

Strategies for Green Bonding

How can we make adhesives and bonding processes more sustainable?

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The demand for sustainable adhesive solutions is growing worldwide and is increasingly gaining attention. This is particularly true for packaging companies in the food and consumer goods industries, as they are in direct contact with correspondingly conscious end consumers in their markets. But how can industrial bonding actually be made more sustainable throughout the various industries?

The answer lies in a resolutely holistic approach that goes well beyond the mere development of bio-based adhesives. In order to be able to meet the demanding goal of conserving resources, it is important to focus not only on the adhesive itself but, equally importantly, on the bonding process as well.

Sustainable bonding requires combining the highest possible certified bio-based raw material content in the adhesives, low maintenance and energy requirements in the bonding process, high compatibility of the adhesives with existing application systems, and, especially in the packaging industry, high compatibility in terms of downstream paper recycling. All of this must be achieved at competitive prices.

A sustainable bonding process always begins with selecting the right adhesive. "Green adhesives" should fulfill various aspects of sustainability in this regard and offer every manufacturing company the opportunity to make bonding more responsible and resource-efficient—both in terms of the environment and with regard to its employees and customers.

Using Certified Bio-Based Adhesives

For companies that want to significantly and demonstrably increase the proportion of sustainable raw materials in their production, certified organically based adhesives are an ideal fit. The right adhesive should be selected with a holistic view; simply substituting fossil raw materials with renewable raw materials is not always sustainable.

For example, the use of bio-based raw materials only makes sense if those raw materials can also be obtained in an environmentally friendly manner. Renewable raw materials may be in direct competition with their potential use as food or animal feed, or their extraction may require the creation of additional agricultural land, which is usually not very environmentally friendly.

Therefore, organic residues are the ideal basis for an environmentally friendly adhesive formula. One bio-based product family relies almost exclusively on tree resin from demonstrably sustainably managed forests, pine resin that is a byproduct from paper production, and resin from orange and lemon peels.* These organic raw materials are comparable to petroleum-based systems in terms of availability and adhesive performance and can already be used to create oxidation-stable formulae.

Such well-established bio-based adhesives currently contain well over 40% organic material. Of course, the actual proportion of renewable raw materials in the end product adhesive must also be verifiable. The necessary certainty is guaranteed to the companies using them by corresponding USDA certifications, for example. The percentage of organic substances is reliably determined using the radiocarbon method (also known as the C14 method). This measuring method is based on the fact that the proportion of bound radioactive C atoms decreases in fossil raw materials but remains almost constant in living organisms (i.e., renewable raw materials).

As an alternative or in addition to the direct use of bio-based raw materials, bio-based polyolefin polymers could also be used as a basis for sustainable packaging adhesives. In this case, the bio-based content of the adhesive can be calculated using the mass balance method. The currently still very high product prices and the mostly still limited availability make their use seem not very economical at present. In principle,

however, the mass balance method is regarded as a key method for the competitive use of bio-based raw materials on a large scale in the future.

Healthy Living Thanks to Low-Pollutant Adhesives

End consumers are placing more and more importance on the harmlessness of their environment. This means that materials and objects used every day should be free of harmful substances and thus harmless to humans and animals alike.

The development of environmentally oriented adhesives should therefore also take health into account. Low-pollutant and low-emission adhesive solutions offer considerable relief in this respect. On the one hand, they present a long-term advantage when used in the end customers' environment due to containing low amounts of substances that are harmful to health, such as formaldehyde and plasticizers. Moreover, their application generates low emissions.

For example, in the automotive industry, adhesives with reduced VOC and FOG values, which means they release few volatile organic compounds and condensable substances, ensure healthy air quality and increase the driving comfort in the vehicle's interior while simultaneously ensuring high process reliability. In food packaging, MOSH/MOAH-free adhesive solutions meet the high food law requirements. And in the construction industry and furniture production, special attention should be paid to matching the sustainable properties of adhesives to wood, a natural material. Compared to concrete, the latter renewable raw material has little negative impact on the environment—as long as forests worth protecting are preserved as ecosystems—and has a positive effect on a healthy indoor climate. What's more, even as an end product, wood stores carbon over the long term.

Sustainably Increasing Occupational Health and Safety

A commitment to enhancing employee protection is another hallmark of a company that wants to act sustainably and responsibly. Employers are responsible for the health and safety of their employees. As part of the substitution requirement, for example, they can effectively contribute to reducing the risk potential in the workplace and thus to improving occupational safety by switching to monomer-reduced hot-melt adhesives.

In line with the substitution requirement, monomer-reduced PUR hot-melt adhesives have a low diisocyanate monomer content of less than 0.1%. They can be processed without harmful substances in many production areas. Users are protected, and adhesive applications are made possible without additional training for employees. In addition to the health and safety benefits, there are also economic advantages to their use in sustainable bonding processes.

Using Resource-Saving Adhesives

The reduction of energy costs is also the focus of companies committed to environmental and climate protection. High-yield, low-temperature hot-melt adhesives meet these requirements and support energy-efficient production processes.

Conventional hot-melt adhesives are usually melted and applied at high temperatures, depending on their composition and intended application area. Temperatures of up to over 200°C are often the norm. Under these conditions, heating the adhesives is associated with a high energy consumption in the bonding process and a risk of burns at the workplace.

On the other hand, low-temperature hot-melt adhesives can be melted and applied at significantly lower temperatures of around 120°C (and sometimes less) without having to accept impairments in the adhesion properties. This leads to a significantly optimized, resource-saving bonding process in terms of energy. Another advantage of reducing the processing temperature is the improved thermal oxidation stability of the adhesives used.

Thinking Holistically and Sustainably

Green adhesives in all their facets are undoubtedly the fundamental building block on the way to more sustainable industrial bonding. However, the resource efficiency of the entire bonding process is of overriding importance.

For example, applying adhesives as precisely as possible due to more efficient use of materials effectively reduces the contamination of machine parts and products. High-yield adhesives ensure high bond strengths despite lower material consumption. The high thermal stability of the adhesive used prevents the formation of oxidative residues that can result in long maintenance and equipment downtimes. And low application temperatures significantly reduce the energy requirements of bonding processes.

Bonding processes should always be viewed holistically in terms of a sustainable approach. Making the overall process less resource-efficient, less compatible with health and the environment, and possibly even uneconomical at the expense of increasingly higher proportions of bio-based raw materials in the adhesive would be counterproductive for all concerned. Sustainability in bonding is diverse—and complex.

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*Jowat's Jowatherm® Grow