Statement by the *International Committee for Certification of Adhesive Bonding Processes - ICCAP*

The significance and indispensable necessity of adhesive bonding technology

Content

Summary

Significance of adhesive bonding technology

Adhesive bonding has become an indispensable joining technology and is a **key technology of the 21st century.** Adhesive bonding technology is used in almost all industries – from microelectronics to aerospace, from everyday life to the energy transition. Without adhesive bonding technology, modern wind turbines, vehicles, and circular economy concepts would not be feasible.

Adhesive bonding is the only joining technology that meets the requirements of multi-material design, which is important in the 21st century: joining different materials without weakening them through mechanical (e.g., drilling) or thermal processes in order to obtain the **required material properties for the end product**. This ensures structural integrity and opens up new design possibilities.

These very properties are also prerequisites for resource-efficient products and their integration into the circular economy. **Adhesive bonding technology is a key enabler of lightweight construction, miniaturization, and sustainability.**

Adhesive bonding and sealants are now "advanced materials" and pioneers in precision, sustainability-related resource efficiency, and groundbreaking innovations. **Those who ignore adhesive bonding technology are ignoring the future. Adhesive bonding technology is, in fact, the key to the future:** Rail vehicles without adhesives and sealants? Technically unthinkable. Energy transition without adhesives and sealants? Not feasible. Electromobility without adhesives and sealants? Impossible.

To ensure the reliability of adhesive bonding technology, the use of adhesives, sealants, and adhesive tapes has been subject to international quality assurance standards for over a quarter of a century. These quality assurance standards are established worldwide as industrial standards. The *International Committee for Certification of Adhesive Bonding Processes (ICCAP)* acts as an authority for securing and further developing this technology. It harmonizes certifications according to globally recognized standards (e.g., ISO 21368, EN 17460) to ensure the international comparability of company certificates.

The goal is clear: **to further establish adhesive bonding technology as an indispensable joining technology for industry, sustainability, and innovation.** Around 1,200 companies worldwide, including in Europe, are already benefiting from these quality assurance standards, giving them a decisive advantage in terms of trust among regulatory authorities, customers, and clients.

Against this background, the ICCAP makes it unequivocally clear:

Adhesive bonding joining technology is one of the keys to the future!

Relevance of adhesive bonding technology for Europe's competitiveness

The use of adhesive bonding technology is one of the solutions to the challenges of the 21st century. No CO_2 reduction, no circular economy, no reduction in energy consumption, and no climate neutrality without the involvement of adhesive bonding technology.

Europe still plays a leading role in adhesive bonding technology. However, the EU-wide regulatory measures, which are interventionist and therefore hostile to innovation, are unfortunately acting as a brake, which will cost Europe its leading role in this area too. **The development of adhesive bonding technology will then take place outside Europe.**

This technological leadership in this key technology must therefore not only be maintained, but also promoted through smart, forward-looking, and competitive industrial policy in Europe!

1 Adhesive bonding technology: An integral and indispensable part of our world

1.1 Where is adhesive bonding not (yet) used?

In a world that is constantly reinventing itself, adhesive bonding technology is becoming the invisible architecture of progress. Adhesive bonding is already being used underwater, on water, on land, in the air, and even in space. Adhesive bonding is used on a micro and macro scale. It is used in everyday civilian (professional) life as well as in the military sector. There is hardly an industrial sector that can do without adhesive bonding technology – often it is not just an option, but the only bridge between idea and realization. In this context, the ICCAP represents the key technology of adhesive bonding from an application perspective (see section 5) with the following clear position worldwide:

The use of adhesives and sealants is indispensable in industry today, and this trend will continue to grow in the future.

The importance of adhesive bonding technology today has long been comparable to that of conventional joining technology such as welding, screwing, and riveting. This is demonstrated, among other things, by the fact that, due to the increased use of adhesives, sealants, and adhesive tapes, quality assurance standards for the proper use of adhesive bonding technology have been developed, published, and implemented worldwide across all five continents at the DIN, CEN, and ISO levels for over 25 years. Quality assurance in adhesive bonding technology is therefore globally comparable and has become an international industry standard.

1.2 The significance of adhesive bonding technology in the 21st century

Adhesive bonding technology is not a short-lived trend, but a quiet revolution. Anyone who believes that adhesives, sealants, and adhesive tapes are just a temporary fad of the 21st century is underestimating their strategic importance. Their use is not driven by the spirit of the times, but by the harsh realities of technological innovation, economic efficiency, and environmental responsibility – requirements that will shape the coming decades.

The products of the future are based on two key developments:

1. **An increasing variety of materials** that enable new functions and properties.
2. **Design strategies that intelligently join this diversity** so that complex applications can be implemented efficiently and sustainably

The functional performance of an end product is largely determined by the compatibility of the material and joining technology. Therefore, the technological adequacy of the joining technology is a key factor in reliably meeting the requirements of modern material systems in terms of mechanical, thermal, and chemical properties.

1.3 “Suitability of a joining technology” for different materials

In multi-material design, different materials must be joined in such a way that the product remains stable and reliable.

The decisive properties come from the materials themselves – they determine the function of the end product. The central task of joining technology, i.e., its “suitability,” is to ensure that these properties are not altered during joining. Only if the joining technology ensures this can the product fully meet the required performance characteristics.

1.4 “Suitability of a joining technology” in relation to adhesive bonding

The compatibility of joining technology with material properties required for multi-material design is uniquely fulfilled by adhesive bonding technology. Its unique selling point is that it is the only and most versatile joining technology capable of

1. permanently, stably, and safely joining all materials in a wide variety of combinations
2. while maintaining the intrinsic properties of the materials to be joined unchanged in order to meet the requirements of the end product
   (In concrete terms, this means that adhesively bonding is the only process that avoids structural damage such as drilling, which is necessary in mechanical joining processes (screws, rivets, nails), as well as thermally induced weakening, which occurs in welding or soldering processes.)
3. in contrast to conventional joining methods, additional functions can be incorporated into the product design via the adhesives and sealants used, which go beyond mere joining.
   (Depending on the adhesive and sealant used, these integrated additional functions include thermal and electrical conductivity or insulation properties. In addition, adhesives can serve as barrier materials against water vapor, plasticizers, and other media, giving them a multifunctional role in material compound.)

2 Adhesive bonding technology as a driver of innovation: technologically, economically, and ecologically

2.1 Chances through the use of adhesives, sealants, and adhesive tapes

Adhesive bonding technology opens up a new dimension in material compounds—a symbiosis whose combined property profiles cannot be achieved with any other joining technology. This unique capability of adhesive bonding technology holds enormous potential for the innovations of tomorrow. The future of adhesive bonding technology is just beginning – and adhesives and sealants are already “advanced materials” that are indispensable for shaping the 21st century with its environmental challenges. They are joining “materials between materials.”

2.2 Lightweight construction

Lightweight design is one of the most effective eco-design strategies for reducing material consumption and saving energy during the use phase of a product's life cycle. Due to its potential as described in Chapter 1.4 – in particular the preservation of material-specific properties (in this case: lightweight construction properties) — adhesive bonding technology is a key technology for implementing both structural and material lightweight construction.

Adhesives and sealants act as innovation accelerators in this context, as they enable the realization of complex multi-material concepts for lightweight construction.

2.3 Miniaturization

Miniaturization, including in electronics, is one of the approaches to improving energy efficiency and innovative new applications. Smaller components require less space and weight, while offering faster signal processing and higher energy efficiency. In electronics manufacturing, adhesives are ideal for the safe and long-term stable bonding of a wide variety of materials in confined spaces without impairing their inherent properties. In the course of miniaturization, they enable high-precision, material-compatible joining of microcomponents – for example, when fixing coils, sealing housings, or as potting compounds in high-reliability applications to protect sensitive chip structures and wire joints from mechanical stresses such as vibrations, thermal fluctuations, and environmental influences such as moisture and corrosion.

Other joining technologies can only meet these requirements with considerably higher effort or are technically completely unsuitable.

2.4 Energy transition

Wind turbine rotor blades are fully adhesively bonded structures made of glass fiber reinforced plastic (GFRP). Given the extreme mechanical and abrasive stresses at rotational speeds of up to 390 km/h, the use of alternative joining techniques would not be technically or economically feasible. Welding processes are ruled out due to the lack of weldability of GFRP. Mechanical joining technologies such as screws, rivets, or nails would cause local material damage due to the necessary drilling, leading to high stress concentrations under load. The necessary reduction of these stresses would require massive wall reinforcements,

which would make the structure considerably heavier and drastically reduce energy efficiency.

In addition, a protective layer is adhesively bonded to the highly stressed leading edges during production to minimize abrasion. This adhesive bonding layer ensures a permanently smooth, aerodynamically optimized surface – even under extreme offshore conditions.

The adhesive bonding technology therefore not only maximizes energy yield, but also makes the economic implementation of this key technology for sustainable energy production possible in the first place.

2.5 Development of alternative energy sources

Without adhesive bonding technology, the energy transition remains theoretical. Based on the current state of the art, the development of alternative energy sources is simply not feasible without adhesives and sealants. Electromobility? Impossible without adhesives — they ensure the assembly of magnetic cores, the hermetic sealing of battery cells, and the efficient thermal management of battery systems. The same applies to fuel cells: without long-term stable sealing and precise joining of the bipolar plates, the entire technology comes to a standstill.

Adhesive bonding technology is not a minor detail—it is the invisible key technology for the future of energy.

2.6 Circular economy

Adhesive bonding technology – understood as the use of adhesives, sealants, and adhesive tapes – is an active driver technology for the goals of the circular economy. The central goal of the circular economy, the decoupling of economic growth and resource consumption, requires a transition from a linear economy to a circular economy, in accordance with the EU Action Plan. The widespread reduction of this term to “recycling” is a fundamental misconception: the circular economy evaluates the entire product life cycle holistically in terms of resource efficiency. The circular economy does not focus on recycling.

The **EU Waste Framework Directive** and the European Commission's **nine R strategies** clearly show that recycling is at the bottom of the hierarchy. Circular economy means eco-design, reuse, repair, and more – a systematic approach. In this context, adhesive bonding technology is indispensable: technologically, socially, and politically.

The common misconception, both among the general public and in political circles, that adhesive bonding technology is not suitable for recycling because it is classified as a “non-detachable joining technology” is both false and significant. The fact is that every joint can in principle be separated – even an adhesively bonded joint. The difference between ‘detachable’ and “non-detachable” merely concerns the geometric integrity of the joined parts after separation.

Through targeted product design and suitable separation processes, repair and recycling are also technically feasible for adhesively bonded products (source: **DIN/TS 54405-04**, Construction adhesives – Guideline for separation and recycling of adhesives and substrates from bonded joints, DIN Media Berlin, 2021 and **ISO/WD 21037**, Adhesives – Guideline for separating adhesively bonded joints enabling repair and improving recycling, current ISO project).

Anyone who dismisses adhesive bonding technology as an obstacle to recycling is not only ignoring the “state of the art,” but also jeopardizing the implementation of the circular

economy. Without adhesive bonding technology, the circular economy remains a political buzzword – and not an industrial reality.

Adhesive bonding technology is therefore not in contradiction to recycling. Adhesive bonding is partner in the circular economy.

2.7 CO_2 neutrality

Traditionally, adhesives are predominantly based on petrochemical raw materials such as crude oil and natural gas. However, in view of ecological challenges and limited fossil resources, bio-based alternatives are becoming increasingly important. These innovative adhesive systems help to conserve resources and reduce CO_2 emissions along the value chain.

Natural polymers such as starch, cellulose, and casein have been used in adhesives for packaging, wallpaper, and labels for decades. Current developments go beyond these classic approaches: polyurethane adhesives increasingly contain bio-based polyols, while epoxy resins use hardeners based on renewable raw materials such as cashew shell oil. The trend is also continuing in the field of hot melt adhesives: here, lactic acid, obtained from plant residues such as corn or sugar cane, serves as the starting material, supplemented by tree resins and vegetable oils. The result is adhesives that are completely bio-based and largely biodegradable – ideal for applications in packaging, furniture, hygiene products, and bookbinding.

Many of these raw materials have a virtually climate-neutral balance. Their use makes a significant contribution to environmental protection and the sustainable utilization of natural resources, thereby ensuring their availability for future generations.

The adhesive bonding technology is therefore not in contradiction to CO_2 neutrality.

3 Who we are

The **International Committee for Certification of Adhesive Bonding Processes (ICCAP)** is an association of various interest groups with the aim of promoting the use of adhesive bonding technology internationally through quality-assured organizational and implementation processes. ICCAP has recognized the importance of adhesive bonding technology for industry and its technological, economic, and ecological potential for the future. The committee therefore promotes the further development and dissemination of this important, future-oriented, and innovative joining technology, which is indispensable for the development of the future. At the same time, ICCAP supports superordinate cooperation in the context of technological applications between parties involved in the manufacture of adhesively bonded joint products worldwide.

The work of ICCAP is based on the relevant quality assurance standards for adhesive bonding technology, such as ISO 21368:2022 – “Guidelines for the fabrication of adhesively bonded structures and reporting procedures suitable for the risk evaluation of such structures.”

Based on these standards, the tasks of the ICCAP include harmonizing the global certification activities of the ICCAP certification bodies.

The members currently represented in ICCAP are primarily users of adhesive bonding technology from various industrial sectors.

The certification bodies represented in ICCAP serve around 1,200 companies worldwide—and the trend is rising! – that are certified for the implementation of adhesive bonding technology in accordance with adhesive bonding quality assurance standards. This work now extends far beyond the borders of Europe. All globally certified companies (www.iso21368.com / www.en17460.com) are regularly audited by the approved certification bodies. The certificates issued give the certified companies a head start in terms of trust with regard to their application of adhesive bonding technology vis-à-vis supervisory authorities, customers, and clients in relation to the organizational and technical implementation of adhesive bonding technology in their respective companies.

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