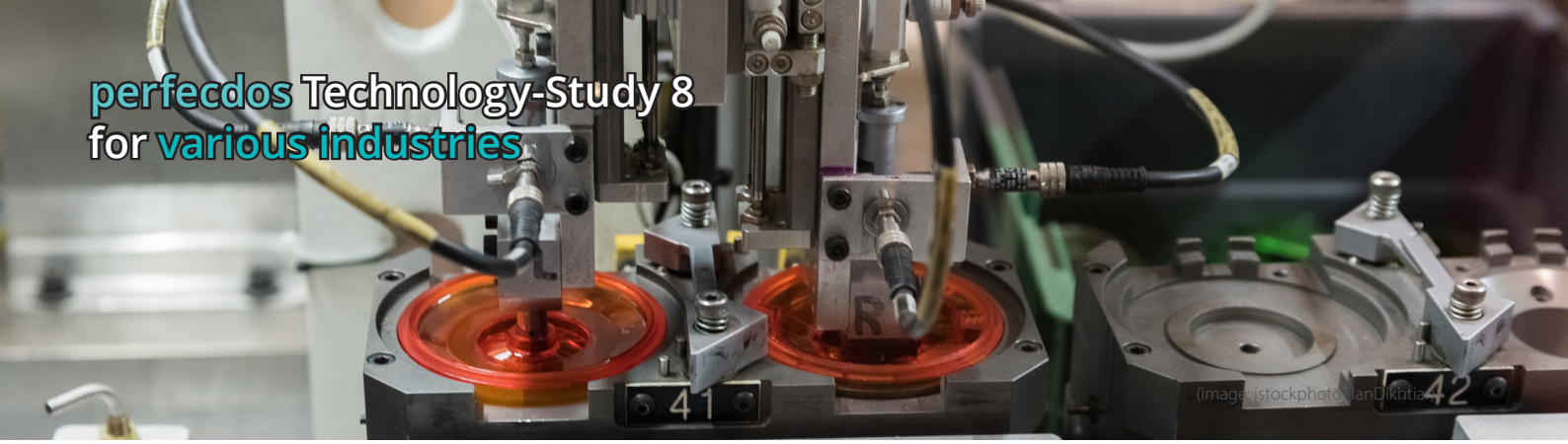

Simply „glue“ the seals in place

Using cyanoacrylates and in a controllable process

“Gluing” seals in place? – that sounds paradoxical at first – after all, bonding can limit a seal’s performance, or adhesives can react chemically with elastomer seals. These theoretical problems are, however, well under control in practice. And if cyanoacrylates are applied without contact, a controllable process is even available.

Properly designed seals only function effectively when they are positioned exactly where they belong in the sealing area. “Bonding” seals offers many advantages (Figure 1), but must be taken into account both in the design of a sealing area and in component production.

Design and development teams must first verify and test whether the planned adhesive could impair the seal’s performance. Once this issue is resolved, various design freedoms can be utilized in component design, including simplifications. These include::

- Grooves or undercuts that provide support for the seal can be minimized.
- Flat seals are fixed to surfaces without the need to mill or cast grooves.
- Mechanical clamping can be eliminated. Housings can be built more compactly.
- Tolerances can be compensated for – seals (especially those made of elastomers such as EPDM or NBR) are subject to manufacturing tolerances. An adhesive bond secures the seal so that it does not “bulge” or become pinched when the housing halves are joined, which would later lead to leaks.

There are additional advantages in production—many products are transported during production and/or manufactured “overhead.” In such situations, unsecured seals can easily get lost or slip out of place. A single “fall” can then bring an entire production line to a halt. “Gluedin” seals, on the other hand, remain exactly in their intended position. This reduces downtime and the need for manual intervention.

Adhesive dots are also helpful during assembly—they serve as orientation aids. Especially with asymmetrical seals, adhesive dots ensure that the seal is not inserted upside down or twisted. Automated camera systems (vision sensors), for example, can detect adhesive dots and immediately determine whether the seal is present and correctly aligned. Another benefit is improved handling during final assembly. Components such as motor housings or electronics boxes are often pre-assembled at one location and undergo final assembly at another. “Bonded” pre-assembled modules can be easily stored and transported without having to worry about the seal being lost along the way.

Practical Tip from Benjamin Kratz:

Dosing CA safely and economically means mastering the process. Contactless dosing with jet valves saves a lot of trouble here.

Selecting the right adhesive – there are various options here that should be carefully evaluated from both a process engineering and economic perspective:

- Heat-curing adhesives such as epoxy resins or UV-curing adhesives require ovens or lamps for curing—which cost money, space, and energy.
- Hot-melt adhesives require a melting system. In addition to the costs of the equipment, space, and energy, they also require a time-consuming cleaning process.
- Two-component adhesives must be mixed, and the equipment requires additional space.
- Cyanoacrylates—their application incurs no follow-up costs. They are therefore the best choice for this application if you can achieve a stable automated process.

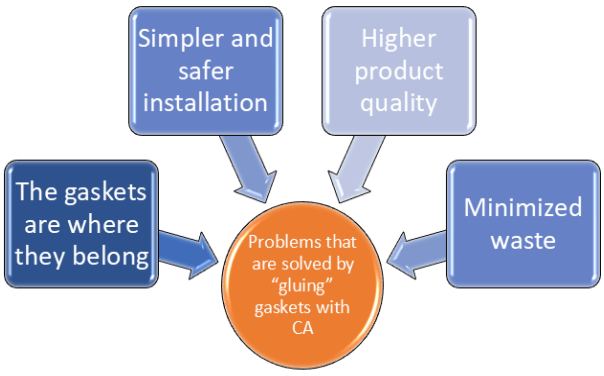

Bild 1: Common practical problems that can be solved with the right bonding technique (Image: perfecdos)

I would be happy to assist you with your project

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Mastering CA

Fundamental concerns regarding the CA bonding process – bonding a seal with cyanoacrylate (CA) is simple in theory, but in automated series production it presents a challenging dispensing task. This is why many users avoid CA (see box). In this application, the task typically involves applying the adhesive in dots or lines. The adhesive must be applied in the milliliter range. Until now, this has been achieved using peristaltic pumps or diaphragm dispensing valves—though often too much adhesive is applied to prevent a rapid reaction. The consequences: high costs and adhesive everywhere on the component and the machine—in other words, exactly where you don't want it.

The process itself is simple: After cleaning the components—that is, removing release agents from the seal (often silicone oils or talcum powder)—adhesive dots are applied into the groove or onto the seal. The seal is then inserted. The adhesive cures within a few seconds, with immediate fixation provided by contact moisture.

The Solution – Dispensing CA with Jet Valves – Using the PDosX1 (Fig. 2), the cyanoacrylate (Fig. 2) is dispensed fully automatically and contactlessly in individual drops at a very high frequency of up to 300 Hz. The droplets can range in size from 250 µm to 2.5 mm. The adhesives are dispensed with a repeatability of 99% in terms of dispensing volume. The jet valve allows for free-space dispensing. This opens up new degrees of freedom in component design and enables simpler and thus more costeffective machine designs. Furthermore, common errors and contamination caused by varying adhesive volumes are virtually eliminated with this process. Longer downtimes do not lead to the valve sticking or clogging. With appropriate process design, the valve needs to be cleaned only once a week. The process developed by perfecdos puts an end to:

- long unplanned downtime caused by the dosing device becoming clogged or stuck,
- poor product quality due to excessive adhesive volumes and blooming,
- disproportionately high adhesive consumption
- production interruptions caused by lengthy and laborintensive cleaning of the dispensing device

Overall, the process improves component quality and minimizes scrap (Figure 3). Concerns regarding the use of CA—such as the "sticking" of gaskets—as well as those associated with other CA bonding processes are unfounded. With contactless dispensing, these issues are manageable.

Why do users struggle with CA?

There are various reasons for this, which may occur individually or in combination:

- The "clogging" of the dispensing needle, i.e., curing within the system. In an automated system, the dispensing needle is the critical point, because during cycle pauses, the adhesive cures at the tip of the needle. The result is clogging, uneven application, or a complete line stoppage—with the resulting costs. Initial remedies here include Teflon needles, climate-controlled boxes above the needle, or automatic cleaning cycles.
- Material embrittlement and the "glass-like effect"—CA cures to an extremely hard and brittle state. When the seal then adapts to operating conditions during use, the hardened adhesive joint breaks. This results in tiny, sharp adhesive splinters that "cut into" the soft seal from the inside or migrate under the sealing lip, causing leaks. Initial remedies here include impact-modified or flexible CA, e.g., with a rubber content.
- Blooming / Frosting – many are familiar with the white haze around a CA bond. The volatile monomers of the CA evaporate and settle as a white powder in the surrounding area. This results in visual defects on visible components and potential contamination of sensitive sealing surfaces. "Low-odor/low-blooming" adhesives or extremely rapid assembly/extraction provide an initial remedy here.
- Dosing accuracy with low viscosity – Standard CA adhesives are often as thin as water. The adhesive then runs out of the groove before the seal is inserted ("capillary effect"). It may therefore end up where it is not supposed to be, e.g., on the sealing lip. This problem can be solved with gels or high-viscosity variants and volumetric dispensing systems, which always dispense exactly the same amount.

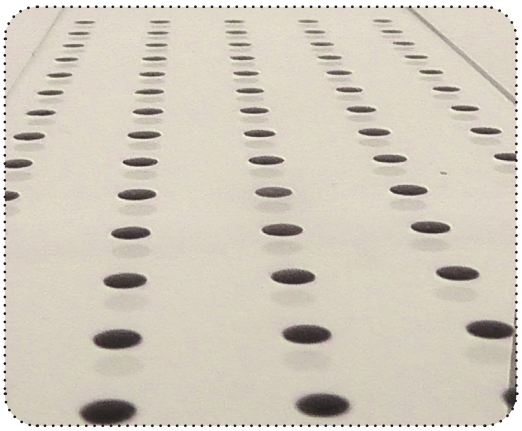

Figure 2: Precise dispensing results, e.g., with Loctite 480—a cyanoacrylate (CA) suitable for bonding gaskets. This material has a high rubber content, making it a challenge for jetting. (Image: perfecdos GmbH)

Figure 3: Contactless dosing in a process optimized for CA offers many advantages (Image: perfecdos GmbH)