Some adhesives melt hot, some not

Be it such varied issues as packaging, or tapes used for medical applications or in construction and building – adhesives are what holds the world together. Some 250 or so representatives of some of the companies that make this happen met at the 41. Munich Adhesives and Finishing Symposium from October 17-19 in Munich, Germany, last year to discuss aspects of such varied topics as extrudable films, hot melt adhesives and their formulations and characterization, adhesive application, converting or the ramifications of circular use of raw materials. That these issues are a world-spanning matter was made evident by the 18 different nationalities of attendees. Aside the 28 papers given, tabletop presentations provided further food for thought on the subject. This year's event is scheduled for October 23-25. It will feature gluing, converting and printing. Call for papers is on going until April 30, 2017.

INFLUENCE OF CONSUMER NEEDS ON RAW MATERIAL INNOVATIONS

Traditionally raw materials suppliers came up with innovations in their lab, which were then marketed. However, due to modern media consumer preferences and concerns rapidly spread across the world, developments force raw materials innovation to develop as a form of backwards engineering from the consumer need. For example, migration issues in food packaging in Germany have lead the industry to react. Ralf Eberhardt and Dr Monika Tönnießen from Henkel show that substances potentially able to migrate into packaged food stuffs are inherent to hot melt adhesives too, so that each of their basic components must be subject to a detailed risk assessment so that food safe hot melt adhesives can be formulated. According to research, everyone has 2 cl mineral oil in his body.[1] Mr Holst from Treofan explained how it got there: it migrates from packaging into the food we consume. Since 2014 Treofan is member of The Joint Industry Group (JIG) «Barriers against Migration from Food Packaging Materials» of the Swiss Packaging Institute (SVI), founded in 2013. In his paper he strongly advocated developing new packaging systems including a barrier that are cost efficient and developed in cooperation with the customer. Andrea Büttner from Fraunhofer IVV showed how the purification and processing strategies currently the norm were not sufficient so that plastic waste and recyclates often also contained odorous contaminants stemming from what had been packaged. These contaminants can also be noxious, as is the case with the mineral oil residue. Based on a case study of product development for the food packaging industry (pure monomer resins and novel Regalit™ grades for food contact applications), Gert-Jan van Ruler and Michaela Hofbauer from Eastman Chemical show how raw materials suppliers must be in close dialogue with consumers to promote a mutual understanding of customers needs versus the possibilities to fulfil them. With saving food being a global issue and in our western world single or two-party households a majority, Dr Christophe Robert from Bostik presented several case-studies which showed that such consumer demand can be met by adding reclosable functionality to multilayer barrier films while at the same time providing a sustainable product. Odorous contaminants of a packaged good may be less dangerous, but certainly they are also a no-go for customers.

Although sustainability is such a buzzword, Dr Stephen M. Willging from H.B. Fuller Company comes to the conclusion that currently the global market pull for sustainable chemistry in adhesive production is weak and cost and performance are key factors. However, bio sourced feedstocks and raw materials may eventually play a greater role in the supply chain.

THE INNOVATIONS:

Low-trauma hot melt adhesives. To permit skin-contact adhesives to be removed painlessly, primarily silicone-based adhesives requiring special coating lines are employed. Wolfgang Aufmuth from artimelt introduces the company's formulation of skin-contact adhesives and shows their benefits against silicone-based systems. For one, they can be converted on hot melt coating lines, so that no further investments are necessary. Secondly the low peel systems require less machine space all the while permitting higher output per time.

High performance HMPSA for construction purposes. Andy Swain from Henkel gives insights on market trends and key application of HMPSA (hot melt pressure sensitive adhesives) in building and construction as well as the technical challenges and his company's new developments with a performance level more often associated with acrylic based systems.

Next generation hot melt adhesives for packaging. Packaging was the largest application segment of hot melt adhesives and accounted for more than 33% of the total demand in 2014 and it is likely to continue this dominance up to 2023.[2]

New catalysts for the synthesis of thermoplastic polyolefins, such as metallocenes, have promoted new options in production of polymers. These benefits are also increasingly being adapted to hot melt adhesives. Using selected practical examples, Anja Scholz, Dr Carola Haider, Dr Hartmut Henneken, Dr Christian Terfloth from Jowat presented the performance of these new hot melt adhesives and compare them to the current state of the art.

Reactive hot melt adhesives. According to Dr Jürgen Wagner from the ChemQuest Group, Inc , 15% of all adhesives employed are hot melt adhesives (HMA). Making up some 17% of HMA, the

king's class of these adhesives are reactive hot melt adhesives (RHMA) – why is this so? According to Dr Wagner this is due to their enormous growth potential: by 2020 he expects their growth rate to be double that of other HMA. He chalks this down to their added functionality: thermoplasticity gives way to thermosetting once the post-curing process involving environmental moisture sets in, and thus makes them thermally and chemically more stable. This should open up many future new markets not only for these adhesives but also for their metering and dispensing equipment.

Styrenic block copolymer based hot melt adhesive. Due to their rubbery behaviour combined with high cohesion, styrenic block copolymers are the polymers of choice for hot melt adhesive for highly demanding applications such as hygiene, packaging or hot-melt PSA. Polymer architecture and block molecular structure can be altered to meet a broad range of mechanical and viscoelastic properties while at the same time balancing performance and cost. Martine Dupont, Kraton Polymers Research introduced innovative production and formulation examples in various applications.

Polyolefin-only hot melt pressure sensitive adhesives. Dr Erik Hauck from Clariant Plastics and Coatings featured his company's latest amorphous polypropylene grade for pressure sensitive adhesives for e.g. labels and tapes. These are free of styrene-block polymers and free of mineral oil. The recipes show enhanced peel strength and ageing resitance and offer lower VOC with any migration into the substrate (bleed- through) and they are completely free from MOSH and MOAH, while at the same time reducing the add-on level during application by 50% compared to SBC benchmarks.

Cyanoancrylates – a novel approach. Previously cyanoacrylates were not employed in PSA production. Reinhold Domanski from Lohman showed that including the new monomer 2-Phenylethyl cyanoacrylates in the reactive hot melt formulation, PSA could be produced with viable results in performance tests compared to common PSAs. This product combines pressure sensitive properties such as initial tack and easy to use with lap shear values like liquid glues. Due to the curing mechanism, no extra curing is required.

Tailor made resins. Viscosity, substrate wetting, tackiness, open time and SAFT are examples of how adhesive formulations are adjusted and optimized using hydrocarbon resins. Dr Jun Liu explains how Rütgers Novares designs tailor made hydrocarbon resins and discloses the results of pure monomer resins in a HM formulation to show the relationship between monomer composition and the application profiles.

Novel performance polymers for hot melt adhesives. Yann Devorest, Jean-Roch Schauder, Jurgen Schroeyers, Jennifer J. Austin, Jim N. Coffey from ExxonMobil Chemical introduce their company's Vistamaxx™, a family of polymers manufactured using ExxonMovil Chemicals proprietary metallocene catalyst technology. It is applicable to films, nonwovens and PP. It offers attributes such as elasticity, softness, high filler acceptance and viscosity tailoring making hot melt adhesives containing this formulation suitable for packaging, hygiene and assembly applications.

New APAO with boosted properties. Amorphous poly alpha olefins (APAO) are being used in hot melt formulations since 1950's. Using the example formulations for hygiene and packaging applications, Dr André Ebbers, Dr Sebastian Babik, Dr Simon Kraus from Evonik Resource Efficiency presented the first two of the company's new commercially available Vestoplast grade, newly developed APAO grades with balanced property spectrum.

Solvent-free systems crosslinking at room temperature. Solvent-free pressure sensitive adhesives based on acrylics are considered to be the typical hot melt adhesive. Their processing temperature is 100-140 °C, so special hot melt equipment is required to use it in self-adhesive materials production. UV-cross-linkable acrylic pressure sensitive hot melt adhesives requiring UV technology in the UV-C range, whereby properites such as tack, peel and shear depend on the UV crosslinking method to a large degree. Prof Dr Zbigniew Czech, Agnieszka Kowalczyk, Ewelina Minciel and Wojciech Stanuch from West Pomeranian University of Technology Szczecin, Poland, introduced the new generation of solvent-free systems crosslinking at room temperature and using conventional technology: low viscosity coatable pressure sensitive adhesives based on acrylics (SF-LVS). They can be used to make one- or double-sided self adhesive tapes or carrier-free transfer PSA tapes with a coating weight of 1000 g/m2. These SF-LVS provide fantastic optical clarity, high tack, excellent peel adhesion and very high shear strength after UV initiated crosslinking under a UV-lamp in the UV-A range. They are well-suited for the production of technical tapes, sign and marking films and labels.

Impact of stabilizers on hot melt adhesives. A combination of hindered phenols and phosphites serve to stabilize plastics against thermal degradation especially at higher temperatures. Due to polymer similarity, this technology was transferred to hot melt adhesives, without, however, taking into account application temperature and other raw material ingredients such as tackifiers. These issues along with recent advances in raw materials and processing call for a different approach to stabilizing hot melt adhesives. Dr Bernd Hövel from BASF introduced the new Irgastab® series of antioxidants focusing on the adhesion properties of hot melts and showed the selection criteria with regards to hot melt composition and application temperature.

Advantages of PUR hot melt adhesives in lamination. More and more high performance adhesives are reactive polyurethane hot melt adhesives. Michiel van Duijn from Morchem walked the audi-

ence through the principals of using these reactive polyurethane based adhesives comparing their advantages in use against water- or solvent based adhesives: increased performance, reduced cost and less impact on the environment.

Adhesive production process. Daniel Beller from Coperion pitched continuous production of hot melt adhesives against the conventional dissolving and kneading of raw materials to make hot melt adhesives in batches. Comparing dosing, recipe changes, cleaning, thermal stress of the melt (degradation), personnel costs and quality consistency, he concludes that the advantages of continuous adhesive production outweighs its disadvantages except where small batches, often product changes, very complex recipes and raw materials not in a flowing state are required.

COATING AND CONVERTING

Adhesive application. Which method of application can guarantee the best result? For intricate products such as hot foil, cold foil, and lacquered film for transfer applications such as are required to finish luxury packaging boxes Mirko Rinco from Bobst Italia discussed the production line set up beginning with the coating method and what needs to be taken into consideration in the subsequent processes, such as drying, metallizing, printing, laminating. Typically, coating weight, continuous or discontinuous adhesive production, and lastly the adhesives characteristics play a role in keeping the final product up to par.

Maintenance. Everything is perfect: the right hot melt coating system is installed, applying the right adhesive in the right coating thickness etc. So that things stay that way, Heidrun Neumann from Nordson Germany, recommended continuously improving the running system and adopting a cost effective maintenance plan and mapped out the road to get there.

Plasma treatment and hot melts? How hot is plasma? In the industry, plasma can reach a temperature of up to 1 eV and generally 1 eV ~ 11600 K. Can plasma be used for sensitive materials? Using the examples of a cell culture chip, aluminium foil as an example of thin film application and LDPE hot melt coating on aluminium Roig Leibrandt from Relyon Plasma GmbH showed how, using a software developed in-house and based on measurements, getting process parameters right, process control as well as the plasma gas, plasma treatment was possible.

Determining creep. Creep behaviour over a certain time plays a significant role for an adhesive's application properties. Torsten Rammler from Malvern Instruments illuminated the basics of creep testing using a rotation rheometer and explained typical hot melt test results and how to interpret them.

Predicting bleeding of HMPSA. Should bleeding of pressure sensitive adhesives finally have become predictable? Prof Dirk Burth introduced a new high precision measurement system with a resolution in the nano scale which permits following the development of bleeding in a HMPSA that provides fast information about their interaction with release liners at different separation rates.

Air in coating solutions. In the course of mixing the components of a coating fluid, air can be incorporated into coating fluids either in solution or in the form of micro bubbles. With rising temperatures, the air in solution will diffuse and form micro bubbles. Both should be avoided as they lead to coating failure. Prof Franz Durst describes these defects in detail and introduces approriate fluid-supply and degassing systems as well as special mixing equipment to keep air out of the coating fluid.

Determining the coating weight. Boris Hille from Process Sensors Europe introduces NIR online measurement technology providing non-contact and non-destructive online measurement of the thickness or the coat weight. The sensors work with light at specific wavelengths. Their reflection behaviour is different depending on the quantity of adhesive applied.

Protein based coatings. One of the ways in which packaging concepts can be made more sustainable is by replacing mineral oil based polymeric material by biopolymers on the basis of renewable resources that are compostable. By and large these materials display the same properties as conventional film materials, except that their barrier properties are still limited. This is a problem especially where sensitive food products are packaged. Accordingly research is under way to remedy this. Dr Klaus Noller from Fraunhofer Institute for Process Engineering and Packaging IVV gave examples from the current state-of-the-art as well as current research.

1) Barp, Laura et. Al.: Mineral oil in human tissues, Part 1: concentrations and molacular distribution, 2014
2) Global market insights: https://www.gminsights.com/industry-analysis/hot-melt-adhesives-market