Company profile

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HNP Mikrosysteme: micro annular gear pumps for precise dosing and metering applications

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For many machine and system manufacturers, pumping, conveying and metering is their daily business. However, when dealing with minimal quantities of low or highly viscous fluids, the task quickly turns into a challenge. Additional demands such as a high differential pressure, aggressive liquids and maximum precision sometimes make the task appear unsolvable. However, many of these extremely demanding metering jobs can be mastered – with the aid of micro annular gear pumps.

Company

HNP Mikrosysteme develops, manufactures and markets micro annular gear pumps worldwide, which are ideally used where fast and highly precise dosage is required. The company is based in the North of Germany, which is where mzp-pumps are made, starting from the concept via design and assembly right up to validation. Started in 1998 by a team of five, the company now has more than 70 employees.

High precision – low pulsation

Micro annular gear pumps (mzp-pumps) are characterized by low pulse delivery and minimal dead volume. They are precise, with long service life and small dimensions, made from ultra-hard materials and easy to maintain. The hermetic inert series has been specially conceived to fulfil the most challenging tasks in chemical processing, mini plant and flow chemistry. The rotor sets of this pump series are made from partially stabilized zirconium dioxide; further

functional parts consist of aluminum oxide or tungsten carbide.

These materials, recognized for a high chemical resistance, allow for pump use with oxidizing and reducing liquids, acids, bases and solvents, while at the same time showing excellent resistance to wear. Hot isostatic pressed silicon carbide (SiC) has been used as shaft and bearing material and the body consists of alloy C22 or stainless steel.

Precision in applications

Five series of mzp-pumps permit a multitude of applications. In addition to several application possibilities in analytical instrumentation, plant engineering and construction, mzp-pumps are used for demanding metering tasks in the field of chemical and pharmaceutical processing, microreaction technology and in new markets like organic electronics or aerospace. With differing equipment, metering volumes from 0.25 µl, volume flows from 1 µl/h to 1.1 l/min and pressures from 0 to maximum 150 bar can be realized. The range of media viscosity extends from 0.3 to 1,000,000 mPas. The pumps are suitable for lubricating and non-lubricating media. Operation in areas protected against explosions is also possible.

The mzp-pumps make conventional applications more effective and open up new technological fields. One application field of many is the coating technology. Here, mzp-pumps supply spray systems and slot dies with liquids for the application of very thin layers. The low pulsation flow rate guarantees that minimal volume flows of 0.1–500 ml/min can be constantly applied across many square meters of surface. The procedure is used for the coating of stents with medication, glasses lens and solar cells with functional layers and wafers or DVDs with layers of paint, and also in the production of organic electronics and battery systems. Micro annular gear pumps feed reactors in intensified chemical processes as well as printing devices or slot dies in roll-to-roll processes.

Furthermore, the characteristics of the mzp-pump permit its integration into devices for DNA analysis, blood

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analysis and also in open pipetting systems in which the user can program their requirements according to liquid handling tasks. Due to their compact construction, they are predestined for the realization of projects for device miniaturization, as on the one hand, the pump principle permits low pulsation metering of shear-sensitive liquids, and on the other hand, it is possible to take up and deposit small quantities of liquid using the mzp-pump (aspiration and dispensing) or to convey high volume flows continuously, for example for a cleaning process. All three functions can be conducted by the same pump and thus simplify the liquid organization in analysis devices. Quantities of around 5 μl can be metered to a precision of 1%.

During the production of medical products such as disposable syringes, infusion sets, indwelling cannulas, customized tubes and medical stopcocks, the use of silicone as a lubricant between the moving parts or as a glide agent for pain-free application of indwelling cannulas is state of the art technology. The minimization of the silicone quantities to 0.1–0.2 μl per device results from the healthcare service specifications. Required tolerances are not realizable using metering valves and pressure-time-controlled metering systems, but enabled by mzp-pumps.

Similar to the use of silicone, the metering and dispensing of adhesives is an important aspect of modern plant engineering. For example, when joining optical systems, transparent UV-curing adhesive is used which is metered bubble-free with high repetitive accuracy at minimal volumes of 0.5–10 μl .

Further application fields are the metering and dispensing of hot melt adhesives for efficient and long-term stability joining processes, the highly dynamic and precise minimum quantity metering and dispensing of greases, and the highly accurate filling of minimal quantities of

Figure 1 Operation principle of micro annular gear pumps.

Figure 2 Assembly of the smallest annular gear pump of the world.

Figure 3 mzp-pumps permit a multitude of applications.

Figure 4 Micron accuracy of functional parts for highest precision in application.

oil, grease, alcohol and many other liquids. Pump materials which are resistant to wear and corrosion permit numerous applications in chemical and pharmaceutical production.

Operational principle of the smallest annular gear pump in the world

The micro annular gear pump (mzr-pump) by HNP Mikrosysteme is the smallest well-known micro annular gear pump in the world. It belongs to the group of rotary positive displacement pumps on which the displacer consists of two components: an externally toothed inner rotor and an internally toothed external rotor, whereby the external rotor has one tooth more. A precisely controlled electric motor drives the inner rotor, which in turn takes the rotatable-mounted external rotor with it. During rotation, the eccentrically mounted rotors form a system of several sealed pumping chambers which increase on the induction side and simultaneously decrease on the delivery side. In this way, an even and low pulsation flow rate is generated between the kidney-shaped inlet and outlet, which simultaneously connects several pumping chambers.

Production accuracy in the micrometer range

Maximum precision is on the one hand realized by mzr-pumps when smallest volumes or volume flows must be applied highly precisely, and on the other hand required during production of the functional components.

The high performance capability of the mzr-pump is substantially influenced through minor inner leakages. These so-called backflows are more obvious in little pumps than in large ones, as micro pumps convey less, meaning that the relative leakage flow has a greater effect. On mzr-pumps, these gap heights total 2 μm . In comparison, a red blood cell with a size of 7 μm already exceeds the production tolerances of the functional components on mzr-pumps multiple times and a human hair with a diameter of approximately 70 μm is huge.

For further information on the company and the products at HNP Mikrosysteme GmbH, see www.hnp-mikrosysteme.de.