November 17, 2023

MODIFIED STARCHES: SUSTAINABLE INNOVATIONS FOR WATER-BASED ADHESIVES

AGRANA Research & Innovation Center; AT-Tulln
Dr. Bernhard Seidl

Abstract:
Modified starches, derived from abundant and renewable sources, have emerged as versatile biopolymers capable of enhancing adhesive properties across various industries.

This presentation will address potential challenges associated with the use of starches in adhesive formulations, including stability and moisture sensitivity. Strategies to overcome these hurdles will be discussed: The possibilities of starch modification ranging from physical treatments, chemical treatments to enzymatic processes and combinations thereof are shown.

Case studies will be presented, showcasing successful applications of modified starch-based adhesives in industrial applications. These examples will underscore the adaptability and efficacy of modified starches in meeting the specific demands.
Furthermore, the presentation delves into the environmental benefits of starch-based adhesives, such as biodegradability, renewable sourcing and increasing bio-based carbon content.

Overall, this presentation will provide a comprehensive overview of the transformative potential of modified starches in adhesive formulations. Attendees will gain valuable insights into the diverse applications and sustainable advantages of utilizing modified starches, supporting adhesive industry towards a more eco-conscious future.

AUTOMATION AND DIGITALIZATION, TRANSFORMATION TO CONSISTENT, EASILY CONTROLLABLE AND EFFICIENT PRODUCTION

Automation X; AT-Graz
Ewald Harrer

Abstract:
Integrated manufacturing processes from input/output level up to the business system within one platform and from raw material sourcing, including the production process up to final goods shipped to customer…..
Wishful thinking and steps towards reality.
Market, resources, quality and other requirements force us for actions, but where to start and what investments are necessary?
Proven examples and results from industrial customers as well as future outlook (optimization of complex processes and use digital twin technologies).

PERFORMANCE OF CASHEW NUTSHELL LIQUID BASED POLYOLS AND DILUENTS IN ELECTRICAL VEHICLES

Cardolite Specialty Chemicals Europe; BE-Mariakerke-Gent
Tom Berckmans

Abstract:
Cashew nutshell Liquid (CNSL) is a non-food chain bio-based feedstock found in the honeycomb structure of the cashew (Anacardium Occidentale) nutshell. Versatile chemistries from CNSL allow the design of high bio-content hydroxyl functional molecules i.e., CNSL polyols, diols, and diluents.

In this paper, key properties of CNSL hydroxyl functional molecules were examined to identify utility of CNSL technology for electrical vehicles (EV) battery packages. CNSL diluents can lower viscosity and control cure speed while the diols and polyols enabled the optimization of strengths and flexibility of polyurethane adhesives. Outstanding hydrolytic stability, thermal and chemical resistances of CNSL-based polyols were demonstrated along with good dielectric properties and fire resistance.

FUTURE HIGH-PERFORMANCE SOLUTIONS FOR ADHESIVES:
NEW TECHNOLOGY AS AN ANSWER TO THE ISOCYANATE RESTRICTION?

Cargill; BE-Gouda
Erwin Honcoop

Abstract:
In modern society the demand of smart and multi-functional adhesives is becoming continuously more important.
But today the market is also requesting solutions that can reduce the carbon footprint, have a concrete sustainability benefit and a potential alternative to the question on isocyanate restriction. Finding a reliable solution to provide performance and sustainability in one single solution is a major challenge.

Cargill is a leading global solution provider of high-performance building blocks that provide a variety of smart effects and benefits in a wide range of polymer types and applications.
Cargill has been working on an innovation that provides an answer to the restrictive requirements of the use of isocyanates. The potential offering has been evaluated, help our customers to tackle this challenge.

The use of this new technology can support the formulators to modify coatings and adhesive systems, offering flexibility, extreme hydrophobicity, improved flow and unique combination of improved adhesion to various substrates.

With our innovation we offer formulation freedom, enabling new and exciting high-end applications without the use of isocyanates for example in electronics, automotive and sportswear.

LIGHT CURING TECHNOLOGY – INNOVATIVE SOLUTIONS FOR MEDICAL WEARABLES DEVICE ASSEMBLY

Dymax Europe; DE-Wiesbaden
Therese Hemery, PhD

Abstract:
Medical wearables market needs, as well as customer requirements have become increasingly challenging over the last few years. While meeting the rapidly evolving trends in bonding, sealing, encapsulating, and coating, the product performance also plays a critical role in the assembly of medical devices, which are worn on the body for short- or long-term periods. To bond a variety of different substrates, including difficult to bond and low-surface-energy materials, Dymax has developed a new range of light curing products. These materials are formulated with (very) low-sensitizing ingredients and engineered for reliability with excellent adhesion and aging performance. They also pass rigorous skin sensitivity standards for medical wearable devices. These biocompatible UV-curable products are designed for the assembly and protection of sensitive circuitry and components and to perform at a more demanding level. Whilst driving the assembly process efficiencies to significantly increased capacity and productivity they can lead to possible production cost reductions of up to 30 %.

BIO-BASED EPOXY ADHESIVES: HIGH PERFORMANCE WITH AN EYE ON THE PLANET

Elantas Europe; IT-Lemignano
Dr. Giulia Mannoni

Abstract:
The topic of environmental sustainability and climate change has become crucial in every sphere of economic development.

Biobased materials enable the possibility to move toward a more sustainable society, due to the independence from petroleum resources that comes with their use.
In many industries, such as automotive, marine and racing, the demand for bio-based products is constantly increasing. In these sectors, adhesives play a key role in structural and non-structural applications. They allow strong bonds, even between different materials such as metal and composites, reducing weight and thus fuel consumption.
The purpose of this lecture is the presentation of the new bio-based epoxy adhesives that can be implemented as drop-in replacements for existing technology. The right selection of bio-based raw materials makes possible to achieve the same properties as corresponding adhesives of petroleum origin and with a lower environmental impact.
The development of this new generation of adhesives confirms the effort of Elantas in the high-performance products with a focus on sustainability

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TBA

Elementis Services; DE-Köln
Anja Baumann

Abstract:
Coming soon

DIGITALISATION IN BATCH PRODUCTION

Fitech; CH-Amriswil
Patrik Thoma

Abstract:
Coming soon

OPPORTUNITIES OF LAB AUTOMATION FOR THE ADHESIVES INDUSTRY

Füll Lab Automation; DE- Ostfildern
Benjamin Gmeiner

Abstract:
The potential applications of laboratory automation within the adhesives industry are highly diverse. With fully automated dosing of liquids and solids, a wide variety of adhesive formulations can be produced. Moreover, subsequent steps like applying the produced adhesives in various forms, such as dogbones or thin adhesive films, can also be automated. To complete an end-to-end workflow, it is possible to automate the characterizing of adhesives, including measuring properties like viscosity, pH value, tensile strength, and tensile shear strength.

For example, a system for automatic adhesive formulation and application was developed for Henkel's Inspiration Center in Düsseldorf. (see references: adhäsion_66_22 and adhesion_19_22)

The automation of laboratory processes not only significantly enhances throughput, thereby reducing time to market, but it also affords highly qualified employees more time to engage in value-added activities, such as experimental planning and the research of innovative products.
Automation provides the additional advantage of ensuring maximum reproducibility and minimizing human errors, which is particularly important for QC. Due to the automatic documentation of all data and measurement results, the data structure of automated processes is excellent. The evaluation and utilization of such high-quality data through artificial intelligence is a promising avenue for future developments.

USING LOW MELTING ALLOYS TO SEPARATE ADHESIVELY BONDED JOINTS FOR REPAIRING AND RECYCLING

[1] Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM; DE-Bremen **and**
[2]RPTU-Rheinland-Pfälzische Technical University Kaiserslautern-Landau / AWOK; DE-Kaiserlautern
[2]Achim Baumgarten*, [1]Thorsten Fladung, [2]Paul Ludwig Geiß, [1]Michael Noeske

Abstract:
The circular economy is a concept of production and consumption in which existing materials and products are shared, leased, reused, repaired, refurbished and recycled for as long as possible. Concerning adhesively bonded joints the main task is to provide a separating mechanism, which is easy to separate and at the same time ensures a reliable bond throughout the whole lifetime.
We describe a new approach on how Low Melting Alloys (LMAs) are used as separation layers in bond lines, thus providing a thermally activated separation only determined by the melting temperature of the LMA. The LMAs are either used as a coating on the adherends, or as a foil/film embedded in the bond line (interlayer), thus not limiting the user to specially formulated adhesives or hot melts. Furthermore, the separation uses a nondestructive approach, assuring the same mechanical properties as before the separation.
Concerning the separation layers different materials and production processes are tested. LMA interlayers and coatings are made of either a Bismuth-Indium eutectic (BiIn), a Bismuth-Tin-Silver alloy (BiSnAg) or pure Tin (Sn). The interlayers can be separated in two main groups, firstly foils made by use of roller, heating press or doctor blade unit and secondly physical vapor deposition (PVD) interlayers on a backing film of polyethylene terephthalate (PET) or polyimide (PI). The interlayers and coatings are analyzed by X-ray fluorescence (XRF) or Energy-dispersive X-ray spectroscopy (EDX), to assure the same composition as the raw material, therefore providing the same melting characteristics. Grain structure, homogeneity, closeness and surface roughness are analyzed using optical microscopy and scanning electron microscope (SEM). Durability of the bond line is tested by use of salt spray test and water immersion on lap shear specmens. To assure the main feature separation tests are performed using conduction, radiation, convective flow and electromagnetic induction to apply heat.
The separating layers can be implemented in inline, as well as in single unit production, providing a safe and easy way of separating components.

Acknowledgement. The ongoing project is funded with grants from the German Federal Ministry for Economic Affairs and Climate Action (BMWK) in the framework of the “Industrielle Gemeinschaftsforschung” (IGF 22404 N) and hosted by DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e.V.
The authors would also like to kindly acknowledge the support provided by the Advanced Materials Engineering (AME) priority research activity of Rhineland-Palatinate.

DEVELOPMENT OF INNOVATIVE MATERIAL, TESTING METHODOLOGY AND SIMULATION MODEL FOR SAFE BATTERY SYSTEMS

Henkel; DE-Düsseldorf
Dr. Uwe Franken

Abstract:
The topic of Thermal Propagation Prevention (TPP) is increasingly coming into focus in the e-mobility industry. With an increasing number of reported cases of fire on electric vehicle roads, legislation in China has caught up and is placing new safety requirements on electric vehicle manufacturers, and NA and EU are expected to follow soon.
The presentation will provide an overview of thermal runaway and its propagation, efficient testing of battery systems under thermal runaway, thermal runaway simulation for best material selection and fire-protection material testing methods. Together with classical thermal management, bonding and sealing technologies and products, this will help that the safe integrity of the batteries meets and follows the regulatory requirements for prevention in electricity storage systems of a battery.

DEVELOPMENT OF A NEW RECYCLING-FRIENDLY MULTICOPTER: HOW AN IDEA TOOK TO THE SKIES

Jowat; BE-Detmold
Dr. Hartmut Henneken

Abstract:
Coming soon

QUALITY RELEVANT CONSIDERATIONS WHEN PROCESSING 2C ADHESIVES FROM CARTRIDGES

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

Abstract:
Even though the use of 2C adhesives from cartridges is considered foolproof on the first glance, there are a few details to be considered in order to avoid or detect errors and to achieve a high-quality bond in the end. The presentation is addressed to manufacturers and suppliers of adhesives filled in 2C cartridges as well as to the users of such adhesives. The interaction between the respective adhesive, the double-chamber cartridge, the different technologies of available static mixer, the dispensing device and, last but not least, the parameters of the bonding process will be covered.

TBA

Kaneka Belgium; BE-Westerlo-Oevel
Nick Dewingaerden

Abstract:
Coming soon

TWO-PART HIGH PERCENTAGE BIO-BASED POLYMERIC COMPOSITIONS

L&L Products; US-Romeo
Kevin Cox

Abstract:
Petroleum-derived materials are becoming less attractive for a number of reasons including cost and resource scarcity. In addition, one can expect growing regulation related to manufacture and consumption of petroleum-derived products in coming years. This provides an incentive for alternative renewable sources with comparable or better properties and cost. Researchers and manufacturers have recently relied on bio-based resins synthesized from glycerol-based epichlorohydrin, bio-based polyols, bio-based acids, epoxidized oil resins, and others. Some well-known sources of epoxidized oil resins include unsaturated oils such as vegetable, nut and seed oils. These epoxidized oils typically contain aliphatic, disubstituted oxirane rings which are nearly unreactive with traditional epoxy curative systems, such as amines and polyamides. These materials tend to have plentiful feedstocks, can be produced easily and safely, are low cost, and tend to have attractive handling and health and safety profiles. Given the advantages that these ingredients offer, it would be useful to have a way of using these materials more broadly than what has been possible to date due to limited reactivity of these epoxides with conventional epoxide curatives. The use of highly reactive acidic compositions including phosphoric acid, phosphoric acid derivatives, phosphate esters, and other acids, allow for the ring opening of these disubstituted oxirane rings, and furthermore, allows for the usage of previously mentioned sources of bio-based resins at high levels including the possibility of it being the sole epoxide in the composition. Though curing speed, open time and foaming speed are tunable, the use of phosphoric acid, phosphoric acid derivatives and phosphate esters allows for systems containing polyfunctional aliphatic glycidyl ethers and polyfunctional peroxyacid epoxies that cure in under an hour, whereas traditional curatives may take well over 24 hours. The current teachings relate to a two-component system with one side containing epoxide functional constituents and one side containing acidic materials, where one or both components are comprised of one or more bio-based constituents. The resulting polymeric composition is an optionally foaming adhesive that may contain over 90% renewable organic carbon content. Foaming materials are used in applications such as sealing and noise, vibration and harshness reduction where low density, adhesion to multiple substrates, and accounting for variable gap thickness may be

beneficial or required. As an additional benefit, the phosphorous in the curative imparts a degree of flame retardancy in the systems. Potential uses include seals, gaskets, closure strips, isolators, damping materials, and general gap filling.

BONDLINE THICKNESS EFFECT ON THE TENSILE FRACTURE TOUGHNESS OF ADHESIVELY BONDED JOINTS

[1] Leibniz-Institut für Verbundwerkstoffe / Dept.; Fatigue & Life Time Prediction; DE-Kaiserlautern and [2]ar-engineers; DE-Hamburg
Francis M.G. Ramírez[1], Luiz G.M. Lise[2], Fabian Nowacki[2] and Joachim Hausmann[1]

Abstract:
The bondline thickness can deeply affect the fracture behavior of composite joints. The present work intends to experimentally and numerically evaluate the bondline thickness effect on the fracture behavior of adhesively bonded glass-fiber reinforced polymers (GFRP). Four bondline thicknesses, 0.2, 0.8, 1.4 and 2.0 mm, were evaluated under pure tensile loading (mode I). A two-component epoxy-based adhesive system SikaPower® 880 was used to join the GFRP plates. Double cantilever beams (DCB) specimens were used to conduct the mode I quasi-static tests. The load displacement (P-δ) curves were obtained and the critical fracture toughness (GIc) was estimated in terms of the strain energy released rate (SERR). To determine the SERR, a data reduction scheme based on the crack equivalent method was considered. This method estimates the SERR only as a function of the compliance, which is a parameter measured during the tests. A two-dimensional finite element model was used to validate the experimental results. The model was developed using ANSYS Parametric Design Language (APDL). A linear softening law was considered to simulate the fracture degradation behavior. A good agreement was found between the GIc of the numerical simulations and experimental results. Moreover, the model was use to analyze a larger spectrum of thicknesses.

Keywords: adhesively bonded joints; bondline thickness effect; fracture behavior; double cantilever beam specimens.

NEW FRONTIERS IN STABILITY ANALYSIS OF COMPLEX FILLED ADHESIVES WITH STEP- & CAT-TECHNOLOGY®

LUM; DE-Berlin
Stefan Kuechler

Abstract:
Modern adhesives and sealants are applied in consumer electronics, e-mobility and many other High-Tec products. They are complex formulations, designed to match highest requirements in performance, handling, usability and costs. The spectrum of parameters to meet manufacturer and end user specifications results in time consuming and costly testing methods.
Dispersion stability and mechanical stability are two essential figures, closely linked for adhesives. A careful selection of fast, precise and innovative testing method for them - chosen by the developers - is the key to defend or reach the pole position in the market.
In the field of adhesives, highly filled formulations bear special challenges for the dispersion stability analysis. Typically, classical methods are either too time consuming or does not allow to provide a look inside the adhesives and sealants. This is due to high opacity (i.e., when carbon black is incorporated), high viscosity, high solid concentration or combinations thereof. Here the combination of STEP-Technology® based LUM instruments provides new insides and testing solutions – especially if they contain carbon black or nano particles.
On a number of examples, it will be demonstrated, how the combined use of STEP-Technology® instruments provides new insides into the dispersibility and dispersion stability of these complex formulations in a much shorter time and with unmatched resolution. In addition, we introduce the CAT-Technology® as a quick and reliable tool to investigate the mechanical stability of the newly designed adhesives.
The combination of both technologies reduces the development time of new adhesives and sealants significantly without compromises regarding reliability and development time.

SUSTAINABILITY IN THE MIXING PROCESS – HOW IS IT POSSIBLE?

medmix; CH-Haag
Joachim Schöck

Abstract:
In recent decades, the use of 2K adhesives has increased in various industries. Due to the increased use of plastics and the ongoing challenges of disposal, the search for more environmentally friendly materials and reliable dispensing systems is unreduced.

As a leading manufacturer of 2K component mixing and application systems, medmix has already implemented sustainability into its development processes to meet this goal. This article discusses how optimal mixing technology can contribute to a sustainable mixing process.

One approach is to use sustainable materials. However, the question arises whether the use of these materials makes sense when disposable mixers are involved. Another approach is to miniaturize our mixers by selecting the best mixing technology for each application. A smaller mixer results in less plastic waste, but also reduces the amount of raw material that remains unmixed in the mixer.

Related to this, the potential of dynamic mixing systems is discussed.
The selected technologies will be discussed based on LCA- (Life Cycle Assessment) analysis.

MOLECULAR PLASMA – SOLVING BONDING CHALLENGES WITH SOLVENT-FREE FUNCTIONAL COATINGS

Molecular Plasma Group; LU-Foetz
Kevin Braun

Abstract:
Molecular Plasma Group’s unique MolecularGRIPTM technology uses cold atmospheric plasma as a vector to covalently bond a wide range of organic precursors onto any kind of substrate, thus generating a permanent nanocoating. By doing this, the surface can be functionalized in various ways, one of which is the significant improvement of the adhesive properties of former inert or sensitive materials by grafting reactive chemical groups such as amines, epoxies, acrylics, hydroxyls, isocyanates, etc.

The technology works in a single-step, solvent-free and dry process at room temperature and atmospheric pressure. Besides materials such as polymers, metals, ceramics and glass, it also allows the treatment of temperature-sensitive substrates such as bio-based materials and ultra-thin films. Since the chemical is covalently bonded to the surface, the technology offers significant operational advantages in terms of open time. It replaces conventional solvent-based primers by a very eco-friendly and efficient process while realizing even better adhesion and also goes far beyond the possibilities of a standard plasma surface activation technology.

The industrial plasma systems are scalable, fully automated and fully traceable, enabling also the in-line inspection and quality control of the generated layer through the simultaneous deposition of tracer molecules and the subsequent determination of the coating thickness. The systems can be installed as a standalone machine or integrated into any production line. Besides the PlasmaSpot® system to treat rather smaller surfaces, 3D shapes, fibres or powders, the PlasmaLine® is the only atmospheric plasma system in the market that is able to homogeneously treat large surfaces up to a width of 1600 mm in a continuous process.

STICK & PLAY: CHEMICAL HOOK-AND-LOOP FOR SPORTS AND MORE

Nolax; CH-Sempach Station
Ralph Schaller and Cornelia Javet

Abstract:
Coming soon

OPENAIR-PLASMA® IN SEMICONDUCTOR MANUFACTURING

Plasmatreat; CH-Diepoldsau
Klaus Kresser

Abstract:
Why is it beneficial to use OpenAir® technology in Semiconductor Manufacturing? For these applications a lot of different substrates made of metals and plastics are used for gluing and coating applications. This means that for the actual function - such as adhesion, corrosion protection, etc. efficient and environmentally friendly inline treatment solutions are needed. In addition, new chip and PCB designs are established and new legislations must be considered. For this a universal and flexible treatment system is preferred especially when it is about to change from low pressure plasma batch processes to in-line suitable atmospheric pressure plasma processes.
Here, OpenAir®-Plasma technology simplifies the processes. All different types of materials like plastic, metals like aluminum or copper, etc. can be treated with OpenAir®. Plasma. This process is already being used successfully for surface treatments in many different electronic market applications and for other industries and applications. Herewith OpenAir®-Plasma technology assure long-term adhesion and corrosion protection.

In the paper, the following topics will be introduced and discussed:
Explanation of the basic principle of the OpenAir®-Plasma treatment on plastic and metals
Distinction between different plasma technologies: Activation of surfaces and coating of surfaces via PECVD (Plasma Enhanced Chemical Vapor Deposition).
Examples of substrate/adhesive combinations, where PECVD can be used for electronic applications.
Examples of successful implementation and industrialization of green processes and new materials with PECVD technology
Examples Lean pre-treatment solutions for bonding & coating which are industrialized.

MOLECULAR BONDING AND DEBONDING ON-DEMAND THROUGH THE USE OF PLASMA AND METAL IONS

ZHAW Zurich University of Applied Sciences; CH-Winterthur
Prof. Dr. Christof Brändli

Abstract:
A novel technique has been developed to bond polymer surfaces without leaving any residue, thereby facilitating polymer recycling and enabling the bonding of polymers that are normally incompatible. This technology involves altering the polymer surfaces to create functional groups that facilitate reversible bonding through intermolecular interactions between two solid polymer surfaces. Specifically, surfaces were modified using oxygen plasma (both low-pressure and atmospheric plasma technology) and acrylic acid grafting through a wet chemical process. These modified surfaces were then treated with copper(II) ions to investigate the impact on adhesive strength and separation. Key factors for successful bonding include surface roughness, surface modification, the presence of surface ions, and bonding temperature. When these parameters are appropriately combined, they allow for strong, reversible bonding between polymers, which can be easily separated using specific chemicals.
