Rapid Adhesive Bonding by Induction and Microwave Curing

Background

Adhesive bonding in industrial production often requires very short curing times. In case of reactive adhesives, this generally means high curing temperatures. Unlike conventional heating of the whole assembly by using convection ovens, the application of electromagnetic induction or microwave radiation enables rapid processes and curing even of such bond lines that are thick or difficult to access.

Principle of Operation

When applying induction curing the energy is introduced in the substrate by means of alternating electromagnetic fields in the kHz frequency range. In case of conductive metallic parts the work pieces will heat very quickly and so the bond line will do. Compared to traditional heating there is no time needed for the heat transfer, thus the adhesives can be cured within minutes or even seconds. In case of non-conductive substrates, like ceramics, polymers or composites, the adhesives will be modified with appropriate fillers. This will cause direct heating of the bond line and hence rapid curing.

A similar effect can be achieved by using microwave energy in the GHz frequency range, preferably in case of non-metallic or partial metallic bonding partners. Generally, adhesives show a good absorption of microwave energy due to their polar groups, and will heat within seconds independently of their thermal conductivity and across the whole volume. Design and use of appropriate microwave probes will enable a targeted irradiation of the bond line.

The Solution

Polytec PT provides suitable 1- and 2-component adhesives that can be selected and customized exactly according to the desired processing parameters as well as thermal and mechanical properties. Together with our partner companies we will develop the appropriate bonding process.

The IFF GmbH Institute at Ismaning is an expert for induction curing. The IFF provides custom specific process development, inductor design and ramp-up qualification. Our partner for microwave induced adhesive curing is the Fraunhofer Institute for Chemical Technology at Pfinztal having long-time practical experience.
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Applications of Inductive Curing

✓ Attachment of ferrite magnets to metallic substrates
✓ Potting of sensors in housings
✓ Sealing/casting of continuous goods, e.g. optical fiber cables
✓ Bonding of electronic components to polymer and metal substrates

Applications of Microwave Curing

✓ Joining of glass and plastic components to each other or to metallic workpieces
✓ Accelerated curing of fiber reinforced polymers
✓ Curing of coatings
✓ Glop-top for flip chip mounted SMDs

Key Features and Benefits

✓ Adhesive curing in minutes to seconds
✓ Joining of metallic parts (induction curing) or of metallic with non-metallic substrates
✓ Potting and bonding of non-metallic components (glass, ceramics, plastics, PCBs...) that won’t be heated themselves
✓ Preferably at bond line thicknesses above ca. 0.5 mm and for potting of medium to high volumes

A Comprehensive Solution

Induction curing is a procedure that has to be evaluated and customized according to the respective application regarding adhesive properties, substrate and equipment geometry, frequency and power, to find an optimum temperature profile. The same applies for microwave curing, where appropriate devices like continuous ovens, batch ovens or directional antennae are available. Together with our partners we are ready to perform a feasibility study with regard to your individual application.