

# Gluing, converting and printing

Packaging is the first haptic point of contact that a consumer has with a product. The efforts that go into making the packaging an experience the consumer cares to repeat involve high-tech gluing-, converting- and printing technology and know-how. Some of the trends and common themes leading this industry were distilled into 34 papers presented to approximately 280 peers from the industry from all over the world at the 39<sup>th</sup> Munich adhesives and finishing symposium from October 20–22 last year.

Both speakers and participants represented the major players in adhesive production, manufacturers of machinery and equipment as well as academia. As Evert Smit, Arizona, remarked, the trends and themes all of these parties have in common are «The landscape in which we operate is changing, and fast. (Back) towards more systems integration, simpler logistics, and more eco and sustainability. These aren't hollow phrases (anymore), as several talks showed the progress and affirmed each other's actions. Instead of dividing the process to come to an article in many disparate steps by several intermediate producers, companies are integrating backwards and forwards for more control, logistics and ultimately cost saving by reducing complexity. Significant internal know-how is the UBR (Unique Buying Reason). This was clearly visible from the equipment manufacturers' talks (ITW, TSE Troller, Maan, Softal, Kroenert, Dr. Hönle etc), and very clearly from the CNC talk by Dr. Barth and the OE-A talk by Dr. Mildner. Just In Time, described as being basically «moving the warehouse to the highway», is losing importance. Flexibilisation is bucking the trend to outsource to e.g. China, as material movements should be minimized to meet the significantly shortened deadlines. This creates new growth (mainly?) in Europe in «mature» areas like (specialty) packaging and bookbinding. Flexibility and individualization (each their own niche). The human touch in business is getting clearer, as businesses move to human-to-human, partnership and again, systems integration. Product safety (including but not limited to food contact) is still gaining importance. Lots of activities in the coating and curing area, allowing new bonding methods, lower material use, and use of more sensitive materials. Basic adhesion understanding is a topic on many companies' agenda. Rheology is the number 1 tool.»

**QUO VADIS PRINTING AND FINISHING?** «Converting requires innovation in all sub processes: efficient paint application and new drying methods promote the industry. Printed Electronics creates new applications.» Wolfgang Mildner, Organic and Printed Electronics Association OE-A, sums up the session he chaired. Flexibility drives the developments in ink application: Roger Ineichen, WIFAG-Polytype Technologies, presented his company's inkjet technology customizing every step of the way: print head electronics, ink, primer and ink receiving layers.

When patterns are meant to functionalize a substrate, as in printed electronics, precision and again flexibility are core criterions.

Christian Werner from Kroenert shows that slot die, deep valley and flexo printing, screen and ink jet printing have application advantages and disadvantages. So in the end the product design (size, pattern, repeatability) dictates when patterns need to be printed, and when they can be coated.

Using the example of HD Flexography, Prof. Dr. Martin Dreher; DFTA-Technology Center, shows that how evenly ink is deposited plays a role, how it is measured and how to improve print quality using a newly developed halftone screen.

Both Dr. Peter Barth; CreativeNetworkConsulting, and the following panel discussion on 3 D printing (chaired by Prof. Dr. Dieter Roller; IRIS – Institute of Computer-Aided Product Development Systems/ University Stuttgart, Germany and including Alexander Hafner from Makerbot, Jonas Grunert from University Stuttgart, Nadine Nottrodt, from Fraunhofer Institute for Laser Technology ILT and Stefan Ritt, SLM Solutions) showed new scenarios to organize process production and new production methods which promise to turn our current production situation topsy-turvy.

Dr. Christian Schmidt, Jowat, showed in his paper co-authored with Dr Hartmut Henneken and Dr. Christian Terfloth how the print finishing industry, too, is becoming different: changes in machine technology as well as the ongoing search for new sales opportunities have noticeably increased the requirements on modern adhesives. Additionally, the end customer desires more and more spectacular finishing results within strongly decreased process times. This forces the print finisher to push process times further down to the limit: e.g. window laminating. Windows in packaging giving the consumer an idea of the product are manufactured using the window patching method. The film, which is the window itself, is bonded to the inside of the package by a small surface around it. Any foil lamination of the printed area on the outside of the package has to be done in an additional production step. Barrier films that need to be applied from the inside of the package cannot be applied using window patching. Now, a «window laminator» by Exosystem Costruzioni, Italy, is available on the market, which can apply these films from the inside or from the outside of the package. This provides post press finishing companies with a promising market niche.

With new applications come new drying requirements. Change a running system by using a different technology altogether, such as the acoustically enhanced heat and mass transfer proposed by Dr. Gene Plavnik; HTI – Heat Technologies Inc., or enhance a the running system - by diffusion-optimized convection drying as proposed by Prof. Dr. Franz Durst, FMP Technology. The presented data showed compelling results for both concepts. Prof. Dr. Dirk Burth, University of Applied Sciences, showed how the UV-curing test method developed at the University of Applied Science in Munich can give insight on how different curing parameters influence the process. Dr. Matthias Reinelt from Fraunhofer

Institute for Process Engineering and Packaging IVV took the problem solving discussion to the next level: using the example of film converting he explained how best to find a solution where trade-offs are concerned: e.g. better performance comes at a higher cost.



Wolfgang Mildner, OE-A, Frankfurt am Main

#### APPLYING COATING AND ADHESIVES, FUNCTIONALIZING THEM AND MAKING THEM STICK.

«The session of the following contributions demonstrates the impressive diversity and dynamics of machinery evolution in converting operations: web pre-treatment, coating modules, quality monitoring, and most advanced applications.» Michael R. C. Gerstenberger, Lion Consult, sums up the session he chaired. One catalyst to the developments in mechanical engineering is printed electronics. Be it the development of slot coating, not just a pre-metered method providing savings (Jeff Seckora, Nordson EDI), or enabling very thin coatings where less is more, as in glue application (Erich Schmidt, ITW Dynatec) or in multi layer coating for organic electronics or very precise layers in the field of batteries (Harald Döll, TSE Troller). Once applied, the coating needs to be cured or dried. Petra Burger gave an overview of UV curing equipment available from Dr. Hönle, explaining the technical properties and differences of these technologies and their applications.

To make coating or adhesive stick to problematic substrates, atmospheric pressure plasma has become widely accepted for the surface treatment of plastics, paper and metal foil to improve the adhesion of inks, lacquers, bonding agents and coatings. Dr Frank Förster from SOFTAL Corona & Plasma presented the currently available technology. He also outlined the EU-project IP4Plasma, which involves Softal's plasma know-how. Spinverse Oy, Finland, is coordinating the project aimed at developing plasma for health-care purposes such as advanced wound care products. It kick-started last year in January and final results will be available at the end of 2016, when the project runs out.

Roelof Klein, showed an example of a roll-to-roll hot melt coater from his company, MAAN Group, which combines the use of these technologies to provide, again, flexibility. Precision in production is not possible without equally precise process control. The precision battle man against machine is clearly won by machine, as the examples shown by Hans Örley from Dr. Schenk Industriemesstechnik strikingly demonstrate. What the perfectly functionalized surface of, for example, a PET-film can be used for shows that printed electronics is no dream: we already use cell-

phone or household appliances equipped with sensors made of these films in every day life, we already have printed electronics enhanced packaging. This shows that the future painted by Wolfgang Mildner, OE-A Organic and Printed Electronics Association, is but around the bend.



Hans Örley, Dr. Schenk GmbH, Planegg

#### SUSTAINABILITY – HOW DO WE MAKE IT HAPPEN?

«Nowadays the sustainability of chemical products should be ensured by providing holistic and balanced life cycle perspectives. Hence, for process engineering including the adhesive bonding technology – as the joining technology of the 21<sup>st</sup> century – the opportunity results, but also the necessity for the development of sustainable, resource-efficient and value-adding processes with their solvent-based, hot melt, water-borne and reactive systems in the diverse application areas in gluing, converting and printing – which were demonstrated impressively by some of the presentations.», remarks Stephan Hinterwaldner, Hinterwaldner Consulting GbR. Benno Blickenstorfer and Dr. Philip Andres from Collano Adhesives discussed a novel class of UV curable pressure sensitive hot melt adhesives from fatty acid derivatives of vegetable oils for label applications. With such adhesives, labels can be produced almost entirely from renewable resources. Other advantages of such adhesives are that they can be produced without using solvents, they can be processed at reduced temperatures, and crosslinking by UV radiation is environmentally friendly. All in all, the very low share of fossil components makes for a favourable sustainability profile. Studies for specific applications are necessary. Julieta González and Lic. O. Ferré from the INTI-Caucho, Instituto Nacional de Tecnología Industrial, introduced an adhesive based on casein and their findings regarding the adhesion properties and water resistance when used for paper labels in contact with glass bottles. Their findings were that, it is possible to improve water resistance of casein-based adhesives by adding CaO or ZnO. CaO can be used as a «coarse tuning» and ZnO as a «fine tuning» modifier. On a cost basis there will be an improvement, too. Dr. Eva-Lena Hult Mori from VTT – Technical Research Centre of Finland explained how fiber-based packaging materials can overcome restrictions such as poor barrier properties: VTT has developed technologies for fractionation and modification of natural polymers such as hemicelluloses, starch and lignin. These competences have been used to improve the water resistance, grease barrier, oxygen barrier, processability and thermoplasticity of the bio-based coating materials. Prof. Dr. Norbert Willenbacher in

cooperation with Wiebke Maassen and Michael A. R. Meier, KIT – Karlsruhe Institute of Technology – Institute for Mechanical Process Engineering and Mechanics, Applied Mechanics and Institute of Organic Chemistry, Applied Chemistry, researched the successful synthesis of monomers based on plant oils in three different types: a three-step, two-step, and a one-step synthesis route. They were able to demonstrate that pressure sensitive adhesives based on renewable resources are able to compete with commercial products in a given range. Their work was focused on pure homo-polymers, which are tunable in their adhesive properties according to the specific demands of different applications.

**LEGALESE ON FOOD PACKAGING.** How to deal with a finished product made of plastics, paper, printing inks and adhesives in the future? It is not easy to navigate through the regulations governing food packaging in Germany, as Dr. Ralph Derra, ISEGA Forschungs- und Untersuchungsgesellschaft, showed. The European Framework Regulation (EU) No 1935/2004 contains general requirements to be observed for all types of materials intended for food contact. The manufacturer of a food packaging must be able to document the conformity with the legal provisions to their customers. For printing inks and adhesives a risk assessment of their effects on food was crucial. In the foreseeable future, a German Printing Inks Decree will be implemented as a national measure within the legislation for materials and articles intended to come into contact with food. It will also have an effect on the European market. However, there are currently no legislative plans to also regulate adhesives in the same manner in place - neither on the national nor on the European level. The difficulties, this situation poses for the producers of adhesives, were illustrated by Dr David Vanraes and Dr Graham Clark from Henkel Belgium using the example of water borne pressure sensitive adhesives.

**INNOVATIONS IN ADHESIVES:** For Evert Smit, Arizona, who chaired the session on the chemistry of adhesives «the session circled around «the Future». Exxon made a (surprise) presentation showing the way in which packaging and hygiene (non-woven) adhesives are going: metallocene PP polymers. These are enabling drastically simpler formulations. The other prevalent more sustainable technology developments in UV curable, renewable and bio-based adhesives were presented subsequently, showing this topic is far from neglected. The session was closed off with very advanced ways to understand adhesion and adhesives.» Innovative light curable dendritics (coming from the Greek word for tree) were introduced by Dr. Belinda Berns, Dymax Europe.



With their semi-symmetrical structure they mimic dendrimers' exceptional properties regarding high temperature and chemical resistance as well as mechanical strength. However, production cost is much lower. Dr Marco Cerra from Vinavil explained the role of the nature of heterogeneities on rheological and performance properties of water based PSAs and how they have been used to improve them, to reach solvent based products adhesive properties and water resistance. Marcus Gablowski, Herma, showed how rheology is the number one tool in the multilayer-slide-die-coating process to produce multilayer self-adhesive systems. In her paper co-authored with Marco Villalobos, Elizabeth Sims, Cabot, also addressed rheological properties aside mechanical and electrical properties and how they influence adhesives on the sub-micron level. Dr. Susanna Zimmer und Jan Scheffel from Biolink explained how to characterize pressure sensitive adhesives using rheological measurements.

**WHERE CAN WE GO FROM HERE?** Next year's Munich adhesives and finishing symposium – incidentally in it's 40th anniversary – will give the players in the industry further opportunity to tell us. The call for papers on pressure sensitive adhesives - dispersions – solvent-borne products – reactive systems – HMPSA is on-going. The deadline is April 24 this year. The programme will be finalized and chosen speakers will be notified by May 8 and proceedings must be submitted by August 31 next year. ↩

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