**Silicone Elastomers Europe**
**27-28 March 2012**
**Mövenpick Hotel, Berlin, Germany**


**Day One: Tuesday 27 March 2012**

08.30 COFFEE AND REGISTRATION

09.20 Welcome and Introduction to Silicone Elastomers Europe 2012

09.30 **Winning against functional competition – the success story of silicones**

Looking at the global elastomers market, Silicone Elastomers continue to be a niche with less than 1% of the global demand in rubber. However Silicones continue to grow faster than many industries and economies. This is also caused by megatrends including aging population for healthcare applications or environmental awareness in automotive and energy or consumer perception and legislation for example in consumer good applications.

While silicones have an almost universal set of physical properties for rubber applications, they are often not selected, based on material cost considerations - instead of judging by system costs. Successful silicone elastomer applications happen, when engineers understand the Silicone product features and creatively build on their connected benefits for new designs.

The paper will help to position Silicone Elastomers vs. functionally competing materials. Those don't only include rubber materials like FKM, ACM, EPDM or natural rubber but also metal in a spring or thermoplastics and glass in optical applications. Examples will benchmark specific properties of Silicone Elastomers leading to their successful application and start the thinking process for the next win against functional competition by knowing the options of Silicone Elastomers and optimizing their value in use by focused design considerations.

*Oliver Franssen & Heiko Bayerl, Momentive Performance Materials GmbH, Germany*

**Session 1: Application of Silicones**

10.15 **Application of highly transparent liquid silicone rubber in automotive headlamps**

Dynamic light distributions, adjusting adaptively and automatically to different driving and lighting conditions, are already state of the art. One way to implement variable light distributions in one system is a projection module with a shaped cylinder. This cylinder, rotating around its longitudinal axis, has different outlines on its lateral surface. The cylinder is located in the pathway of rays between the module's reflector and its lens. Thus, it uses a subtractive way to implement different light distributions. In contrast, future cars will feature adaptive and active light functions realized by activating additional light sources in LED matrix headlamps.

To implement variable light functions such as glare-free high beam, marking light or bending light, in LED matrix headlamps the luminous flux emitted is being split up into discrete solid angles. This way, the illumination of the motor vehicle's foreground is not forced into fixed patterns but can be adjusted freely to fit the demands of the particular driving situation. So-called primary optics, put directly in front of the luminous surfaces, are being used to prevent the Lambert characteristic of the light emitting diodes in a close matrix structure.

This paper should proof, LED matrix systems do not only enhance the possibilities with regards to light distribution and appearance of headlamps. They also demand the application of "new" materials and concepts. Among those, liquid silicone rubber (LSR) stands out for being resistant against high temperatures, violet and ultraviolet radiation while at the same time providing excellent transmission characteristics. When used as light guidance elements LSRs can be directly exposed to white LEDs. Compared to glass, transparent LSRs offer further technical advantages, especially for industrial mass production.

On top of the afore mentioned advantages of LSRs over glass and thermoplastic polymers, the flexibility of the elastomer can be used to mechanically control optical characteristics of secondary optics in a headlamp. Light distributions could be controlled by flexible lens systems. The lens in the human eye serves as a natural model here, changing its focal length by contracting a circular muscle. An actuator system similar to the human eye could therefore contribute to the realization of an accommodating headlamp.

*Marc Kaup, L-LAB, Germany*

10.45 COFFEE AND NETWORKING

11.15 **Fluorosilicone elastomers – innovations for automotive industry challenges**

This presentation aims to demonstrate the various ways Fluorosilicone Elastomers can offer innovations to the Automotive Industry and provide answers for new challenges.

After an introduction of Fluorosilicone chemistry and definitions, we will present benefits of this material class and show typical applications in the automotive industry that can make the most out of

this technology, in the current environments and in the future. To design emission reduction technologies, we need new materials, such as the new *Silastic* 100% F-LSR : a range of products combining Fluorosilicone rubber properties (broad temperature range + fluid resistance) and Liquid Injection moulding technologies (LSR productivity). Developments for Turbo charger Hoses and Exhaust gas Recirculation will demonstrate the progress made in terms of fluid and temperature resistance in combination with optimized processing behavior. Sustainable Innovation is not only a matter of offering new products or improved material performances, it should combine material improvements and intimate market understanding to offer solutions responding exactly to new application challenges.

*Dr Hans Peter Wolf, Dr P Beyer, F Magnan, & B Cuocci, Dow Corning GmbH, Germany*

11.45 **LSR — closing the gap in the medical grade offering**

In the current economical and regulatory environment, raw material suppliers should make sure that they bring solutions to limit the total costs of use and the increased safety concerns expressed by the healthcare industry operators.

We will demonstrate how liquid silicone rubbers, that have proved their processing efficiencies over the years, can also offer application flexibility in healthcare applications.

Tapping into its historical expertise on LSRs, Dow Corning developed *Dow Corning* QP1 LSR, a new range of material, designed to respond to the need of modern medical devices applications. The tests results presented will highlight *Dow Corning* QP1 LSR good compression set and tear resistance, technical features and benefits for medical device application, including short-term insert and implantation.

The supply chain is organized to offer quicker access to the products: Manufactured in 2 qualified production sites, one in Wiesbaden (D) and one in Midland (US), *Dow Corning* QP1 LSR can help customers shorten the lead time in their business developments.

*Simone Marquardt, Dow Corning GmbH, Germany*

12.15 Q & A SESSION

12.30 LUNCH AND NETWORKING

13.45 **Advantages of silicones and future challenges in the world of T&D**

The paper deals with silicones and their application in the transmission and the distribution of electrical energy. Silicone fluids, silicone insulator coatings, silicone rubber and silicone gels for insulating purposes are introduced. Advantageous properties of silicones are discussed in general. A retrospective analysis of properties and applications of silicones is done and it is discussed that there was basically one crucial material property per application that made the main difference between silicones and other insulating materials.

The analyses allows a synthesis and thus a number of promising developments that either adapt existing solutions to a new class of applications, lead to a replacement of currently used materials, to a miniaturization or to a higher thermal utilization of products are introduced.

*Jens Lambrecht & Michael Bünnig, Wacker Chemie AG, Germany*

14.15 **Silicones for technical textile applications**

The application of silicones as a textile coating material brings unique properties to conventional textiles. Due to the high temperature resistance, the inherent hydrophobicity and the high elasticity of the silicone coating, such textiles are used eg. as airbag fabric, protective clothing and outdoor textiles. In most cases, the silicone can easily be applied to the textile using standard coating machines. Additionally the properties of the silicone coating can be easily adjusted on a wide scope.

*Johann Müller & Dr Martin Bortenschlager, Wacker Chemie AG, Germany*

14.45 **Silicones for fabric strain and soft pressure sensors**

Fabric strain sensors or gauges with larger deformation range and higher sensitivity, and soft pressure sensors with adjustable pressure sensing ranges are playing more and more important roles in both industrial fields and daily life, especially for the development of smart textiles.

Silicone elastomers, after incorporated with conductive fillers, are coated onto various fabric substrates to form fabric sensors for measuring strain or pressure. Major features of the fabric strain sensors include larger deformation range (up to 60%), higher gauge factor (as high as 200), higher fatigue performance (> 1 million cycles), and excellent repeatability and stability of the performance. The dimensions of the sensors can be tailored according to users' requirements.

The pressure sensors, with measuring ranges to 1000 MPa, can be used for pressure measurement of many fields, such the pressure between human body and garments, shoes, mattress, cushions, pillows and so on. The pressure ranges, sensitivities, and sizes of the sensors can be controlled and for various applications.

Based on the proprietary fabric sensors technologies, AdvanPro Ltd developed respiration monitoring belt (RMB) and smart footwear system (SFS). RMB monitors subjects' respiration by detecting the changes in chest circumference during breathing, and can be deployed to sportswear, health care products and vital signal monitoring devices for professionals including firemen, policemen, coal miners, and the like. SFY measures the plantar pressure distribution, temperature, humidity, and acceleration and moving speed of the subjects, and can be used for sportswear, protective wear, healthcare and interactive games.

*Dr Yangyong Wang & Dr Guangfeng Wang, AdvanPro Limited, Hong Kong*

15.15 COFFEE AND NETWORKING

**Session 2: Processing of Silicones**

15.45 **Continuous compounding shown on the example of silicone sealants**

Continuous processing, proven state-of-the-art technology in the field of polymer-compounding, has been increasingly important in the silicone industry over the last tree decades.

In the continuous process, solids, high and low viscous components are mixed, homogenized and cooled within a short period and produced to a "ready to use" sealant. The process with the twin screw extruder offers numerous advantages over traditional methods such as:

- High reproducibility
- Short residence time
- Intensive mixing
- High throughput rates
- Self cleaning

The closely intermeshing screws with their deeper cut, self-wiping profile minimize the clearances along the whole length of the process section. The effect: consistently higher degree of process reliability and optimal self-cleaning.

*Johannes Donner, Coperion GmbH, Germany*

16.15 **Procedural implementation of superhydrophobic LSR surfaces**

This paper presents a method which allows the manufacture of super-hydrophobic liquid silicone rubber surfaces in a single stage injection moulding process. The lotus effect known from nature is imitated not by using additives or modifications of the polymer, but by using laser-structured micro-inserts in the mould. This method particularly combines shaping and functionalisation of the part and is thereby economically attractive. Besides the used machine and mould technology, the influence of process parameters on the contact angle for wetting with water as a measure of the hydrophobity are discussed. Rubbers are especially suitable for this particular application due to their durability and scratch resistance of the surface functionalisation.

*Clemens Behmenburg & Christian Hopmann, Institute of Plastics Processing (IKV) at RWTH Aachen University, Germany*

16.45 Q & A SESSION

17.00 CLOSE OF DAY ONE

18.15 EVENING SOCIAL EVENT

**Day Two: Wednesday 28 March 2012**

08.15 COFFEE AND HOTEL CHECK-OUT

09.00 **Silicone mixing concepts**

The paper is divided into five parts:

In the first part of the paper we will make an excursus on the traditional machineries and systems of mixing (Intermixer/Banbury, Kneder or Z-Blades, Roll Mills).

In the second part of the paper we will present a new mixing method: the patented CTM ''conical twin mixer'' analysing its greatly innovative technology.

In the third part of the paper we will compare the traditional mixing system and the new mixing system stressing the benefits of the patented method in comparison with the traditional machineries.

In the fourth part of the paper we will introduce a range of new silicone extruders.

In the fifth and last part of the paper we will examine the performances of new ovens with hot air and with a mix solution of both salt and hot air.

*Dr Ubaldo Colombo, COLMEC SpA, Italy*

09.30 **Extrusion equipment**

*Christian Köhler, Rubicon, Germany*

10.00 **Tailor-made machines for LSR and HTV moulding**

The content of this paper includes the machine basics beginning with how such a machine should be specified, from the clamp unit in different technical designs to the main part for LSR and HCR moulding which is the injection unit. It will explain the different units which are available and which fits best to different applications. Part of the presentation is also the feeding system which is required for the different materials (LSR / HCR), explaining technical solutions for rotation feeding or stuffer devices. The control system and therefore the typical way how to run this type of production with special materials will be discussed as will the variety of LSR feeding pump systems from different suppliers.

One very important thing is the energy saving possibilities and how to do this. Finally, some samples out of production including a short movie of a fully automated, waste free, trim free and flash less production line will be included.

*Dr Leopold Praher, ELAST/LIM-Maschinen, Germany*

10.30 COFFEE AND NETWORKING

11.00 **Advanced production methods for medium and large-sized silicone articles**

Flexible production systems for medium and large-sized silicone articles by means of advanced cold runner technologies and modular mould equipment will be discussed. HTV and LSR processing in high pressure injection machines will be looked with a focus on advantages and possibilities. Detailed information about different cold runner systems and high flexible modular mould systems will be presented.

*Harald Schmid, Klöckner DESMA Elastomertechnik GmbH, Germany*

11.30 **Processing of LSRs for insulators with silicone vacuum treatment**

Using the example of hollow core insulators manufacturing, a new processing technology that has a focus on the vacuum pre-treatment of the silicone components will be presented. Possible advantages of this technology such as freedom of voids or low pressure injection molding will be shown and explained. Possibilities of cycle time reduction will be discussed. In a further step, consequences to mold filling and mold design will be presented.

*Michel Gehrig, Hübers Verfahrenstechnik Maschinenbau GmbH, Germany*

12.00 **The main factors to run a successful LIM production**

-quality issues

-what to take care of

-fully automatic

-wasteless

-no secondary subsequent finishing work

*Kurt Manigatter, Elmet Elastomere Produktions – und Dienstleistungs GmbH, Germany*

12.30 Q & A SESSION

12.45 LUNCH AND NETWORKING

**Session 3: Modification of Silicones**

14.00 **Protection and marking, a new additive for silicones and rubber**

Laser beam marking is used in automotive components, medical products, household articles, electronic components or packaging, as well as in a number of other applications. The advantage is contactless handling, resistant labelling, residue-free welding or reduced thermal and mechanical force on the components. The marking in the silicone is done in a depth of 1 mm, thus labelling cannot be wiped away. Another outstanding effect is the marking of the matrix without damage to the silicone surface.

The use of organic pigments which have a small effect in the visible range and do absorb NIR laser beams is often limited due to the high costs of these pigments. FABULESE agents are a cost-saving

alternative, as these components can also be used for laser beam marking of plastic material and additional additives for marking are not necessary. Due to the temperature stability, FABULASE agents in comparison to other organic pigments are easier to handle for die casting and extrusion.

FABULASE show an extremely good absorption in the NIR-range. This makes it possible to reduce the preheating period of silicones without c olouring to black. As possible application would be cross-linking processes.

FABULASE in combination with BUDIT protects the silicone from attack of germs and fungi. The impact of copper in BUDIT is essential. Due to the fact that copper is an essential micronutrient it can be used in several applications. BUDIT, for example, is FDA approved (Food Contact). Copper ions are also resistant to germs which tend to attack silicone. This effect has been in use for thousands of years, for example, when using copper dishes.

*Rüdiger Wissemborski, Chemische Fabrik Budenheim, Germany*

### 14.30 **Antimicrobial silicones as a toolbox against hospital acquired infections**

Silver ions are the most widely used antimicrobials today. They suppress naturally and continuously the growth of bacteria, mold spores, yeast and prevent the build-up of biofilms. Silver based antimicrobials have shown to initially reduce microbial pollutions within minutes and to maintain optimal performance for years.

Both silicone heat cured rubber (HCR) and liquid silicones (LSR) can be used as elastomeric substrate containing silver based antimicrobials. Silver provides a durable, non-leachable antimicrobial that does not result in the development of resistant bacterial strains. Additionally, silver based silicone rubbers provide flexibility over wide temperature ranges, excellent compression set, a wide hardness range without use of plasticisers , chemical inertness and biocompatibility.

Widespread silicone medical components and assemblies include balloon catheters, cardiovascular catheters, tubing for feeding, drainage, and use with peristaltic pumps, compression bars, multi-port urological catheters, infusion sleeves and test chambers, wire/fluid-path co-extrusion, ear plugs and hearing aids, shunts and septa, and a variety of seals, valves, stoppers and clips.

In medical devices and pharmaceutical applications, silicones are used because of their biocompatibility in variety of applications. The impact of the biomaterial on its host environment is assessed according to recognized standards such as ISO 10993, USP <87>, <88> (USP Class VI) and the European Pharmacopeia. A long history of use in medical devices has made silicone elastomers recognized widely as biocompatible materials in a multitude of applications. Also they do not contain nitrosamines, or plasticiser such as phthalates.

Increasing concerns in healthcare  about microbial growth in or on the human body has prompted many design engineers to seek high performance material solutions with built-in antimicrobial protection against the widespread hospital acquired infections (HAIs).

The intention of this paper is to position silver based antimicrobial silicones as functional polymers which are part of the ammunition that the healthcare industry can use as one of the first defense lines in the battle against hospital acquired infections and also introduces Momentive Performance Materials' antimicrobial StatSil™ range.

*Dr Burkhard Ledig, Momentive Performance Materials GmbH, Germany*

15.00 COFFEE AND NETWORKING

15.30 **Mineral flame retardants for silicone elastomers – an option with many features**

Mineral Flame Retardants, namely Aluminiumhydroxide (ATH), Magnesiumhydroxide (MDH), or the specialty Aluminiumoxide hydroxide (Boehmite) are widely known in polyolefinic or engineering plastics applications. Even in liquid resin applications viscosity optimized grades find a fundamental market.

However, in Silicone Elastomers the Flame Retardancy effect of the functional filler is pushed into the background since the silicone rubber itself exhibits intrinsically a high flame resistance which, of course, can be increased even further with mineral fillers. But in high voltage insulators, the mineral filler has to fulfill other requirements. The filler should improve the electrical resistance, the mechanical strength, the self-cleansing effect of outdoor insulators or even act as a sacrifice-anode to prevent conductive tree formation at high current density. Among these requirements, the end-of-life cycle becomes more important where mineral fillers such as ATH, MDH or Boehmite act environmental neutral in a recycling or disposal process.

Especially with surface coated ATH, such effects can be achieved. This presentation should give an idea about possibilities and application options of surface coated ATH grades. Therefore we will introduce a range of surface coated ATH grades which can be used in silicone rubber formulations for high voltage insulators.

*Dr Oliver Töpfer, Nabaltec AG, Germany*

16.00 **Effect of UV/ozone irradiation on the surface properties of thermoplastic silicone elastomer films and fibers**

Highly hydrophobic surfaces of silicone-urea copolymers were transformed into hydrophilic ones upon UV/Ozone treatment. The extent of surface modification was strongly dependent on the sample preparation method and the exposure time. The physical and chemical changes at the copolymer surfaces were analyzed by spectroscopic (XPS, ATR-FTIR), microscopic (SEM) techniques and static water contact angle measurements. ATR-FTIR spectra clearly showed the dramatic change in the strongly hydrogen bonded urea hard segments and the degradation of dimethylsiloxane units in silicone-urea copolymers. XPS results revealed the formation of $SiO_x$ on the surface, which gradually increased with exposure time. After 3 hours of UV/Ozone exposure, Si(2p) binding energy shifted from 101.9 to 102.85 eV, which is a clear indication of an increase in the oxidation state of silicon. The deterioration of microroughness of the electrospun webs upon UV/ozone exposure, which was revealed by SEM, resulted in a dramatic decrease in the static water contact angle values from 129 to 62°. These results

clearly show that UV/Ozone process is a very simple and facile method to transform hydrophobic silicone-urea copolymer surfaces into fairly hydrophilic ones.

*Emel Yilgor & Iskender Yilgor, Koc University, Turkey*

16.30 Q & A SESSION

16.45 CLOSE OF PROCEEDINGS