WHITE PAPER

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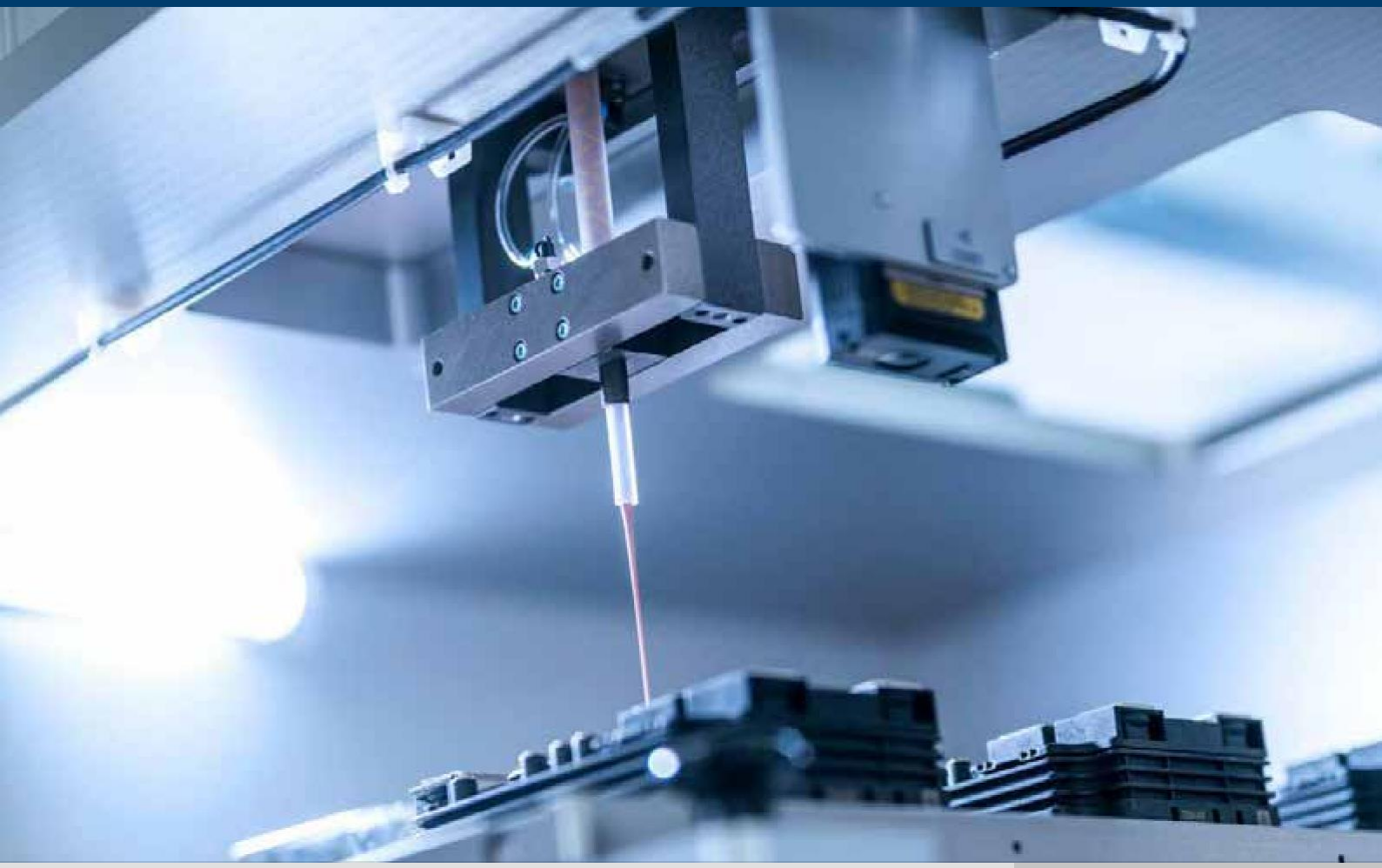


INNOVATIVE TECHNOLOGY

How to optimize **dispensing processes**

PRACTICAL TIPS

PROVEN PROCESSES

USEFUL SERVICES

Effective and reliable dispensing is based primarily on process technology that has been perfectly set up for the specific project. Anyone tasked with planning dispensing systems and responsible for the processes should know the principles and key factors involved so that the dispensing processes can be successfully implemented in cooperation with system and material partners. This White Paper explains the relevant aspects of process technology and provides valuable practical tips.

Five key aspects of process technology

1. Why is a holistic view required?

Examining process technology from many different perspectives will save time and money. It will also improve product quality. Examining process technology along the value chain of a product (Fig. 1) will have a considerable impact on the effectiveness of the dispensing process.

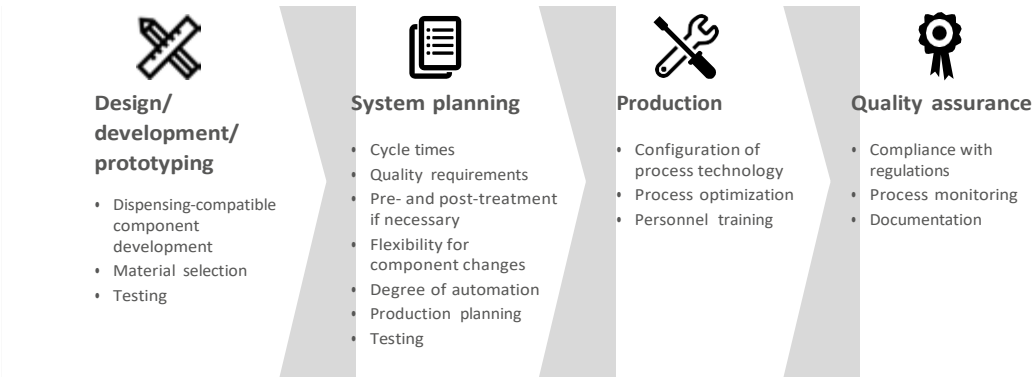


Fig. 1: Process technology along the value chain.

2. Are there any standard solutions from a process technology standpoint?

Yes and no – our system solutions have a successful track record for a wide range of standard requirements. As current trends such as New Mobility progress, the demands on process technology (materials, cycle times, etc.) may increase depending on the project. In such cases, we solve the potential conflicts between “time”, “costs”, “quality” and “flexible production” with customized systems. As a rule, however, system solutions are sufficient in view of their high standard.

Practical tip: Components that have been developed without reference to dispensing technology may be expensive in production. Therefore, the proven route is to involve dispensing specialists right from the development phase.

3. Why are clear task definitions so important?

Liquid sealants, adhesives and potting materials are used today for a wide variety of tasks (Fig. 2). The applied material often performs several functions. This calls for a differentiated analysis of the dispensing process. Clear task definitions save time and money and ensure optimum quality.

Fig. 2: Different tasks need different dispensing solutions.

Contents

4. Which materials can be processed?

There are no limitations here. The variety of sealants, adhesives and potting media is growing day by day but process technology is flexible enough to handle any material. Fig. 3 shows the most important material groups in current use. For the dispensing process only the relevant material properties (Fig. 4) need to be clarified and the appropriate process technology selected.

Fig. 3: What distinguishes one material from another? Details should be clarified with material specialists. Selecting the wrong material usually results in high costs.

POLYURETHANES
– Versatile

SILICONES
– Heat-resistant

EPOXY RESINS
– Robust

ACRYLATES
– Rapid

MS POLYMERS
– All-rounders

5. A project cannot be specified exactly. What do we do now?

This problem is occurring more and more in product development processes these days. For example, many eMobility components are being developed and in most cases produced with materials that need to be dispensed. The classic specification becomes “project-related documentation”. In these projects, it is important to engage everyone involved in the process chain at an early stage and to use our services beyond process technology consultation. This will ensure that the optimum results are achieved quickly and reliably.

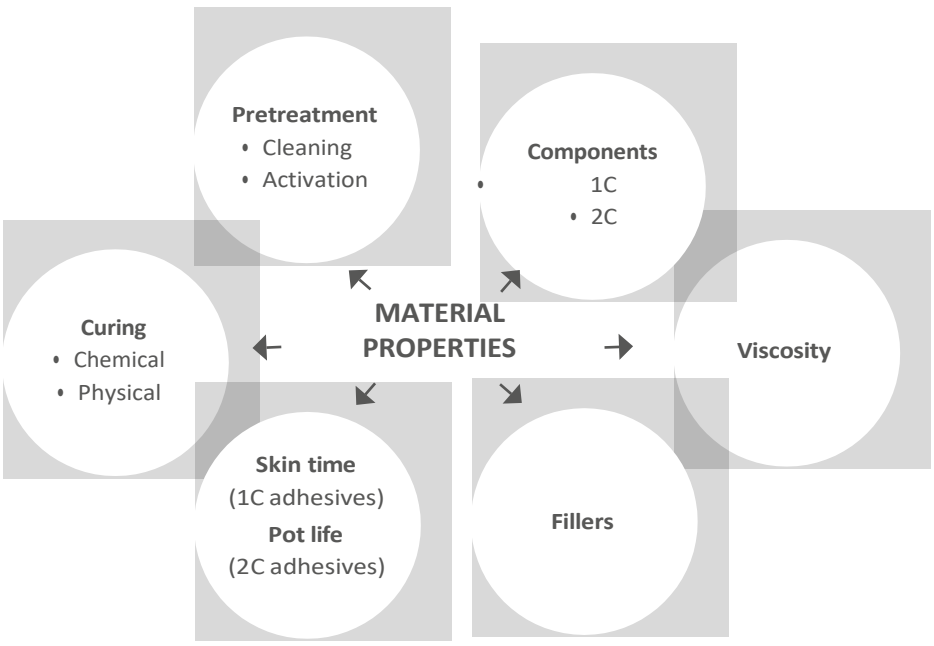


Fig. 4: Material properties that influence the dispensing process and must therefore be taken into account in process engineering.

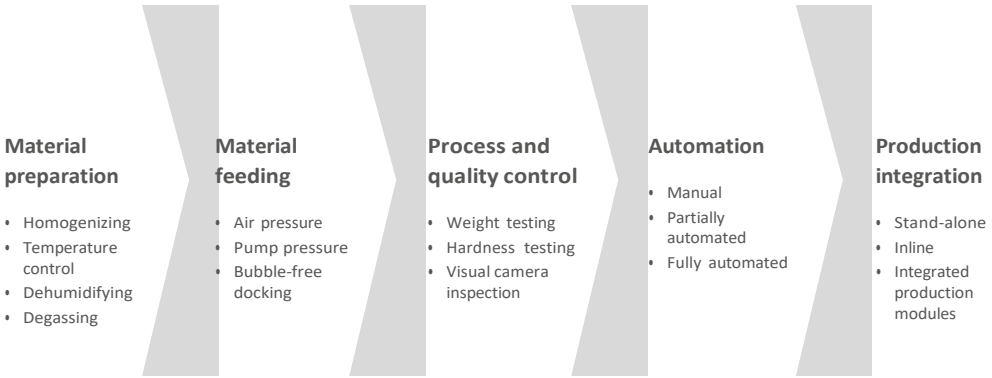


Fig. 5: Sub-processes at a glance – optimum results can only be achieved if they are matched to one another and to the task.

Getting to know the dispensing process

Effective and reliable dispensing is always based on the same sub-processes or sub-systems (Fig. 5). A partial element that has not been properly implemented will damage the entire process and lead to higher costs, time lost and possible loss of quality.

Material preparation – quality and effectiveness start here

Material preparation (Fig. 6) ensures that the material

* has and retains the desired homogeneity,
* is optimally tempered and
* is protected against moisture.

Many materials are filled as standard. Fillers tend to settle. The material becomes inhomogeneous, which affects not only subsequent processes but also the quality of a seal or bond. The effects of temperature on the sedimentation process must also be taken into account. The thinner the medium, the faster the fillers settle.

Moisture can also quickly lead to undesirable material changes. Some resin systems cure in the presence of moisture. Even prolonged contact with ambient air (humidity) is sufficient for this to occur. There are some potting materials that trigger side reactions if they come into contact with moisture. In the case of some 2C media, when the hardener and resin are mixed the hardener will react with the moisture absorbed by the resin. CO_2 is formed and the material froths up. Unmixed hardener also absorbs moisture, which can cause crystals to form. In the worst case, they will clog up the machine filters. These risks can be minimized by storing the materials properly, completely emptying the containers and processing under vacuum.

Constant and gentle circulation of the material by means of a stirring mechanism in the containers will prevent separation and support degassing. For uniform temperature control the storage containers, material lines, pumps and dispensing system will ideally be heated. To summarize, proper material preparation is the first step toward achieving a reliable and economical dispensing process.

Practical tip: If you do not know how the material will behave during preparation you must carry out dispensing tests. This is because changes in the material will have an impact on all subsequent processes.

Fig. 6: LiquiPrep LP804 for self-leveling media ensures reliable preparation and feeding of the medium to the dispenser.

Degassing – removing “harmful” bubbles from materials and processes

Air bubbles in sealants, adhesives and potting materials can cause significant problems. If they get into the dispenser they may falsify the amount dispensed and the mix ratio. This can cause malfunctions in the product.

If the task requires absolutely bubble-free material, a dispensing process under vacuum will not be sufficient. In this case, material preparation and material feeding must also take place under vacuum. This is because evacuation in a vacuum chamber will remove the air contained in the component but not the air bubbles remaining in the potting material or introduced in the feeding process. The solution is thin-film degassing, which removes even the finest traces of dissolved air from the potting material.

Practical tip: Complete emptying of containers by means of follower plates can only be achieved with vacuum solutions.

Material feeding – the reliable and efficient way to reach the dispenser

After preparation, the material is conveyed to the dispensing system. The crucial parameters for selecting the pump technology and the feed technology are the viscosity of the material, the type and content of the filler and the size of the containers. In terms of process technology, it is important to ensure that

* no air is introduced,
* the medium is gently and evenly conveyed throughout the entire process and
* the selected containers are emptied as completely as possible.

Depending on the task, different feeding or pumping technologies are used:

* compressed air – if air bubbles in the material are negligible
* single or double piston pumps – for highly viscous and abrasive materials
* gear pumps – for continuous, pulsation-free conveyance of non-abrasive potting materials
* plunger pumps – for feeding highly viscous material
* diaphragm pumps for self-leveling media – optimum performance and long service life
* follower plates in combination with single/double piston or plunger pumps for conveying highly viscous media from hobbocks or pails

There have been tremendous developments in pump technology in particular in recent years. A good example is the patented diaphragm pump shown in Fig. 7.

Fig. 7: Diaphragm pump – use of state-of-the-art pump technology ensures long service life and reduced maintenance costs

For more information see the White Paper on vacuum encapsulation

Dispensing – three aspects to consider according to the task

To ensure that the defined dispensing quality is efficiently achieved the key factors to consider are the chosen dispensing process, the dispensing method and mixing in the dispensing system.

Dispensing process – vacuum or atmosphere?

The degree to which the material is to be free of bubbles will dictate which process should be used. A central criterion is the required functional reliability of a component. Visual and aesthetic factors are becoming increasingly important. In the case of LEDs, air pockets or impurities in the material can not only damage the lighting elements but also create a poor visual impression. Dispensing under atmospheric pressure is the default for many applications and components. However, complex geometries, small workpieces, high packing densities, the use of moisture-sensitive casting resins and high-quality requirements may require encapsulation under vacuum.

Practical tip: The belief that encapsulation under vacuum is too complicated, too expensive and too slow is wrong. The technology has long been mastered and is economical.

Dispensing method – ensuring precision and repeatability

The requirements for precision and repeatability can differ considerably depending on the task. There are therefore three dispensing principles currently in use:

* Dispensing by mass measurement (gravimetric) – for simple requirements
* Dispensing by time measurement (time/pressure) – suitable only for 1C materials
* Dispensing by volume measurement (volumetric) – for high demands on potting quality

Mixing materials – static or dynamic?

If 2C material is to be used it must be mixed before being applied. Material behavior is a crucial factor when deciding on a mixing system. A basic distinction is made between static and dynamic mixing:

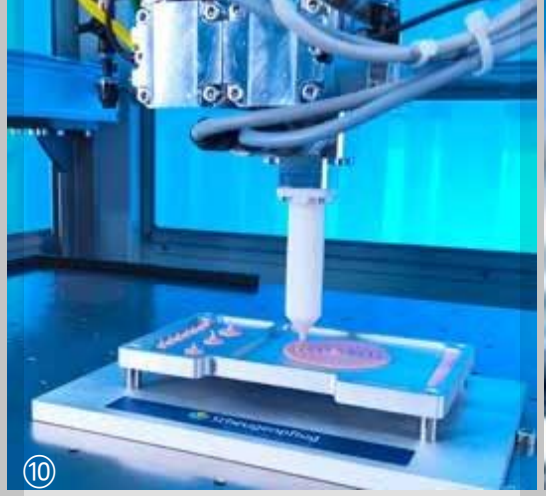
* Static mixers are easy to handle, cost-effective and maintenance-free. Here, the resin and hardener are combined in a plastic tube and mixed homogeneously. The mixing tube is a disposable product and must be replaced regularly. This is the only way to avoid sedimentation and the introduction of cured residue into the component.
* Dynamic mixers are only used for high material requirements and media with very short pot life and extreme mixing ratios. Here, the two components are fed separately into a chamber in a given mixing ratio where they are mixed by a rotating agitator. Since the chamber contains reactive material it must be cleaned in the event of a standstill or a break longer than the pot life. This prevents curing in the mixing system. Because the mixing process is rotor-driven, dynamic mixing systems are generally significantly more expensive and handling is more complicated.

Practical tip: Our new high-pressure mixing tubes (Fig. 8) allow for maximum dispensing rates for high-viscosity materials such as thermally conductive adhesives.

Fig. 8: Newly developed static mixers for a new mixing level.

Dispensers

Dispensers are key process components. Modern systems are optimized for specific tasks. When selecting an appropriate system it is important to have a vendor with a broad portfolio. We have everything from solutions that handle precise and repeatable coating of 1C and 2C materials to multiple solutions for series production and solutions for dispensing small and micro quantities. Another aspect is the development know-how of the system provider, because new market requirements lead to further development even of these systems or, in the case of the new



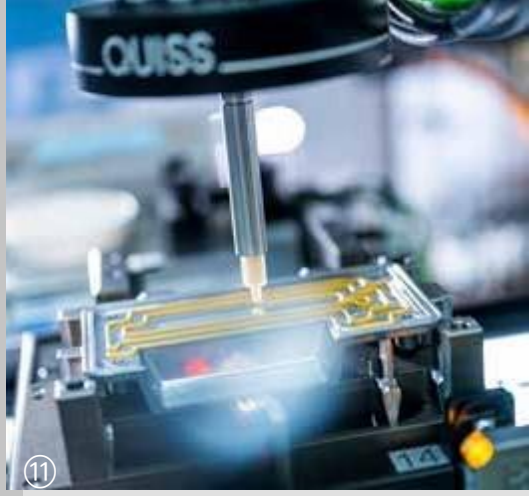


Fig. 9: DosPL DPL2001 – highly precise application from the smallest volumes to the µl range.

Fig. 10: DosP DP2001 – dispensing speeds at a new level are the basis for cycle times required in series production.

Fig. 11: Reworking and rejection are things of the past – with mit RTVision.3d applying adhesive and sealant goes hand in hand with quality assurance.

piston dispensers, to quantum leaps. DosPL DPL2001 (Fig. 9), for example, takes account of the increasing miniaturization of components. DosP DP2001 (Fig. 10) has been optimized for short cycle times. It also enables dispensing speeds for highly viscous materials to be up to ten times faster.

In addition to piston dispensing, geared dispensing systems (volumetric dispensing systems) are also used which have been specially designed for continuous application of liquid to highly viscous potting materials. Classic uses include the application of sealing beads on component housings and the application of adhesives as part of joining processes. Gear dispensers operate rapidly and accurately even for complex geometries.

Process and quality control – ensuring traceable top quality

Maximum repeatability and optimum dispensing quality are now key project requirements. This calls on the one hand for regular control of the process parameters and equipment conditions and on the other for component inspections by modern vision systems. For example, the RTVision.3d image processing system (Fig. 11) allows the dispensing equipment to “see”. Integrated in a dispensing cell, it simultaneously tests and monitors the application of adhesives and sealants. This reduces production time and ensures high, traceable product quality. 100% inline bead inspection for all common adhesives and sealants as well as for the different application types does not lengthen cycle times and there is no need for separate cells. The savings in costs, time and materials due to the use of modern vision technology are significant.

Visual inspection of components by plant personnel is no longer the modern way and is recommended only for very simple dispensing tasks and non-critical components. This approach has another disadvantage in that the test results would have to be entered manually to ensure traceability based on the defined process parameters.

The integrated UViS5 operating concept with its sensor-controlled pressure monitoring and valve status monitoring contributes to optimal dispensing quality during actual dispensing. This is supported by the extensive software functions offered by a powerful process visualization system. Users have an overview of the relevant data for all processes on a 15,6" multi-touch display. Predefined functions as well as instant access to relevant process parameters ensure high efficiency and cost-effectiveness for common dispensing tasks.

Fig. 12: UViS5 software – all the processes plus monitoring, maintenance and analysis tasks always in view.

What's more, the optional UPiCs programming tool, which supplements and extends the UViSs operator software (Fig. 12), enables complex dispensing programs to be quickly and conveniently created.

Another aspect is that bonded components for example cannot be tested non-destructively. Appropriate systems are currently under development. As long as the dispensing quality can be inspected only to a limited extent by such systems, the dispensing process must be perfect and absolutely repeatable. Otherwise, many defects will only occur in day-to-day use. In certain circumstances this may lead to high consequential costs and damage to the company's image.

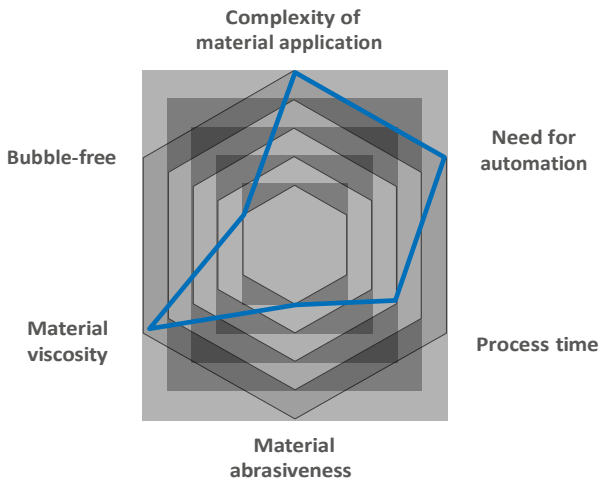


Fig. 13: "Turnkey" dispensing with high-performance system solutions. They are optimized for a specific task and are available for the following:

* Heat dissipation
* Potting/filling
* Sealing
* Bonding
* Coating

Automation – appropriate for the task

The definition of the degree of automation of a dispensing system is important for selecting the most appropriate process technology. Quantities, cycle times, dispensing materials, quality requirements, cost-effectiveness and the production environment are the crucial parameters here. Manual, partially automated and fully automated dispensing solutions are being used at present. Different levels of automation and modular system solutions are available (Fig. 13). These may be combined depending on the particular tasks – regardless of whether dispensing stations are used as manual potting systems or on a robot system, for example for small and medium series, in production cells (Fig. 14) or as process modules in fully automated lines.

Production integration – everything has to fit together

Many dispensing tasks are becoming increasingly automated. As a result, standalone systems are being used less and less. Integrated in complex production environments, the upstream and downstream process steps (such as component and position detection, surface cleaning and pretreatment, and curing) must also be considered holistically and adapted to the dispensing systems. For example, the ten-fold higher dispensing speed of the DosP DP2001 piston dispenser is of little use if the production environment is not tailored to its performance.

Practical tip: If individual modules are not matched to one another in terms of the processes involved the engineering effort quickly becomes a cost driver.

Fig. 14: DispensingCell DC803 – specially tailored to the requirements of industrial series production with short cycle times and high quantities.

Fig. 15: All process-related issues are promptly resolved in our Technology Center.

(All pictures: Scheugenpflug GmbH)

Extensive services

Reliable and efficient dispensing is always a matter of teamwork. Process technology is important when deciding on a dispensing system, but there are a number of other parameters that need to be taken into account when choosing the right system partner. These include know-how, experience and industry expertise as well as a partner network, for example with material manufacturers. As soon as possible the system partner should work with the project team. This team should be drawn from all relevant disciplines and include, for example, personnel from the design, process planning, production, quality management and purchasing departments. Collaboration begins at the development phase for component design and extends through production to after sales, where feedback from the market can lead to new requirements for the product.

Optimal process technology ensures reliable dispensing results and, if necessary, can be adapted to new requirements without great effort. Scheugenpflug dispensing systems meet these demands – from innovative technical details through to modules and system solutions. Effective services also help to achieve the desired performance:

* The necessary basis for decision-making is provided by tests in a technology center (Fig. 15) in agile development processes or on materials for which there are no reliable empirical values.
* Any issues with materials are solved in close cooperation with a material partner network.
* The extensive training program offered by the Academy enables the operating personnel to get the best out of the systems in every respect.
* Technical Service and After Sales ensure optimum plant availability – worldwide, remote and on-site.
* For small batches, as a stopgap until the system on order is delivered or if production peaks need to be covered at short notice, our Dipotec subsidiary can provide support with proven process technology.

Integrated into this service offering, modern process technology efficiently and reliably dispenses any materials that seal, bond, coat, pot or contribute to thermal management. This White Paper not only explains the complex process relationships and the many parameters for reliable and efficient dispensing, it also shows why it makes sense to involve system suppliers and material providers in projects early on. We support you with know-how, high-performance technology and experience so you can use state-of-the-art process technology as economically as possible and meet the requirements of your products with high levels of quality.

Would you like to know more about optimum process technology?

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