EDITORIAL 1ST AFERA TECHNICAL SEMINAR

by Maurice Bowtell, Editor Adhesive Age

SELF-ADHESIVE TAPE INDUSTRY

"Our industry is driven through technical innovation and speed of development". These were the words of Lutz Jacob of ExxonMobil Chemical Europe Inc., Machelen, Belgium, and chairman of the technical committee of the European Association for the Self-Adhesive Tape Industry (AFERA), The Hague, The Netherlands, who opened the 1st Technical Seminar for the Self-Adhesive Tape Industry in Brussels, Belgium. This took place April 18-19 this year and attracted some 150 attendees from 17 countries to hear 16 presentations given by eminent international speakers.

The main aim of this association is to represent the interests of the self-adhesive tape industry by providing the latest information on developments through regular conferences and seminars, an extensive network of industry players, focused committees and working groups addressing important issues and research, as well as fulltime logistical support from its headquarters in The Hague. The association is routinely involved in identifying and researching issues relevant to the tape industry, such as the promotion of use and global standardization, as well as the collection of applicable market and technical data. Also, it collaborates globally with public and private bodies of interest to its members in regard to technical, ecological, economic and social developments within the tape industry.

At the three-part seminar, papers were given by technical experts from notable industry businesses and organizations, together with a panel discussion forum following each session. Topics focused on cutting edge technical developments in taping methods and applications, as well as improvements in characteristics and quality for broad and optimal use. Also covered were updates on tape-producing machinery and a specific lecture on sustainable development related to the production and use of tapes. This was given by Dr Hermann Onusseit of Henkel KGaA, Düsseldorf, Germany.

Onusseit gave an interesting historical account in which he said that since the beginning of the industrial revolution, and especially since the end of the 19th century, one could see a great increase in the consumption of natural resources such as wood, water, coal, metals, oil and so forth. For example, the worldwide consumption of natural resources from 1963 to 1995 increased from four to ten billion tons. Also, during the last 100 years a sharp increase in population growth from less than one billion to more than six billion people has been recorded, and analysts expect that if the consumption of natural resources equates to the population growth, it will quintuple by 2050. On a long-term basis, this will lead to severe problems because it results in more than the planet can supply.

Onusseit was keen to emphasize his views on sustainable development and methods to halt the impending depletion of natural resources; these are the economical handling of resources, repeated use of sophisticated goods, and consequent recycling at the highest technical level. In regard to the production of pressure sensitive adhesive (PSA) tapes, he said that this is characterized by a constantly increasing output of tape production plants. The use of solvent-based PSAs by tape manufacturers however requires incineration or solvent recovery. Under environmental pressure, solventborne tapes and the use of PVC base material will continue their slow decrease of -2 to -3% per year. Since PSA tapes are precoated base materials, during their application not much energy is needed for the rolling off of the tapes. Also, to overcome the problem of the siliconized paper waste of double-sided tapes, special recycling systems like the FINAT label systems are possible. As the amount of adhesive tapes as well as other adhesives is very small compared to the products bonded, a recycling of the adhesive tapes alone is not worth the effort, Onusseit said. Adhesive tapes should however be designed in such a way that the goods they adhere to can be reused or recycled.

At the meeting, Peter Gabriele of Adhesives Research, Inc., Glen Rock (PA), USA, presented his paper on Infrared Imaging: A Complementary Tool to Atomic Force Microscopy (AFM) for Adhesive Surface Analysis. This was the winner of the 2001 Carl A.Dahlquist Award, which is given annually by the Pressure Sensitive Tape Council (PSTC) to the most technically outstanding paper; co-author of the paper was Herb Hand. The presentation provided an in-depth illustration of the way in which AFM is a useful tool for probing pressure sensitive adhesive surfaces at the micron and sub-micron level. Gabriele said investigators were hoping that the spatial resolution of microstructure will provide clues to function. AFM however cannot distinguish functional group chemistry associated with topology, whereas FT-IR imaging microscopy is an emerging technology that has the power to resolve spatially chemical composition at the functional group level.

It was put forward that no single technique exists that can determine the chemical nature and degree of orientation within a surface system while simultaneously being able to specify the morphology. The authors' interest through their study was to complement AFM with FT-IR imaging to examine structural features, chemistry and topology. They reported that FT-IR imaging can be a useful adjunct to AFM in adhesive surface analysis.

The video tack test as a novel tool to investigate the adhesive properties of pressure sensitive adhesives was the subject of a paper by Costantino Creton given on behalf of co-workers from the Ecole Supérieure de Physique et Chimie Industrielles de la Ville de Paris, France. Creton said that although pressure sensitive adhesives have been the focus of much interest from the industry because of their special properties, such as low toxicity and ease of handling, relatively few

academics have published fundamental studies on this subject.

He outlined the development of an instrumental probe device, which gains insight into the microscopic mechanisms of the debonding of a PSA film from a hard surface. Although the apparatus resembles a probe tack device, it has several distinguishing features. Included here are that the displacement resolution is much better and can be as low as 100 nm, the dynamic range of probe velocities can be varied from 0.1 µm/s to 1 cm/s, and in particular very slow velocities permit the observation of the sequence of mechanisms in much greater detail. Also, the apparatus is fitted with a video camera and a microscope, which can film the debonding of the adhesive from underneath a transparent substrate, and the typical contact pressure is of the order of 1 MPa and is therefore much higher than conventional tack measurements.

Creton put forward that the objective of the invention is not really to characterize short time-low pressure tack of the adhesive, but to determine the adhesive properties with a much better defined experimental geometry than in a peel test. The parallel plates geometry between the substrate and the probe ensures that only the adhesive deforms. A further factor is that when a 1 cm diameter cylindrical probe is removed at constant velocity from an adhesive film 100 µm thick, the debonding process can usually be separated into four stages.

These are in sequence homogeneous deformation, the onset of cavitation in the adhesive layer characterized by the maximum measured stress, the lateral growth of cavities which is particularly important on low adhesion surfaces, and the elongation and fracture or debonding of the fibrils characterized by the stress at the plateau and the maximum elongation. Here, the onset of cavitation provides information on the small strain elastic modulus in the high-frequency regime and on the nature of surface or bulk defects, for example surface roughness or pre-existing bubbles in the adhesive layer.

The rate of lateral growth of cavities after they have been nucleated, Creton said, is very sensitive to the interfacial interactions and in particular to the energy dissipated during the propagation of a crack front. A weak boundary layer at the interface or tests performed on low energy surfaces will mostly show on this parameter causing a fast lateral propagation of cavities and no fibrillation to take place. The last stage of the debonding, corresponding to the plateau in the stress-strain curves, is sensitive to the elongational properties of the adhesives.

These large strain properties, which involve substantial chain stretching, can be very different from the small strain elastic properties measured by shear rheology. Also, this maximum elongation of the fibrils is sensitive in particular to the diblock/triblock ratio in SBC-based PSAs, to the gel content in acrylics or to the amount of acrylic acid. The authors concluded that they had shown the probe test to be a very sophisticated and discriminating test for PSAs, since it is well adapted both for fast screening of new formulations and for fine tuning the development of new products.

Dr Noël De Keyzer of Kraton Polymers Research S.A., Louvain-la-Neuve, Belgium, discussed new hydrogenated styrenic block copolymers (SBCs) for pressure sensitive adhesives; co-author

was Xavier Muyldermans. De Keyzer said that Kraton Polymers introduced styrene block copolymer technology in the 1960s and has been a leader in innovative developments of SBCs since that time. These polymers are thermoplastic and elastomeric materials, which typically have a triblock structure; that is polystyrene blocks on both ends of a rubber midblock.

To improve the thermo-oxidative and UV stability of these polymers, the rubber midblock is hydrogenated to create hydrogenated styrene block copolymers, which are well known as Kraton G. When the rubber midblock is polybutadiene, the new molecule obtained after hydrogenation becomes a styrene ethylene butylene styrene (SEBS) block copolymer, which has excellent weatherability, thermal stability, high tensile strength and also the characteristics of a non-polar midblock. According to the company, the midblock low solubility parameter permits the use of more stable hydrogenated formulating ingredients, providing systems of overall high stability, transparency and clarity.

Kraton Polymers has now introduced Kraton GMD-6924. This has a medium molecular weight, a polystyrene content of 21% and a powder morphology. It provides a low hot melt viscosity when formulated, which is an attractive feature for tape and label manufacturers. PSAs based on the product are said to combine a good balance of tack, adhesion, an elevated service temperature of 120°C and above, as well as a low hot melt viscosity. A further factor is that very high cohesion can be obtained when partially hydrogenated aromatic hydrocarbon resins are added to the formulation.

Kraton also says that SEBS-based PSAs have very high thermostability due to the absence of double bonds in the polymer and the hydrogenated hydrocarbon resins. As a result, the hot melt stability is very good at elevated temperatures as high as 190°C without showing degradation. This, the company says, presents opportunities to use these PSAs in tape and label applications where short- or long-term elevated service temperatures are required. Furthermore, when UV absorbers are added to the formulations, weather-resistant pressure sensitive adhesive compositions can be manufactured. AFERA plans to hold its Technical Seminar biennially with effect from this year, and its president Peter Rambusch is keen to encourage participation from the tape industry's Central and Eastern European professionals.