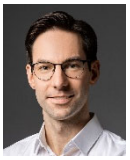
November 20, 2025

Transforming Adhesive R&D with Data Management and Artificial Intelligence




Albert Invent; US-Oakland
Dr. Moritz Haus, Dr. Volker Erb,

Abstract:
The adhesives industry is undergoing a fundamental transformation through digitalization and the application of artificial intelligence (AI). By systematically capturing, structuring, and analyzing experimental and formulation data, organizations can accelerate innovation cycles and significantly reduce time-to-market. Central challenges remain: the inherently high-dimensional design space of coating formulations and the difficulty of structuring R&D data to be "AI-ready".

A modern, domain-specific data management infrastructure provides the foundation for overcoming these barriers. When combined with advanced AI and machine learning, such platforms enable rapid compliance with evolving regulatory and sustainability requirements, efficient substitution of raw materials to mitigate supply chain risks, optimization of critical performance properties, and overall cost reduction.

This presentation will highlight case studies demonstrating how an end-to-end R&D platform streamlines the generation of high-quality, AI-compatible datasets, facilitates collaboration among large, distributed scientific teams, and enhances reproducibility of formulation workflows. We will illustrate tangible outcomes, including compressing development timelines from months to days, achieving performance benchmarks beyond conventional limits, and pioneering new digital business models for the adhesive sector.

Regardless of an organization's current stage of digital maturity, this session will provide scientifically grounded use cases and strategic considerations for implementing end-to- end R&D platforms, laying the groundwork for a data-driven innovation.

Pioneering Biobased Innovations: Furanic Humins and FDCA for Sustainable Adhesives and Binders

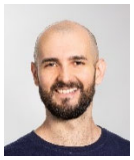
Avantium Renewable Polymers; NL-Amsterdam
Dr. Francesco Acquasanta

Abstract:
Avantium is pioneering the development of next-generation biobased chemical products through its YXY® technology, which catalytically converts plant-based sugar (fructose) into FDCA and furanic humins, representing a sustainable potential solution for binders, sealants, and adhesives industry. Derived from renewable resources, these products are characterized by an attractively low carbon footprint and are approaching industrial-scale availability – with Avantium's 5 kta Flagship Plant in Delfzijl (NL) coming on stream - positioning them as promising alternatives to conventional fossil-based materials. FDCA (2,5-furandicarboxylic acid) is a versatile biobased aromatic monomer suitable for an array of plant-based chemicals and plastics such as polyethylene furanoate (PEF), with potential to drive innovation across multiple adhesive and resin applications, thanks to its unique chemical structure and performance characteristics.
Furanic humins - a co-product of Avantium's YXY® technology - also present intriguing opportunities thanks to their intrinsic thermoset nature; example applications in adhesives and binders will be showcased. This abstract invites collaboration from producers of adhesives, resins, and binders, as well as engagement from end-users seeking sustainable material solutions and lower carbon footprint.

TBA
Polytec PT a part of ARKEMA Group
Robert Mattmer

Abstract:
Coming soon

TBA
Collano; CH-Sempach Station
Joshua Avossa



Abstract:
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CNSL-Derived Polyols and Diols: Enhancing Polyurethane Adhesive Performance with Renewable Materials
Cardolite Specialty Chemicals Europe; BE-Mariakerke
Tom Berckmans

Abstract:
Cashew Nut Shell Liquid (CNSL) is a non-edible natural oil obtained as a by-product of the Anacardium Occidentale nut.

Its main component (cardanol) is characterized by unique chemical features (presence of aromatic ring, phenoxy groups, alkenyl side chain), that allow its industrial use in a wide range of thermosetting materials, from polyurethane systems to friction polymers.

In polyurethane applications, cardanol can be successfully used as isocyanate blocking agent, viscosity reducer and raw material for the production of hydroxyl functional compounds with different functionalities and physico-chemical properties. Cardanol and its derivatives are suitable for CASE applications (where they can provide improved hydrolytic stability, for instance) as well as foams (both flexible and rigid).

This Paper will present the performances of cardanol-based diols and polyols in polyurethane adhesives, highlighting their benefits (e.g. hydrophobicity, chemical resistance, adhesion to various substrates) when compared to both fossil-based and natural-oil derived benchmarks, as well as their favorable sustainability profiles (LCA).

Permanently Plastic Sealants for Easy to Repair Electric Vehicle Batteries
Drei Bond; DE-Ismaning
Dr. Florian Menk

Abstract:
With the publication of the new EU battery regulation from 2023 and the regulation on circularity requirements for vehicle design being in the draft status, it has become clear that electric vehicle batteries must be replaceable and repairable “in a readily and non-destructive manner” in the near future.
While the sealing of the battery housings must prevent corrosive infiltration and ensure tightness during use, e.g. to prevent water from entering, on the one hand, the sealant technology should, on the other hand, allow easy disassembly for repair cases and at the end of the battery’s life cycle.
The use of common sealants poses many challenges when it comes to implementing all these requirements combined, especially with regard to a production-optimized design (groove, chamfer, recesses, etc. lead to increased complexity). Moreover, opening a battery housing usually requires considerable effort plus time and, typically, results in damage of the cover and/or housing.

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Permanently plastic sealants offer immense potential for simplification here. They combine easy processability (no skin formation, no pot life, no high temperatures, etc.) and efficient corrosion protection with the ability to open the battery housing in a simple and non-destructive way. Thus, permanently plastic sealants enable easy repairability without complex design and process requirements

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Development of an Extrusion-Lamination Bonding Technology Using Crosslinkable EVA for High-Performance Adhesive Joints

Dresden University of Technology, Institute of Building Construction
Dr. Christiane Kothe*, Prof. Dr.-Ing. Michael Engelmann

Abstract:
Modern lightweight and multifunctional composites play a key role in sustainable building construction, demanding joining technologies that enable durable, transparent and material-efficient assemblies. Conventional liquid adhesives are often unsuitable for such applications due to limitations in shape control, curing behavior and optical quality. To address these challenges, a new bonding technology was developed. Ethylene-vinyl-acetate (EVA) was selected as base polymer due to its excellent optical clarity, adhesion and aging resistance known from glass lamination. However, its use as a structural adhesive required a new processing concept, leading to the development of a two-step extrusion-lamination process with controlled thermal crosslinking. EVA grades with vinyl-acetate contents of 28 to 40 % were modified with organic peroxide and systematically characterized regarding extrusion behavior, degree of crosslinking and adhesive performance. In shear tests, the optimized formulations achieved up to three times higher adhesive strength compared to conventional hot melt adhesives, while aging experiments confirmed stable adhesion and transparency under thermal and UV exposure.

Concepts for the Automated Preparation of Adhesive Test Specimens – From Manual Bonding to Automated Testing

Füll Lab Automation; DE-Ostfildern
Benjamin Gmeiner

Abstract:
The automated preparation of standardized test specimens represents a key element in advancing laboratory automation within the adhesives industry. Especially for mechanical test-ing methods such as tensile shear and tensile strength measurements, the reproducible production of test specimens (e.g., tensile shear specimens or dogbones) is crucial for obtaining meaningful and comparable results.

In this presentation, concepts for an automated system capable of producing such test speci-mens are introduced. The system combines automated dosing, positioning, joining, and curing operations, enabling the consistent and repeatable preparation of adhesive bonds. Using flexible robotic handling and modular process stations, different specimen geometries and material combinations can be realized within one setup. The approach illustrates how established automation technologies can be adapted to the specific requirements of adhesive testing.

Automating specimen production not only increases efficiency and throughput but also im-proves result consistency and data quality. In particular, the higher reproducibility of the pro-duced specimens plays a vital role in quality assurance, ensuring reliable and comparable mechanical test results. Furthermore, it lays the foundation for fully automated end-to-end testing workflows — from adhesive formulation to mechanical characterization — thereby enabling faster development cycles and more reliable quality assurance.

Redefining Adhesive Processing: The Impact of 3D-Printed Static Mixers and Nozzles

Innotech Marketing and Konfektion Rot; DE- Mühlhausen
Adrien Schmidt

Abstract:
Static mixing tubes available on the market often fail to meet the specific requirements of certain two-component reactive adhesive systems. Standard injection-moulded mixers often struggle with material throughput, dead volume, impractical length or inadequate mixing performance. As a result, they can compromise bond quality and process efficiency.
3D printed static mixers and nozzles offer a tailor-made alternative, optimising both the mixing process and adhesive application. For each project, we create specifically designed mixers and nozzles based on the adhesive properties and process parameters, enabling the rapid creation of customised solutions that ensure optimal mixing quality, precise adhesive placement and controlled application geometry, while supporting sustainable, on-demand manufacturing.
Based on the adhesive parameters, we are able to create optimised mixers and nozzles tailored to each application - eliminating the need for process compromises.
In past projects, we have been able to significantly improve efficiency by reducing back pressure by up to 80% while maintaining or increasing output volumes. Optimised designs and improved flow dynamics minimise excess material consumption and dead volume by up to 20%. In addition, our solutions reduce the time required by up to 80%, while maintaining precise adhepplication—eliminating the need to adapt processes to standardised components.

Motivation
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What a Drop Can Tell: Exploring the Power of Contact Angle Measurement

Innotech Marketing and Konfektion Rot; DE- Mühlhausen
Buruk Sen

Abstract:
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New Adhesive Formulations Based on Novel POM-Polyols from Power-to-X Technologies

Jowat; DE-Detmold and Power2Polymers
Dr. Hartmut Henneken

Abstract:
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Data-Driven Development of Adhesives: Harmonised Data, LLM Assistance, and In-Silico Variant Prioritisation

[1] LabV Intelligent Solutions; DE-Selb
Charles Jouanique* , Dr. Stefan Thomas*, A. Bräkling, Marc Egelhofer

Abstract:
The development of innovative adhesives faces rising cost, regulatory, and sustainability pressures. The core constraint in R&D is often operational: dispersed records, inconsistent units, missing metadata, and poor traceability. Conventional tools document activity but rarely integrate it, which hinders retrieval, comparison, and reuse, and undermines meaningful use of AI.

We overcome these limitations with a harmonised evidence base: one schema for recipe, process, and test data, automatic capture from instruments, and Enterprise Resource Planning (ERP) integration to secure master data and reduce transfer errors. In a representative implementation, iterations per project, documentation effort, and data-search time decreased substantially.

On this data foundation, we deployed an LLM assistant using **retrieval-augmented generation (RAG)** over the unified schema without model training. It accepts natural-language queries, performs semantic search across formulations, processes and specifications, carries out calculations on structured data, and returns clear, units-normalised visualisations with explicit provenance to source records. This supports data-driven decisions during development and shortens analysis time and overall cycles.

We also show that machine learning (ML), trained on past experiments with known outcomes, can rank formulation variants *in silico* using the same qualified, organisation-specific datasets. It operates in two modes: (a) forward performance prediction and (b) constrained inverse design from target windows. This enables the selection and prioritisation of promising adhesive formulation variants *in silico*, reducing laboratory tests and further shortening development cycles.

We refer to this integrated concept of harmonised data and workflows, with LLM and ML components as M**aterial Intelligence**: a traceable evidence base that supports focused experimentation and faster, defensible decisions in adhesives R&D.

Fatigue and impact resistant structural adhesive for lightweight airplane and train seats

L&L Products; FR-Altorf
Dr. Michel Awkal

Abstract:
The feet of airplane and train seats are generally made of metal and are assembled by welding. By replacing these metallic structures with polymer composite materials, it is possible to reduce seat weight and therefore reduce energy consumption or increase payloads of airplanes and trains. Welding can't be used for fabricating thermosetting polymer composite structures. Therefore, an alternative fabrication method must be used. If possible, adhesive bonding generally produces the best outcome for high performance composite assembly.

We have created a heat-activated adhesive that allows for successful structural bonding and cures at temperatures that will not damage the structural composite seat structure. It is understood that airplane and train seats can be subjected to extensive cyclical loading while also expected to resist single event high stress loading conditions. The combination of high strength combined with high fracture toughness to resist cyclic loading conditions is a longstanding difficult set of circumstances for structural adhesives to satisfy.

By utilizing a proprietary combination of phase-separating toughners, high molecular weight polymers, and ingredients that enable localized yielding, L&L Products' adhesive demonstrates high plastic nature combined with high toughness to enable high fatigue and impact resistance.

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The formulation methodology used has enabled creation of a product that has excellent resistance to cyclic bending fatigue (50,000 cycles at 400 N followed by 50,000 cycles at 800 N on bonded assemblies) combined with 16 g aircraft seat impact resistance (SAE AS 8049).

During this presentation, we will discuss the performance needs for such an adhesive, describe the validation methods and results to verify performance, and then discuss how material composition enabled creation of a successful adhesive.

Other important properties such as storage at room temperature, ease of handling, and short curing time will be explained.

Reliable determination of weak adhesive forces – from the challenge to a customized solution

LUM; DE-Berlin
Stefan Küchler

Abstract:
High adhesive strength is an essential property of coatings, adhesives, sealants and composites in many areas of application, from the automotive sector to applied optics, aerospace and lightweight construction. Various methods for determining adhesive strength are available on the market.
The LUMiFrac Adhesion Analyser has long been established in laboratories around the world in industry and research as a multi-sample analysis system with a very large force range in a single device for these and many other applications.
In this article, we will present the strengths of this analyzer in testing very low adhesive strengths, i.e. in the range between 0.035 and 0.5 MPa, in more detail. This applies, for example, to packaging, medical plasters, printed circuits and organic solar cells. While determining low adhesive strengths in solar cells helps to identify weaknesses in the design, the design of medical plasters is specifically geared towards low adhesion to ensure comfortable wound protection and pain-free plaster removal.
This article explains why CAT technology an advantage over conventional tensile testing machines when determining the tensile and shear adhesion strength of weakly adhering bonds. Particular attention is paid to the special requirements for sample preparation and handling. Substrate-dependent adhesive selection is explicitly included.
As a practical application example, the study of the adhesion of medical plasters is presented in detail. Various development samples were provided by a manufacturer. In consultation with the client, these were first tested for their adhesion to a solid standard substrate. For this purpose, an application-specific test setup was designed and tested. Using a slightly modified test setup, the adhesion of the plaster to (artificial) skin was then examined in a practical application.
Furthermore, the conflicting requirements of mechanical stability and low self-weight of the samples are addressed, which are a typical challenge for weakly adhering bonds. procedure for selecting the measurement method to be used is outlined. We highlight the aspects to be considered in test planning and implementation, such as:
- Reproducibility and sensitivity of the measuring device,
- Derivation of possible adhesion tasks, e.g. plaster - substrate, plaster - artificial skin,
to name a few selected aspects.
How these requirements have been mastered using LUMiFrac is illustrated by way of example in order to shed new light on the world of weakly adhesive bonds.

Enhanced Adhesion on Painted Surfaces with Openair-Plasma® Technology

Plasmatreat Schweiz; CH-Diepoldsau
Klaus Kresser

Abstract:
Surface pretreatment is crucial for the permanent adhesion of adhesives to paints or coatings. Conventionally, mechanical processes such as grinding or chemical methods such as the application of primers are used for this purpose. However, these approaches are timeconsuming and material-intensive, can damage the substrate surface or cause environmental and occupational safety problems. Atmospheric pressure plasma (APP) is an efficient alternative that does not require additional chemicals and can be integrated inline into production processes. The generation of reactive species and local UV radiation removes organic contaminants, increases surface energy and introduces functional groups that improve wettability and adhesion. Unlike mechanical processes, APP modifies the surface in a controlled manner without material removal or geometric restrictions and offers reproducible treatment even on complex structures. Compared to primers, there are no additional process steps or storage and disposal costs for chemicals. Overall, atmospheric pressure plasma provides a sustainable, cost-effective and robust method for optimizing adhesion to paints and coatings while helping to reduce environmental impact.

ENSURING A STRESS CRACK FREE FUTURE IN PLATIC BONDING USING ATMOSPHERIC PRESSURE PLASMA COATINGS

SKZ-KFE; DE-Würzburg
David Herbig

Abstract:
Environmental Stress Cracking (ESC) is one of the most common failure mechanisms in polymer components, often triggered by media exposure under mechanical stress. Recent findings show that additives in adhesives can also induce ESC in polymers (adhesive-induced ESC), while conversely, additives migrating from the polymer into the adhesive can compromise adhesion or plasticize the adhesive layer. These interactions are complex and not yet fully understood, and current mitigation strategies are often inadequate due to environmental, technical, or economic limitations.
The presented work addresses this challenge by investigating additive migration mechanisms and developing a novel barrier approach using environmentally friendly, inline-capable atmospheric pressure plasma coatings. These plasma-polymerized layers are applied to polymer surfaces prior to adhesive application, aiming to block additive migration while maintaining or enhancing adhesion.

Experimental results, using the strip bent method, demonstrate that adhesive-induced ESC in polymethyl methacrylate (PMMA) can significantly reduce mechanical strength (Figure 1). In this example, a 2K polyurethane (PU) adhesive was applied to the PMMA surface. However, plasma-coated PMMA surfaces showed restored strength levels comparable to unexposed reference samples. Microscopic analysis confirmed that the coating effectively prevents interfacial degradation. Furthermore, lap shear tests revealed that the plasma coating not only preserves but can even improve adhesive bond strength, increasing from 5.4 MPa (adhesive failure) to 7.2 MPa (cohesive/adhesive failure).

These findings highlight the dual functionality of plasma coatings as both a migration barrier and adhesion promoter, offering a promising solution to enhance the long-term durability of polymer adhesive bonds.

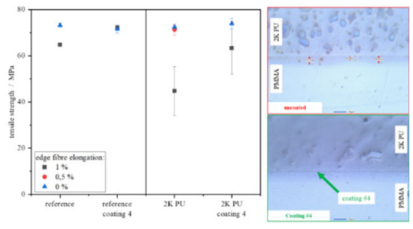

Figure 1:
Left: Tensile strength of PMMA (uncoated, coated) after bent strip tests at different edge fiber elongations (0%, 0.5%, 1%) with a 2K PU. Right: Microscopic images of the interface with and without coating.

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Lighter & Stronger – Next Generation High Performance Eco-friendly STP Adhesives

Siloxene; CH-Brüttisellen
Dr. Matthias Koebel

Abstract:
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Influence of Battery Breathing on the Fatigue Life of Adhesive Bonds in Structural Batteries

University of Braunschweig / IFS; DE-Braunschweig
Michael Griese*, Elisabeth Stammen and Univ.-Prof. Dr.-Ing. Klaus Dilger

Abstract:
As battery electric vehicles gain major market shares of the overall car market, their most important component, the battery pack keeps evolving in a rapid manner. The further development of the design of the battery pack is of utmost importance for automotive companies and therefor new designs are introduced. Nowadays, automotive battery packs consist of battery modules which host several cells and which are integrated into a battery pack. To get rid of these auxiliary structures and to increase the overall energy density of the battery packs, new approaches like cell-to-pack or cell-to-chassis are being introduced. In these designs, the battery cells are directly bonded into the battery pack using structural adhesives to get rid of the module casings or in case of the cell-to-chassis designs, to make them part of the automotive structure and to increase the stiffness of the car body. When battery cells are charged, their electrodes expand due to the intercalation of ions. This effect, called the battery-breathing-effect, is reversible and diminishes when discharging of the cell takes place. Nonetheless, it can threaten the structural integrity of the cell [1] and with advanced cell-chemistries like silicon-rich electrodes, this effect is likely to increase [2]. Due to the deformation of the cell, the surrounding adhesive bondlines are also affected and can be damaged if not properly designed.
In this work, an approach to measure the deformation of the battery cells due to the battery-breathing-effect during charging is presented. The measured deformations are then passed into a numerical model of the battery cell, which is integrated into the battery pack via adhesive bondlines. The resulting stress distributions inside the adhesive are predicted numerically and cyclic tests for fatigue analysis are presented.

[1] M Spielbauer, M Steinhardt et al. Batteries, Vol. 9, 6 (2023).
[2] X. Xiao, W Zhou et al. Adv. Funct. Mater. Vol. 25 (2015).

AI In Adhesives - Building a Future Ready Foundation Through Industry Case Studies

Uncountable; DE-München
Tea Pavlek

Abstract:
This talk will explore case studies from industry leaders, highlighting both the successes and pitfalls of integrating AI into adhesives R&D. Attendees will gain insight into lessons learned, practical strategies, and a clear roadmap for building the structured data foundation required to support predictive modeling, automated experimentation, and long-term knowledge retention.

In today's competitive landscape, adhesives companies are under constant pressure to accelerate discovery, shorten development cycles, and commercialize innovations faster than ever. Artificial intelligence and machine learning present powerful opportunities to transform R&D performance—but their success depends on a critical enabler: structured, high-quality lab data.

By investing in structured data today, adhesives R&D organizations can ensure that every experiment conducted adds enduring value—fueling smarter decision-making, faster innovation cycles, and a sustainable competitive advantage in a rapidly evolving market.

Main points of the talk:
Explore real-world success stories from industry leaders who are transforming R&D with artificial intelligence.
Learn from both wins and challenges to understand what it really takes to integrate AI effectively in adhesives innovation.
Gain practical strategies for building the structured, high-quality data foundation that powers predictive modeling and automation.
Discover how data-driven R&D accelerates discovery, boosts innovation, and creates a lasting competitive advantage

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Display Narrow Border – Challenges for Structural Bonding

Visteon Electronics Germany; DE-Karlsruhe
Manfred Süss

Abstract:
What has long been considered standard in the consumer sector is now increasingly finding its way into car displays – the Narrow Border Display.
A Narrow Border Display describes the distance between the visible area of a display, called the active area, and the external mechanical geometry, and is becoming smaller and smaller.
This area is typically printed with black ink on a cover lens back side where wo do structural bonding against a carrier out of metal or plastic.
This black area must become increasingly smaller, which means that the adhesives must become significantly stronger.
However, it is important to consider the challenges that this reduction in the adhesive surface poses, both for the adhesive and from a mechanical and chemical perspective.
This presentation aims to address these challenges.