perfecdos Technology-Study 4
for the electronics,
automotive industry
and power engineering

Image 1: In this application of a silver-containing TIM, every gram in the right place counts (Image: perfecdos GmbH)

Efficient dispensing of valuable material

TIM: Eccentric screw pump vs. jet valve

The TIM (Thermal Interface Materials) often used today for the heat dissipation of electronic components are valuable and have a great influence on the function and longevity of the component. It is therefore important to dispense them in the best possible way. Their contactless application via jet valve offers interesting advantages compared to contact application via eccentric screw pump.

What is important in the TIM order? – In order for thermal conductive pastes to fulfil their important task in electronic components, for example in the fields of „new energy" or „electromobility", the entire surface of the components intended for heat dissipation must be covered with a thin and uniform layer. This is the only way to ensure the safe dissipation of heat from the sensitive components. At the same time, the required thermal conductivity (W/(m-K) is increasingly rising due to miniaturisation and higher power densities. Today, there are many variants of TIM. TIM pastes often differ in their material composition. They are highly filled with a wide variety of metals and precious metals. However, these abrasive materials place high demands on the dispensing process:

- TIM are expensive and therefore have to be dispensed precisely and as far as possible without losses.
- After application, the fillers must be evenly distributed in the heat-conducting layer so that the heat can be safely dissipated.
- The thermal conductive pastes must be applied without bubbles, as air dissipates virtually no heat.

In one project, a heat-conducting paste filled with silver (Image 1) should be applied to an electronic component. For this purpose, the material was initially dispensed by contact with an eccentric screw pump. During the test phase, various classic problems were encountered:

1. Limited thermal conductivity due to unclean dispensing results caused by broken lines, air bubbles and the TIM flowing after dispensing.
2. Long cycle times due to slow application through feed movement in the z-axis. To form a bead on the component, the dispensing speed of the pump had to be slowed down.
3. Unnecessary and expensive material consumption due to deviating volumes during reflow and dead spaces of the metering system.
4. Material preparation and mixing of the micro quantities were difficult. The material had to be prepared more elaborately under vacuum to achieve the required freedom from bubbles. Static mixing tubes were not suitable for mixing the silver-containing TIM in this case. The volume flow in the static mixing tube was so low that the two components did not mix optimally.
5. Costly cleaning and maintenance - The mixed TIM „infected" freshly mixed and re-feeding material in the dead spaces and changed its metering properties and function.

The solution - dispensing with jet valves – With the PDos X1 (Image 2), the TIM is now applied contact-free in individual drops at a very high frequency and the desired application pattern is created. The optimal distribution of the fillers is ensured. With this system, the droplets can be between 500 µm and 1.5 mm in size. The materials are dispensed with a repeat accuracy of 99% in relation to the dispensing volume.

The perfecdos dosing valves are - from a mechanical point of view - designed as a „normally closed" system (NC). In the design, care was taken to ensure that leakage is reliably prevented in the event of a failure of the supply media. When dosing TIM, special consideration must be given to its abrasiveness and exact filler distribution. The material selection and design of the precision valves are optimised for this purpose.

With regard to the above-mentioned five problems with contact dispensing, jetting with this system offers the following advantages:

1. With lines, dispensed by dot application, interruptions are reliably avoided.
2. The non-contact application eliminates the need for a feed motion. The system's 300Hz dispensing frequency allows the process to be accelerated even further. Dispensing is no longer the bottleneck of the overall process.
3. The system has no dead spaces. This prevents infection with „old medium" and air pockets in the sys-

Practical tip by Benjamin Kratz:

In practice, attempts are repeatedly made to mix such materials by hand. However, these mixtures cannot be reproduced exactly and the results of tests with hand-mixed material therefore have only limited validity.

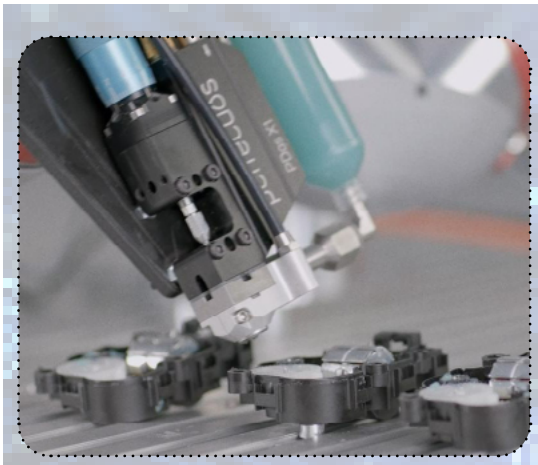

Image 2: With 300 Hz cycle frequency, a high dispensing frequency is achieved at a distance of 50 mm for horizontal and overhead shots (Image: perfecdos GmbH)

Material-saving: up to 1.000€/Layer*

Process secure: Repeat accuracy 99%

Minimal cleaning and maintenance effort

(Image: perfecdos GmbH)

(Image: perfecdos GmbH)

tem. The small internal volume of the dispensing system is also advantageous. The actuator system is completely separated from the part of the valve that comes into contact with the fluid. The internal volume of the system is only approx. 0.258 ml. Due to the principle, this volume is considerably lower than in other dispensing systems. An eccentric screw pump has an internal volume of approx. 4 ml.

4. The TIM are dynamically mixed and degassed after mixing.

5. Quick and easy cleaning of the valves (no dead spaces) allows effective jetting processes.

In practice, cartridges for which the material is prepared and mixed for one layer - according to the pot life - are preferred for dispensing micro quantities. Alternatively, ready-made cartridges can be purchased deep-frozen.

The modular design of the Jet valve allows easy adaptation to the respective tasks - regardless of whether it is a simple retrofit into existing systems, e.g. as a replacement for a contact metering solution, or new systems.

The precise non-contact dispensing of TIM with the PDos X1 jet valve is a concept that pays off, because high-precision non-contact dispensing applies TIM only where heat is to be dissipated. In combination with easy cleaning and the avoidance of - in several respects - cost-intensive dead spaces, this quickly saves more than €1,000 per shift (depending on the material price). Under total cost of ownership considerations, 300 cycles/s, which enable faster production with minimised waste, are central aspects. The simpler machine design and process monitoring also save a lot of money.

So there are numerous aspects in favour of this concept. Image 3 shows the potential of the jet valve in comparison to contact dispensing with eccentric screw pumps. The values are based on practical experience and show that it is worthwhile to look into the potential of jet technology under all the aspects mentioned.

The system in video

* depending on the material price

I would be happy to support you with your project

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Image 3: Contactless dispensing offers many advantages (Image: perfecdos GmbH)