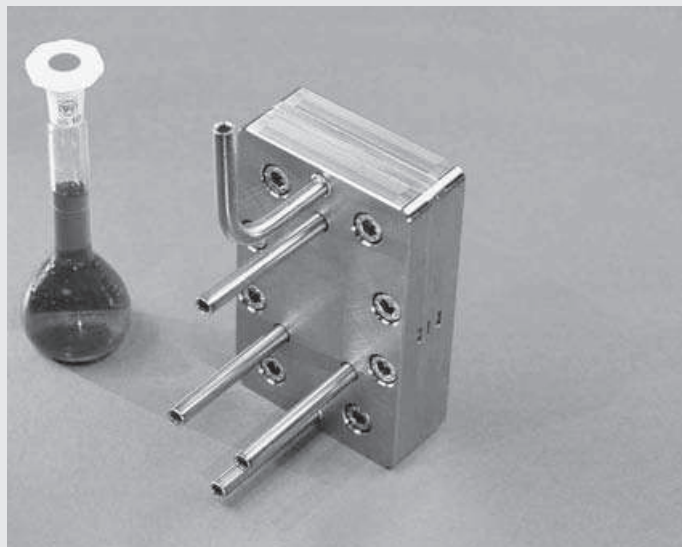
Technical Data

Name	Caterpillar Micromixer R300	Caterpillar Micromixer R600	Caterpillar Micromixer R1200	Caterpillar Micromixer R2400	Caterpillar Micromixer R300-straight outlet	Caterpillar Micromixer R600-straight outlet	Caterpillar Micromixer R1200-straight outlet	Caterpillar Micromixer R2400-straight outlet
Order number	CPMM-V1.2-R300	CPMM-V1.2-R600	CPMM-V1.2-R1200	CPMM-V1.2-R2400	CPMM-V1.2-R300-so	CPMM-V1.2-R600-so	CPMM-V1.2-R1200-so	CPMM-V1.2-R2400-so
Mixing principles	all: bas-relief, recirculation flow (chaotic)							
Size (L x B x H)	60 x 45 x 20	60 x 45 x 30	60 x 45 x 30	79 x 45 x 30	51 x 45 x 20	51 x 45 x 30	51 x 45 x 30	70 x 45 x 30
Connectors (Inlet/Outlet)	1/16" / 1/8"	1/8" / 1/8"	1/8" / 1/4"	1/4" / 3/8"	1/16" / 1/16"	1/8" / 1/8"	1/8" / 1/8"	1/4" / 1/4"
Standard mixing channels (µm)	300 x 300	600 x 600	1200 x 1200	2400 x 2400	300 x 300	600 x 600	1200 x 1200	2400 x 2400
Standard material	1.4435	1.4435	1.4435	1.4435	1.4435	1.4435	1.4435	1.4435
Options	Heat exchanger function is possible; other materials like Hastelloy, Monell, Titan, PTFE or other plastics on request							

Operating Conditions

Order number	CPMM-V1.2-R300	CPMM-V1.2-R600	CPMM-V1.2-R1200	CPMM-V1.2-R2400	CPMM-V1.2-R300-so	CPMM-V1.2-R600-so	CPMM-V1.2-R1200-so	CPMM-V1.2-R2400-so
Temperature (°C)	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220	-40 – 220
Pressure stability (bar)	100	100	100	100	30	30	30	30
Flowrate (l/h)	0.5 – 4	2 – 40	4 – 80	15 – 250	0.5 – 4	2 – 40	4 – 80	15 – 250
Residence time (ms)	3.6 – 72	2.25 – 45	3.15 – 70.2	3.6 – 60	5.4 – 108	2.7 – 54	4.05 – 81	4.32 – 72
Inner volume (µl)	10	25	78	250	15	30	90	300
Max Viscosity (mPas)	100	100	100	100	100	100	100	100
Leakage Class	< L _{0.001}	< L _{0.001}	< L _{0.001}	< L _{0.001}	< L _{0.01}	< L _{0.01}	< L _{0.01}	< L _{0.01}

Single Caterpillar Micromixers with Heat Exchanger Function



CPMM-R2400/10-HEX-ss-wt assembled (left) and disassembled (right)

As an additional feature the Caterpillar Micromixers may be offered with an integrated heat exchange function particularly suitable for applications where pre-heating/-cooling of the mixture is desired prior to the subsequent reactor (by means of e.g. heat exchanger delay loop) thus extending the application range to more exothermic reaction or application of molten materials. Of course, this heat exchange version may also be combined with the straight

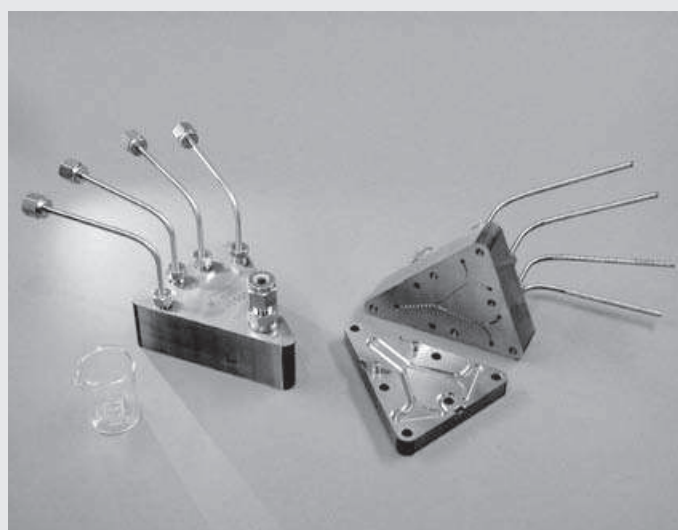
outlet and its housing can be produced in nearly any material desired. Meanwhile, the Caterpillar Micromixers with heat exchanger function are, notwithstanding the above photo of a gasketed one, typically brazed, turning the two heat exchange passages into service free units and enabling even for the gasketed center mixing section high system pressures and temperatures.

Multiple Caterpillar Micromixers



8CCPM-R1200/8.7-PMMA

For special mixing or dispersion applications, where no residence time/delay loop is needed, the Caterpillar Micromixers may be combined to arrays thus enabling a nearly simultaneous mixing of more than 2 fluids at once. With such arrays e.g. multi-component creams can easily be generated.



4CCPM-R952/8.2-R1200/8.1-ss-hplc