

## Dosing pumps for sealing compounds

### Reliable, non-damaging solutions, despite abrasive fillers

UJ - 2008/03/18

Seite 1 von 6

Zimmern o. R., 18.03.2008 - Polyurethane sealing compounds fulfil a variety of purposes in the electronics industry, such as protecting plastic electrical housings, control units, industrial lights and sensors from dust, moisture and unwanted attention. To ensure that they function effectively, the manufacturers of these systems use a variety of fillers which extend the range of properties of the plastic materials. However, these additives present companies using the sealing compounds with the challenge of finding a dosing pump that can handle the compounds without problems.

The process of sealing electronic components is well established. The sealing compounds, either single or two-component products, are processed and applied using low pressure mixing and dosing systems. The dosing pump is an essential component of these systems. Its job is to pump the sealing compound without damaging it into the mixing unit at a precise volume flow rate. A variety of different continuous-duty and intermittent-duty pumps is available on the market. Both of these methods of operation have advantages and disadvantages, but the type of pump chosen will generally depend on the viscosity and abrasiveness of the material and the required flow rate (Table 1).

Feature	Dimension	External gear pump	Screw pump	Piston pump
Viscosity	> 10 <sup>5</sup> mPas	+	+	+
	10 <sup>2</sup> - 10 <sup>5</sup> mPas	+	+	+
	1 - 10 <sup>2</sup> mPas	+	+	+
Fluid structure	homogeneous	+	+	+
	heterogeneous, abrasive	- 0	+	+
Delivery	Non-damaging	0	+	+
Volume flow rate	1 - 100 cm <sup>3</sup> /s	+	+	+
	< 1cm <sup>3</sup> /s	+	- 0	+
	< 0,1cm <sup>3</sup> /s	-	-	+
Differential pressure	< 100 bar	+	-	+
	< 40 bar	+	0	+
	< 10 bar	+	+	+
Dosing time	< 0,5 sec	0	-	+
	< 2 sec	+	0	+
	> 2 sec	+	+	+
Dose size	< 20 mg/Dose size	0	-	+
Continuous operation		+	+	-
Legend:	+ ideally suited	0 suited	- unsuited	

Table 1: Features of dosing pumps

### Comparing dosing pumps

All the pumps described below work on the principle of volumetric dosing. This is the precise and controlled displacement of a material of a specific volume and with a consistent density. In contrast to timed pressure dosing, the volume or mass flow rate is independent of the pressure and viscosity. The main types of pumps for this application are as follows: External gear pumps (sometimes also internal gear pumps)

- » Hose pumps
- » Screw pumps
- » Piston pumps

Gear pumps are amongst the most precise dosing pumps (Figure 1). They are ideal for slightly abrasive materials ranging from liquids to pastes and with or without solid fillers. Wear-resistant coatings and specially designed gear tooth shapes help to increase the service life of the pumps. External gear pumps can be used from a pumping volume of around 0.1 cm<sup>3</sup> per revolution and are suited for dosing pressures up to approximately 100 bar. For smaller pumping volumes, internal gear pumps can also be used. The system shown in Figure 2 has the advantage of being highly compact. The internal gear pumps are fitted next to the mixing system which allows for very high levels of accuracy of  $\pm 1$  percent with dosing quantities of around 20 milligrams (minimum dose of 1 mg). Screw pumps are suitable for dosing liquids and pastes with low and high levels of viscosity. This type of pump is very unlikely to cause damage to the materials and is not sensitive to filled or abrasive materials. However, screw pumps cannot achieve the dosing accuracy and dynamics of gear pumps because of the increased pressure that they exert. For this reason, screw pumps should only be used for pumping volumes of 1 cm<sup>3</sup> or greater at a pressure of up to around 40 bar. Hose pumps are only appropriate for dosing in situations where less accuracy is required, because of the sensitivity of the hoses to pressure. They are a cost-effective solution for dosing filled and abrasive materials. Piston pumps are ideal for demanding applications involving almost any type of liquid or paste. The piston pushes the material out of a cylinder, which has to be re-filled after a certain number of doses. The dosing systems vary in size depending on the application.

### More challenging requirements

The growing physical and chemical requirements placed on electronic components have increasingly resulted in epoxy, silicone and polyurethane sealing compounds being supplemented with fillers to achieve the necessary material properties. This produces a mixture of solids, different liquid phases and structurally viscous properties, which present a challenge to the dosing pump. Particular attention must be paid to fillers such as:

- » Chalk
- » Aluminium
- » hydroxide
- » Quartz flour
- » Drying agents
- » (zeolites)
- » Thixotropic agents
- » Hollow spheres



**Figure 1: Gear pumps are among the most accurate dosing pumps.**

There is a risk that these materials will cause damage to the dosing pump. However, the pump may also give rise to changes in the property profile of the materials. These are generally gradual processes which are not easy to identify in advance and are usually the result of the materials passing through components of the wrong size. The following factors must be taken into account when designing hydraulic circuits: constant flow speeds pipe systems designed for ideal flows low levels of pressure the lowest possible material shear (this is the deformation speed of elements in the volume flow) The type of material is the first consideration when choosing a pump (Table 1).

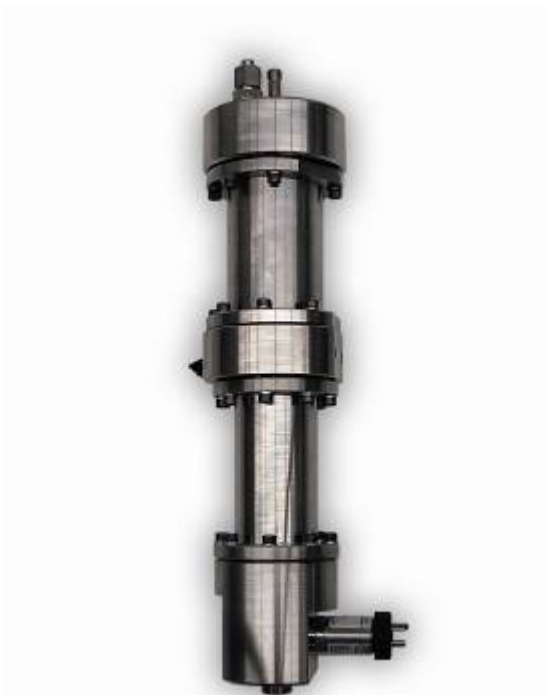
However, other decisive factors include the dosing conditions, such as:

- » Dosing time
- » Volume flow rate
- » Precision
- » Process sequence
- » Dosing temperatures

The comparison of three different pumps (Figure 4) clearly shows that the piston pump produces the best results with regard to the scatter of the individual doses and therefore is the best solution in terms of machine capability.



**Figure 2:** For dosing very small quantities, gear pumps can be mounted next to the mixing system. The pumping volume is 50 mm<sup>3</sup> per revolution.



**Figure 3:** Piston dosing pumps are ideal for demanding applications involving almost any type of material. The piston pushes the material out of the cylinder.

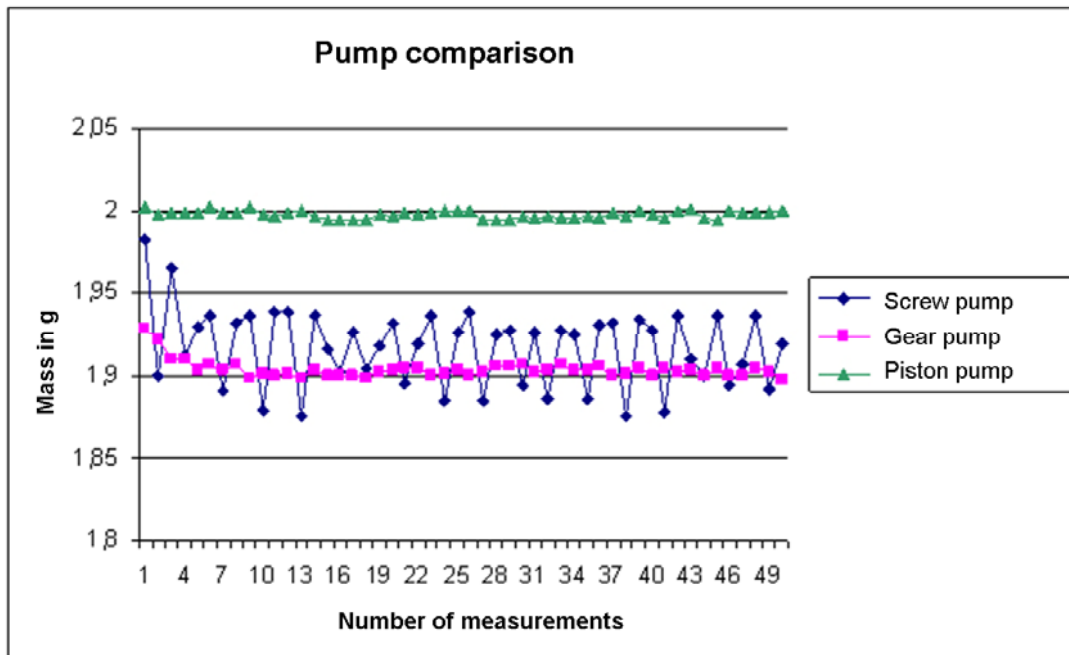


Figure 4: Comparison of three types of pump for dosing polyol with a density of around 1.6 g/cm<sup>3</sup> and a viscosity of approximately 15,000 mPa s.

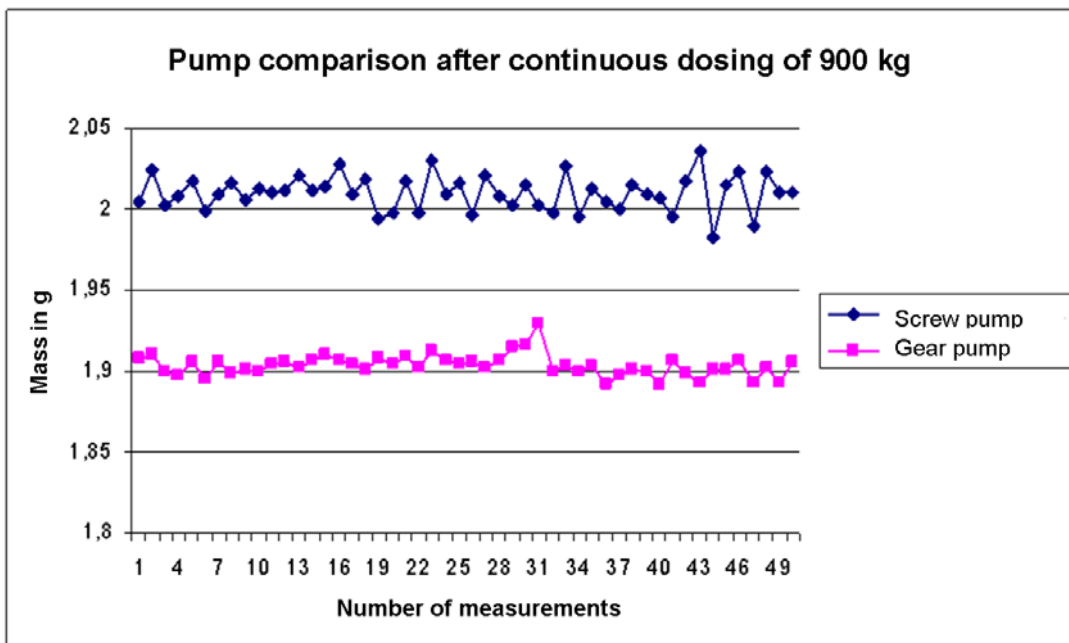


Figure 5: Long-term comparison of a gear pump and a screw pump. Material: polyurethane sealing compound, filler: non-abrasive, proportion of filler: 66%, average grain size: 16 µm, viscosity: 20,000 ± 1,000 mPa s, density: 1.64 to 1.68 g/cm<sup>3</sup>.

## Summary

Practical experience shows that piston pumps give the best results in terms of service life, accuracy and precision, but gear pumps make a good alternative. They are more cost-effective than both piston pumps and screw pumps and can pump continuously. Screw pumps are also suitable for continuous dosing of filled materials. There are no good or bad pumps in this respect. The decisive factors are the requirements placed on the system. If more than one type of pump is available, personal preferences and logistical considerations will often play a role in the decision-making process.

Herausgeber:  
RAMPF Dosiertechnik GmbH & Co. KG  
Römerallee 14  
D-78658 Zimmern o. R.  
T + 49 (0) 741 2902-0  
F + 49 (0) 741 2902-2100  
E [info@rampf-dosiertechnik.de](mailto:info@rampf-dosiertechnik.de)  
[www.rampf-dosiertechnik.de](http://www.rampf-dosiertechnik.de)

Ihr Ansprechpartner für Bildmaterial und weitere Informationen:  
Ulrike Jäger  
RAMPF Holding GmbH & Co. KG  
Albstraße 37  
D-72661 Grafenberg  
T + 49 (0) 7123 9342-1041  
F + 49 (0) 7123 9342-2041  
E [ulrike.jaeger@rampf-holding.de](mailto:ulrike.jaeger@rampf-holding.de)