Henkel Excellence is our Passion

Technical article
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Innovative low-pressure molding process with shorter cycle times

Durable protection for electronic components

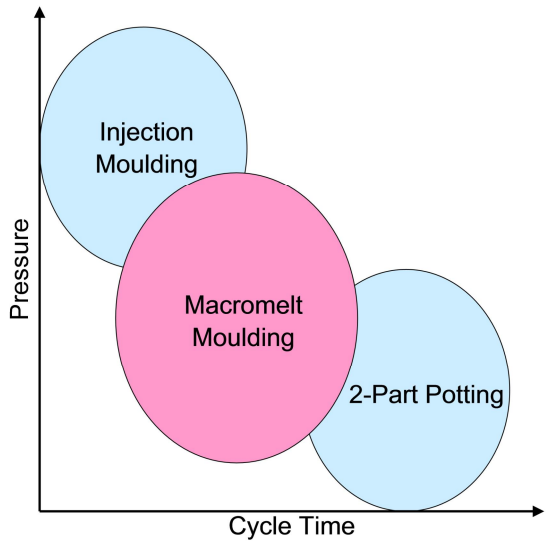
The adhesives industry has evolved continuously over the past years. This has resulted in many new developments, including innovative hotmelts which Henkel markets under the Technomelt brand. These have a broad range of uses, as hotmelts are now available for almost every imaginable application area. With the low-pressure molding technique it is possible not only to bond surfaces but to provide protective encapsulation even for small and delicate electronic components. In the automotive industry in particular, the resistance of the adhesives used to high temperatures, moisture and aggressive oils plays a decisive role in assuring the performance of sensors and other sensitive components.

In today's world, many electronic components are exposed to extreme conditions such as strong temperature swings, corrosive environmental media, or high humidity. The components nevertheless have to deliver the expected performance in spite of these difficult environmental conditions. Almost all items of daily use such as coffee machines, television sets or smartphones contain delicate electrical and electronic parts. Modern cars, heavy machinery and aircraft would not work without these components either. They fulfill important functions and must therefore be especially well protected from outside influences such as splashing water, lubricants, UV radiation, and vibration. This is where hotmelts can demonstrate their capabilities.

An overview of hotmelt molding

In the low-pressure molding technique, the components are placed in a mold without a housing and encapsulated with the hotmelt. Once the molding has cooled and solidified, the components are ready for further processing. Hotmelt molding uses one-part adhesives, resulting in a simple, fast and clean production process.

The technique lies halfway between injection molding and potting with reactive compounds like two-part epoxy resins. As a production process, injection molding has an even shorter cycle time than the hotmelt molding process, which itself takes only 40 to 60 seconds. However, classic injection molding requires a pressure of 100 to 1,000 bar, while hotmelt molding operates at low pressures of only 2 to 40 bar. This permits applications such as molding of electronic components, connectors or cables that could not be done by traditional injection molding without damaging the components. At the other end of the scale, the potting method works at atmospheric pressure. However, as it uses two-part potting compounds, the cycle times are long – often up to several hours – to allow for curing of the reactive constituents.



Another advantage of the hotmelt molding process is that no oven curing is required. This reduces the equipment footprint to less than two square meters. Nor is any additional housing needed as the hotmelt itself not only encapsulates the component but acts as a protective shell.

Positive aspects such as gentle molding, fast cycling and low cost of the molding equipment show that hotmelts offer major advantages over conventional injection molding for certain applications.

Use of hotmelts boosts productivity

Low production costs are key to a company's competitiveness. Leading producers in the adhesives, sealants and composites industry therefore continuously develop new and economical manufacturing methods. The hotmelt molding process can help to achieve substantial cuts in production costs. In addition to shorter cycles, the aluminum molds themselves also help processors to save time – and hence money.

One of aluminum's greatest advantages is that it dissipates heat quickly, which helps to speed up the solidification of the hotmelt and facilitates demolding.

Differences between reactive and non-reactive hotmelts

Different curing mechanisms and hotmelt chemistries may be used, depending on the production workflow and intended use of the products. Suitable chemistries for hotmelts are generally polyamides, polyurethanes and polyolefins. The most commonly used of these are polyamides. For processing, the hotmelts are heated in a melter, then injected into the mold where they harden by solidifying. Solidification occurs when the molten adhesive has cooled to the ambient temperature. Reactive hotmelts react with the water molecules in the air and thus cure chemically. Once they have cured, the reactive hotmelts cannot be re-melted. Non-reactive hotmelts, also known as thermoplastics, cure by a purely physical mechanism. These can be selected for components which will not be exposed to elevated temperatures. Because of their composition, non-reactive hotmelts can re-melt whenever they are exposed to heat and are therefore not suitable for hot environments. The permissible service temperatures range from –40 to +180 degrees Celsius, depending on the material used.

Hotmelts offer many convincing features

An adhesive product should not just process efficiently but also offer convincing performance features in the manufactured product itself. The hotmelt molding method also scores well here as it provides a range of materials to meet different customer needs. By varying the combination of raw materials, the properties of a hotmelt can be adjusted as required to suit a particular application. If the finished products have to withstand particularly cold environments, for example, the hotmelts can be designed so that they will retain their positive properties even at extreme sub-zero temperatures of as low as –50 degrees Celsius.

What all hotmelts have in common is that they protect the components they encapsulate from corrosion and environmental media. This allows components to be used even in environments where they will be exposed to damaging influences, such as in the engine compartment of a vehicle. Sealing is achieved here by adhesion to the substrate. Moreover, hotmelts do not react chemically with any other product parts, so they will not damage other materials. For processing and for later service it is important that the hotmelt should not contain any solvents or pollutants. One very useful feature for providing information on a component is that the cured hotmelt surfaces are printable. No separate stickers or labels are required.

The right hotmelt adhesive for each application

Whenever a new composite is to be introduced in a production process, the first question to be asked is whether the product can be supplied in the desired form. Hotmelts have the advantage of offering a large selection as they are produced in sticks, powders, granules, films or blocks. A suitable product is therefore available for each application area and each machine type.

There is also plenty of choice when it comes to color. The basic hotmelt colors of amber/clear, beige and black can be modified with the help of colored master batches. A hotmelt can thus be produced in orange, for example, so that the subsequent component will have a clear signaling effect for use in hybrid or electric vehicles.

Almost limitless uses

Thanks to their versatile properties, hotmelts can be used in many different areas. Moreover, hotmelt molding allows almost any housing shape to be produced so that the hotmelt process can be easily adapted for a wide range of product geometries.

The already mentioned low processing pressure of between 2 and 40 bar and the melt temperature, which can lie below 230 degrees Celsius in some hotmelt varieties, enables gentle processing. This makes it possible to encapsulate even small and delicate parts with hotmelt adhesive. The process is therefore ideal for printed circuit boards and electronic components.

In addition to delicate small components, it is also possible to use hotmelts for molding large parts, such as special connectors for vehicles. The cured hotmelts show no tendency to crack even with large-area surfaces, thus providing a good level of protection for the component they have been molded around.

The product ranges include hotmelts that can even withstand temperatures of –50 degrees Celsius or above +140 degrees Celsius. These are particularly advantageous for demanding applications such as in vehicles where the material has to show very good cold flexibility or withstand elevated temperatures.

Fit for service even in hot and humid environments

Other hotmelts show a high resistance to humidity, with no appreciable loss in mechanical performance even after 1,000 hours in a climate with 85 degrees Celsius and 85 percent relative humidity. These hotmelts are therefore especially well suited for automotive sensor applications. Materials have also been developed with especially good resistance to UV radiation, making them suitable for use in outdoor applications.

Most of the hotmelts also have a flammability rating of UL94 V-0. They are flame-retardant and self-extinguish after only a few seconds. Thanks to the use of renewable raw materials, hotmelts are more environmentally compatible than other products and can be used without concern even in applications falling under the EU's RoHS, WEEE and End-of-life Car Directives.

Application examples of hotmelt molding

Complicated cable junctions which used to be realized using special plastic grommets, can now be sheathed in just one production step using the hotmelt molding process. Molded in place as grommets on the cable, the hotmelts can also serve as anti-kink protectors.

Frequently operated sensors, microswitches and coils, or even cable harnesses and cable bundles, can be supported and sealed at the same time by encapsulating them with hotmelts.

Hotmelts can also serve as insulants for electronic components since they are not electrically conductive. Use for strain relief is also conceivable as it is possible to provide sheathing directly around susceptible areas of the product.

Encapsulation with hotmelts is exceptionally effective as protection against environmental factors such as water, dust and heat. They can be used to seal printed circuit boards water-tight, thus permitting use in humid environments. Molding can also provide effective protection against damage due to shocks and vibrations, which are so common in tools and vehicles.

Low cost and effort, numerous opportunities

Hotmelt molding is ideal for any application requiring short cycles with low injection pressure for encapsulating delicate components. It is also a sound choice when products have to be protected in an inexpensive way against environmental influences such as oil or water. The low production effort for hotmelt molding, which also often eliminates the need for a separate housing, makes the low-pressure method attractive for many different applications.

Further information on the wide-ranging product solutions that Henkel offers the automotive industry and the many application areas for Technomelt hotmelt adhesives can be found at www.henkel.com/automotive and www.henkel.com/technomelt.

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Photo material is available at http://www.henkel.com/press

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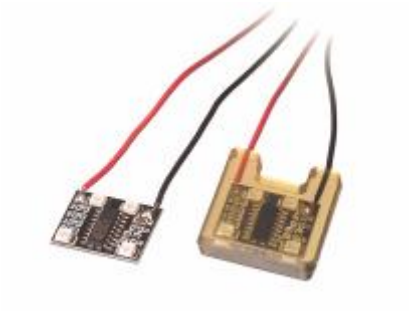
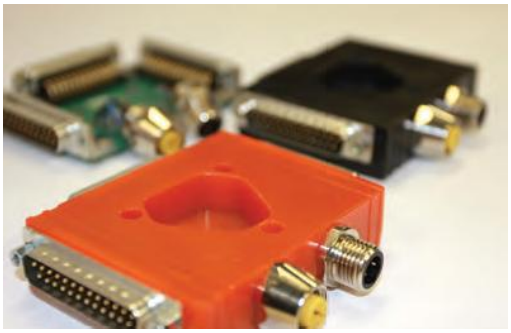


With the low-pressure injection molding technique it is possible to provide protective hotmelt encapsulation even for small and delicate electronic components, thus protecting them from damaging environmental influences.

Hotmelts can be used in many ways. As encapsulants they can even replace separate housings with the advantage that such housings can no longer slip on the component.

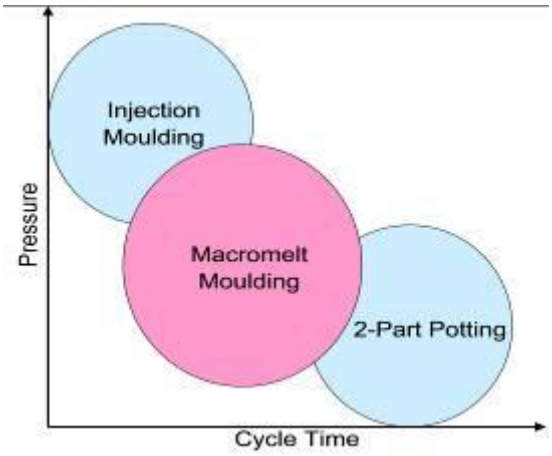


The innovative hotmelts can be molded into any desired shape. They can also be joined to other components such as electronic power plugs to form a finished product.

In addition to the basic colors of the hotmelts (beige, amber/clear and black), the range includes other, more vibrant colors.

Hotmelts can be supplied in many product forms, for example in sticks, powders, blocks or – as in this photo – in granules.

Once molded and cured, the hotmelt surfaces are printable. This eliminates the need for producing and applying labels to a component. Instead, the information can be printed rapidly and cost-effectively directly on the component.



The hotmelt molding process lies between injection molding and two-part potting, thus combining the best of both.