in-adhesives 2025
Munich, February 11, 2025

Abstracts **Day 1**

in-adhesives
Symposium on Innovations in
Adhesives and their Applications

November 28, 2024

Tuesday, February 11, 2025

09:00 – 09:25

NOVEL RECYCLED BASED POLYOLS, RAISING THE BAR FOR MORE DEMANDING POLYURETHANES ADHESIVES

Cargill; BE-Gouda
Erwin Honcoop

Abstract:
As the industry shifts towards sustainable raw materials, the demand for recyclable materials is on the rise. In response, Cargill has redesigned its polyol product line, introducing offerings that contain up to 100% recycled content specifically for adhesive applications.

These advanced polyols deliver both durability and performance in polyurethane adhesives. They are crafted from recycled plastics and diacids sourced from natural oils, resulting in a liquid polyol with a crystalline structure that enhances adhesion to steel and aluminium while maintaining flexibility.
The hydrocarbon composition of the bio-based diacids and polyols provides water repellency and a balanced combination of strength and elongation.

Furthermore, the integration of recycled and bio-based materials in these innovative polyols creates a unique formulation that offers excellent hydrolytic, thermo-oxidative, and chemical resistance, making them ideal for demanding applications such as sealants, sportswear, and automotive components.

09:25 – 09:50

ADVANCING CIRCULARITY USING MS POLYMER™ - SUSTAINABLE FOIL ADHESIVE FOR THE BUILDING ENVELOPE

Kaneka Belgium N.V.; BE-Westerlo-Oevel
Tom Leemans

Abstract:
Through the years Kaneka has developed several types of silane terminated polyethers (known to the market as Kaneka MS Polymer™). A special and exclusive group within this polymer range are the acryl modified MS Polymer™, a blend of silyl modified polyacrylates and silane terminated polyethers.

The combination of polymers with a different chain composition and structure allows strict control on morphology, compatibility and even glass transition temperature (Tg). It results in polymers with unique properties like adhesion to plastics and dissimilar materials, combined with a high-strength level adhesion. In the latest trends regarding more sustainable developments, MS polymers can play a key role to provide high performing solutions in different markets. With this technology a continuous progress is achieved both in polymer design and practical applications.

In the view of a more greener future, fast improvements in the current construction market are needed to get new & refurbished buildings more energy efficient, and even carbon neutral. In this respect, a foil adhesive will be presented that is part of the building envelope to create a barrier to reduce the energy losses within buildings. The design of the MS polymer™ grades are done in a way that they can be combined with different other raw materials as well. The permanent tackiness of such products allows for a circular way of building. The continuous development of these new polymer grades shows that Kaneka MS Polymer™ remains a key technology for the future and provides solutions for changing applications.

09:50 – 10:15

CURE BEHAVIOR OF FURANIC HUMINS, A 100% BIOBASED THERMOSET

Avantium Renewable Polymers; NL-Amsterdam
Tom Claessen

Abstract:
Coming soon

10:15 – 10:45 REFRESHMENT BREAK

10:45 – 11:10

AMBIENT-CURABLE, CRASH TOUGHENED STRUCTURAL ADHESIVES WITH PROPERTIES CLOSER TO HEAT-ACTIVATED ADHESIVES

L&L Products; US-Romeo, MI
Dr. Yuan Lu

Abstract:
Crash toughened structural adhesives have been widely used in various industries, particularly the automotive industry. These adhesives have been used to increase the stiffness of the car body for driving comfort and allow the use of lightweight materials for fuel efficiency. When used in combination with mechanical fastening including welding and riveting, these structural adhesives improve crash worthiness of a vehicle due to even distribution of the load and the toughened bonding. Typically, these adhesives require heat to activate the curing chemistry. High heat generally facilitates high crosslinking density and improved adhesion to lubricant contaminated surface, both of which contribute to bond durability upon exposure to harsh conditions. Additionally, phase-separation toughening mechanism of carboxyl-terminated butadiene-acrylonitrile rubber and urethane-based toughenes also relies heavily on curing at high temperatures.

This performance dependence on cure temperature explains the property gap between ambient-curable adhesives and heat-activated adhesives. Ambient-curable adhesives in the market often suffer from inferior toughness, poor adhesion to contaminated surfaces, and chemical resistance. In this paper/presentation, L&L Products' ambient-curable adhesives will be showcased as examples with properties closer to heat-activated counterparts. By utilizing a proprietary combination of chain extenders, phase-separating toughenes, high-molecular weight polymers, and flexibilizers, L&L Products' ambient-curable adhesives demonstrate increased plastic nature, improved toughening, and matrix flexibilization for high peel and impact resistance. The unique selection of the above-mentioned ingredients enables reduced shrinkage upon curing, superior chemical resistance, and improved adhesion, providing a durable bond against harsh conditions. These adhesives are characterized by high lap shear strength (>20 MPa), wedge impact peel strength (> 30 N/mm), T peel strength (> 9 N/mm), superior adhesion to lubricant and mold release

contaminated surfaces, and excellent resistance against exposure to humidity, salt spray, and highly caustic media.

11:10 – 11:35

REPLACEMENT OF SOLVENT-BASED PRIMERS USING OPENAIR-PLASMA® FOR ADHESIVE BONDING

Plasmatreat; DE-Steinhagen
Klaus Kresser

Abstract:
The transition from solvent-based primers to Openair-Plasma® technology represents a significant advancement in bonding applications across various industries. Openair-Plasma® offers an environmentally friendly alternative by eliminating volatile organic compounds (VOCs) associated with traditional solvent-based primers. This technology enhances surface energy, thereby improving wettability and adhesion properties of substrates such as plastics, metals, and composites.

Openair-Plasma® operates under atmospheric pressure, making it suitable for inline integration into existing production processes. This results in increased production efficiency, reduced manual intervention, and lower operational costs. Additionally, the technology's ability to uniformly treat complex geometries and large surface areas ensures consistent quality and performance.

The adoption of Openair-Plasma® not only aligns with stringent environmental regulations but also meets the growing demand for sustainable manufacturing practices. By replacing solvent-based primers, industries can achieve superior bonding strength, enhanced durability, and overall improved product quality. This abstract highlight the potential of Openair-Plasma® to revolutionize surface treatment processes, paving the way for more sustainable and efficient industrial applications.

11:35 – 12:00

ENHANCING ALUMINUM-ADHESIVE BONDING FOR AUTOMOTIVE USE VIA ATMOSPHERIC PLASMA POLYMER PRIMERS

[1] University of Applied Sciences and Arts Northwestern Switzerland - FHNW; CH-Windisch
[2] Collano, CH-Sempach Station
Dr. Thomas Danny Michl[1]*, Alain Schwegler[1], Philippe Keller[1], Michael Grob[1], Marcel Fischer[2], Heiko Jung[2], Raphael Schaller[2], Philipp Frei[2], Sonja Neuhaus[1]

Abstract:
Improving the adhesion between aluminum and amine-based fast curing adhesives is crucial for automotive applications, where strong and durable joints are essential. We introduce a novel approach that replaces traditional primers with nanometer-thin plasma polymer layers deposited via atmospheric gliding arc plasma (AGAP) technology. This plasma polymer acts as an effective primer replacement, significantly enhancing the lap shear strength of adhesive bonds from 3-6 MPa on untreated aluminum to 15-20 MPa when combined with the amine-based fast curing adhesive. Changing the failure mechanism from adhesive to cohesive (see Figure 1).

Atmospheric gliding arc plasma deposition offers a rapid, solvent-free, and environmentally friendly method that can be seamlessly integrated into existing production lines and scaled up for industrial use. The process requires only electricity, benign and readily available

gases, and minimal amounts of monomer precursor, eliminating the need for noble gases or toxic chemicals.

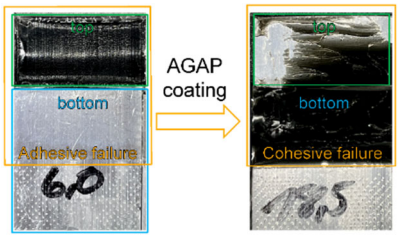

Figure 1:
Post-shear images of aluminum lap shear samples, showing uncoated (left) and AGAP-coated (right) surfaces.

Comprehensive characterization of the plasma-polymerized aluminum surfaces was conducted using X-ray Photoelectron Spectroscopy (XPS), Confocal Scanning Laser Microscopy (CSLM), and ellipsometry to elucidate changes in sur-face chemistry and roughness induced by the plasma polymer. Mechanical evaluations, including lap shear and peel tests, confirmed the substantial improvement in adhesion strength when using the plasma polymer primer with the amine-based adhesive. Aging studies following PV1200 and PV1210 standards test the long-term durability of the adhesive bonds, exploring the technique's suitability for auto-motive applications.

Our findings establish that gliding arc plasma polymer primers are a viable and effective technique to enhance adhesion between aluminum and amine-based fast curing adhesives, offering significant implications for bonding applications in the automotive industry and beyond.

We would like to thank the Innosuisse agency for funding this project (102.681 IP-ENG)

References: https://www.plasmatreat.com/plasma-treatment/plasma-pretreatment/plasma-coating_nano_coating.html

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12:00 – 13:30 LUNCH

13:30 – 13:55

VARIETY OF LASER BASED SURFACE TREATMENT – FROM CLEANING TO FUNCTIONALIZATION

TRUMPF Laser- und Systemtechnik; DE-Ditzingen
Volkan Yavuz

Abstract:
TRUMPF Laser & Systemtechnik SE is a high-tech company with a very broad product spectrum ranging from industrial laser sources to system solutions to optical sensor to novel products using quantum technology. Especially with the product portfolio of our industrial lasers we address solutions for various industries such as mobility and e-mobility, aerospace, medical, consumer electronics, energy, and data storage.

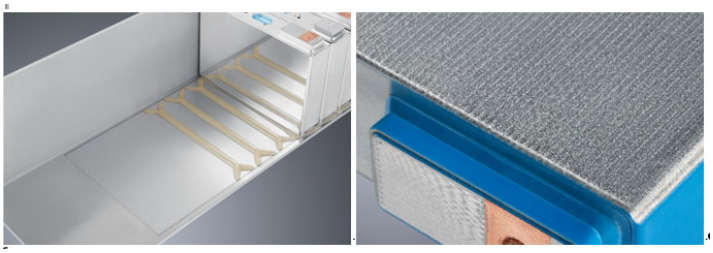

Figure 1:
right: Cleaning of the battery pack for adhesive preparation (cell-to-pack technology).
left: Cleaning of a prismatic battery cell as surface preparation for (a) coating and (b) welding (terminals).

In particular, pulsed ns, ps and fs laser sources are becoming increasingly interesting for laser-based surface treatment, including cleaning, ablation, micro- and nano-structuring.

The advantage of the laser as a surface treatment tool is that the workpiece is treated selectively, reproducibly, contact-free, without chemical additives and with minimal energy input. The laser is often used for pre-treatment for subsequent processes, such as bonding, welding, coating, sealing, or painting of workpieces, e.g. to increase the adhesive strength or improve welding quality. Moreover, laser surface structuring can be used to significantly improve or alter the properties of materials significantly, such as hydrophilicity and hydrophobicity, by creating micro- and nanoscale patterns. Furthermore, the requirements for surface preparation, e.g. the cleanliness of components and the absence of chemicals, have increased in sectors such as e-mobility or the semiconductor industry and are diverse and complex.

In this paper, we present the principles, mechanisms and recent advances in laser cleaning, ablation and structuring. We aim to demonstrate their potential for industrial applications, with a focus on e-mobility.

13:55 – 14:20

CLEANING WITH LASER LIGHT - SUSTAINABLE AND LONG-TERM STABLE SURFACE PREPARATION OF METAL PARTS ON FUNCTIONAL AREAS FOR ADHESIVE BONDING

clean-Lasersysteme; DE-Herzogenrath
Tobias Weichert

Abstract:
Partial cleaning and pre-treatment of the surface is an important prerequisite for a high-quality adhesive surface. In the laser process, dirt particles, oxide layers and other impurities are vaporized by focused light alone. The laser pre-treatment frees the metallic surface from impurities and prepares it well for bonding. The substrate is not damaged by the laser light. If required, micro-roughness or surface modifications can also be produced. Metallic materials can be "modified" within the upper boundary layer with appropriately enhanced laser parameters to also achieve suitable surface tension values. The modified surface is able to match the bonding mechanisms of different bonding systems with different viscosities.

Light metal components, such as aluminum, are particularly well suit ed for laser processing. Numerous studies have found that extremely high, particularly long-term stable bond strength is achieved with certain parameters. Due to the reduced corrosion, the element results are up to five times better than with wet chemical treatment. Stainless steel can also be treated with the laser to achieve better adhesion results. After pre-treatment, inline bonding is possible. Both processes, laser cleaning and bonding, can be combined in one machine to optimize the process chain. With this process and automation possibility, a wide range of bonding applications from different industries can be realized, e.g. in the automotive or aircraft industry.

The presentation will show more details about the laser cleaning process and its mechanism and effect on the surface of light metals and stainless steel. Its influence on the adhesion of adhesive systems will also be a topic. In addition, concrete and latest application examples from research and development will illustrate the mode of action. Finally, automation concepts for laser cleaning and bonding will be presented for a better understanding of feasibility and versatility.

14:20 – 14:45

COMPREHENSIVE MULTI-SAMPLE ADHESION TESTING OF HIGH-END COMPONENTS FOR THE ENERGY SUPPLY OF TOMORROW

LUM GmbH; DE-Berlin
Stefan Küchler

Abstract:
Batteries are the heart of electrical vehicles (EV) and most electronic devices as well as core components of aircraft or handheld medical devices. Huge efforts are spent to increase their capacity, life time and safety, while reducing production costs employing new materials and technologies. A crucial role in battery development plays the cohesion inside the electrode material as well as the adhesion between the electrode base (Cu, Al) and its coating. Both defines essentially the battery performance and lifetime under real world conditions.

With the LUMiFrac Adhesion Analyser we introduce a robust and reliable high throughput tool for fast screening of battery and fuel cells. Selected results from recently finished projects will be presented. Selected case studies demonstrate the high potential of the analyzer for tensile and shear strength determination of electrode preparations for batteries and fuel cells.

In a second topic we present results focussing on state-of-the-art lightweight components for renewable energy generation. Blades of wind turbines require high end coatings to resist to harsh operation conditions. Layers of different functionality are employed and have to adhere to the basic structure and to each other. The case study illustrates the challenges and chances of the Centrifugal Adhesion Testing method for this more than ever ongoing topic.

14:45 – 15:15 REFRESHMENT BREAK

15:15 – 15:40

FIBER-REINFORCED ADHESIVES - ANALYSIS, SIMULATION AND MODIFICATION OF THEIR ANISOTROPIC PROPERTIES

University of Braunschweig / Institute of Joining and Welding; DE-Braunschweig
Jens Philipp*, Elisabeth Stammen, Klaus Dilger

Abstract:
Short-fiber-reinforced adhesives are essential for the production of very large and at the same time highly stressed adhesive layers, also with regard to the resulting adhesive layer volumes and the common tolerances. One example of such an application is the manufacturing of rotor blades for wind turbines, which are mainly produced by bonding prefabricated half-shells, webs and spars using large quantities of adhesive. In the context of in-depth experimental investigations on adhesive tensile specimens made of short-fiber-reinforced adhesives, significant fluctuations in stiffness and strength were determined in mechanical characteristic value determinations. The cause of this behavior was identified as a systematic alignment of the short glass fibers due to the adhesive bead application and the subsequent flow process in the adhesive joint caused by the joining process. This identified anisotropy offers the possibility of specifically influencing the properties (in particular strength and stiffness) of the bonded joint (possibly even locally) in order to adapt it to specific requirements.

Non-destructive micro-computed tomography (µ-CT) is used for analysis to gain an understanding of the cause and effect of the alignment of short fibers in structural adhesives

resulting from the application process. On the one hand, the three-dimensional structure of the adhesive layer in the volume is examined in order to be able to carry out further mechanical tests on specifically isotropically or anisotropically produced adhesive samples and investigate the adhesive properties. On the other hand, an algorithm for fiber reconstruction is used to determine the fiber orientation and the corresponding orientation tensors. Using adhesive samples from various parameterized application processes, the specific orientation tensors as well as flow-related fiber orientations are analyzed. The results from the investigations of the process-related influencing variables on the fiber orientation via µ-CT serve as experimental calibration data for the validation of models of numerical flow simulations for the prediction of local fiber movements and orientations depending on the adhesive application and the joining process.

15:40 – 16:05

TRACKING AND DOCUMENTATION OF BONDING PROCESSES – WHY IT IS IMPORTANT TO FOCUS SENSORBASED DATA

B.A.T. BetterAdhesiveTracking GmbH; DE-Frankfurt am Main
Marco Rodriguez

Abstract:
In most automated productions, many parameters of the bonding processes are recorded and perhaps also analysed.
But what about the many manual and semi-automated production processes?
Unfortunately, process parameter monitoring is neglected here, perhaps also because there is no sensible monitoring option.
We should also play it safe in these areas and record and analyse the process-relevant data. A good way is to monitor the adhesive chain...from dispatch to application. One possibility is NBIOT or LoRaWAN sensors that transmit data to a cloud in near real time. Errors and warning limits can now be used to react to possible influences.

If this is then recorded in a document, the issue of traceability can be solved.
We need to find new and safe ways of bonding that enable us to detect errors at an early stage so that we can learn from our mistakes.

16:05 – 16:30

ADHESIVE BONDING IN THE CIRCULAR ECONOMY – CONTRADICTION OR OPPORTUNITY

KLEBTECHNIK Dr. Hartwig Lohse; DE-Breitenberg
Dr. Hartwig Lohse

Abstract:
While in the past the most important question when deciding for or against an adhesive bond was whether it would hold, the proven durability of adhesions is now being used as an argument against bonding. Since adhesions are proven to hold, it is often concluded that adhesions cannot be removed and are therefore not suitable for a circular economy because they supposedly prevent or complicate recycling and reparability.

That this is not correct is shown by a multitude of examples from various fields and not least by the standard DIN/TS 54405 Construction adhesives – Guideline for separation and recycling of adhesives and substrates from bonded joints, which was published in December

2020 and is currently being transferred into an ISO standard with the addition of an appendix with examples from practice.

Furthermore, it must be pointed out that circularity should not be reduced to recyclability and reparability. The basic concept of the circular economy is built on nine so-called R-strategies. Recyclability and reparability are ranked quite low in the hierarchy of R-strategies, at 8th and 7th position respectively.

Furthermore, it must be emphasised that circularity must not be reduced to recyclability and reparability. The basic concept of a circular economy is based on nine so-called R-strategies. Recyclability and reparability are ranked rather low in the hierarchy of R-strategies, at 8th and 7th place respectively. The R-strategy ‘Reduce’, i.e. increasing resource efficiency in the manufacture or use of a product, comes in third. Extending the lifespan of a product contributes to the more intensive and prolonged use of products e.g. via new business models like product-as-a-service (R-strategy Rethink, position 2). The assessment of circularity thus requires a holistic consideration and evaluation, taking into account all 9 R-strategies, but also the other requirements placed on a product, in order to ultimately achieve the optimum.

In European and international standardisation, various standardisation projects are ongoing or have already been completed to provide users in a wide range of industries with support in product development... but there is still a long way to go.