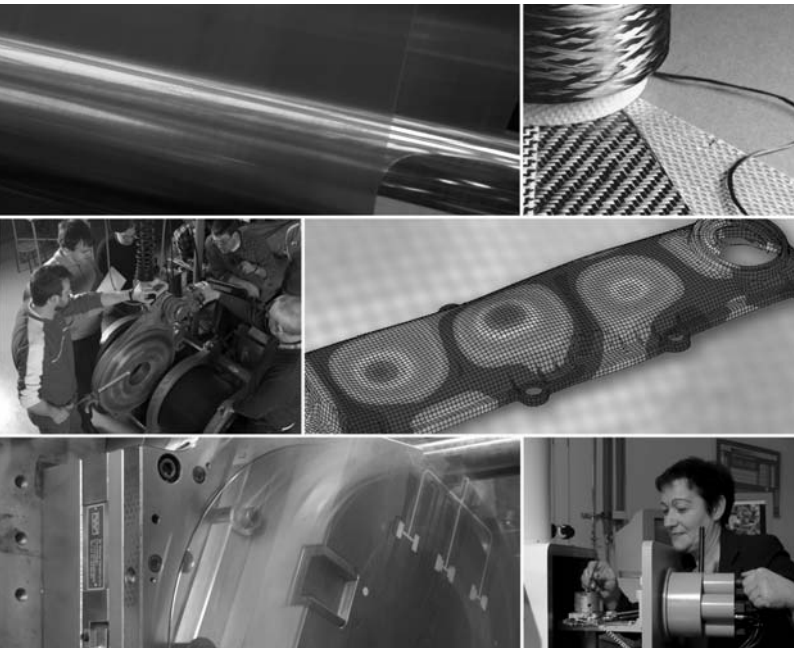
INSTITUT FÜR
KUNSTSTOFFVERARBEITUNG
AN DER RWTH AACHEN

# IKV at K 2010 –
## Information and Highlights



www.ikv-aachen.de

# Highlight at K 2010

## Hybrid Production – Bringing Power to Plastics

Combining different processes to create a single-step process makes it possible to combine different materials and thus different functionalities in one moulded part. Although electrically conductive plastic/metal-components can nowadays be produced by a wide variety of different processes, they all tend to have certain disadvantages, such as the many cost and time-intensive production steps, restrictions on part complexity, and the attainable dimensions of the conductor tracks. A method needs to be found to eliminate these disadvantages. This is where the "hybridization" of products and processes comes in.

IKV has developed a new and efficient process chain for the production of electrically conductive plastic/metal-parts. The innovative aspect of this project is the processing of the plastic and the metal in a hybrid, single-step

multi-component injection moulding process. The project is being developed as part of the Cluster of Excellence at RWTH Aachen University "Integrative production technology for high-wage countries".

Together with ten partners from industry, IKV will present a specially developed demonstrator. The research group has designed a pair of sports glasses specifically to demonstrate the advantages of the hybrid multi-component injection moulding process. The lenses are heated by a conductor track to prevent condensation. The IKV research team is able to make the flow of electricity indirectly visible via the heat discharge. In addition, the demonstrator shows that there is considerable design freedom of the geometry of the conductor track and that a reliable contact between the inserts and the metal component can be achieved.

**Contact:** Dipl.-Ing. Andreas Neuß
Telephone: +49 (0) 241 80-93827, E-mail: neuss@ikv.rwth-aachen.de

## Highlight at K 2010 - Partners of the project












**Contacts at IKV:**
Dipl.-Ing. Oliver Grönlund
Telephone: +49 (0) 241 80-93827, E-mail: groenlund@ikv.rwth-aachen.de

Dipl.-Ing. Andreas Neuß
Telephone: +49 (0) 241 80-93827, E-mail: neuss@ikv.rwth-aachen.de

Dipl.-Ing. Moritz Gründler
Telephone: +49 (0) 241 80-93981, E-mail: gruendler@ikv.rwth-aachen.de

Dipl.-Ing. Johannes Wunderle
Telephone: +49 (0) 241 80-93979, E-mail: wunderle@ikv.rwth-aachen.de

# Extrusion and Further Processing

**Contact:** Dipl.-Ing. Christoph Kremer
Telephone: +49 (0) 241 80-28372, E-mail: kremer@ikv.rwth-aachen.de

## Compounding, reactive extrusion and quality control

PA6 clay masterbatches are produced by in-situ polymerisation in a twin-screw extruder. The process can be scaled up to an economically interesting industrial scale. The filler distribution is analysed by x-ray computed tomography and computer-aided quantitative characterisation.

Furthermore, the quality control of textured surfaces by inline inspection is presented.

## Film and sheet extrusion

In film and sheet extrusion, the focus is on increasing efficiency.

For film extrusion with degassing, a closed loop control for the vacuum pumps has been developed to achieve constant product quality.

To optimise material and colour changeovers in film extrusion, different strategies have been investigated with the aim of reducing duration and material consumption.

In foam extrusion, new physical blowing agents have been tested to improve the foaming behaviour and the resulting foam structure.

## Rubber technology

In the field of rubber technology, IKV is studying the compounding of TPE-V in an internal mixer.

Furthermore, a new measuring device for the analysis of the expansion behaviour of rubber samples with chemical blowing agents is being developed.

In the area of injection moulding of rubber, research is concentrating on a new process of physical foaming.

## Blow moulding and thermoforming

The IKV focuses on process and structural simulation of the stretch-blow moulding process. Not only the reheating step and the inflation process but also the resulting material properties can be calculated.

A newly developed measurement system allows the determination of parison wall thickness during the blow moulding process. The contactless method combines capacitive and laser-optical measurement.

The IKV analyses the influence of additives and processing parameters on the quality of thermoformed parts. Several influencing factors are examined.

## Injection Moulding / PU Technology

**Contact:** Dipl.-Ing. Andreas Neuß
Telephone: +49 (0) 241 80-93827, E-mail: neuss@ikv.rwth-aachen.de

### Special injection moulding processes

The possibilities of injection moulding can be extended by special injection moulding processes. The Projectile Injection Technique (PIT) allows the production of hollow parts with a large diameter and very consistent residual wall thicknesses.

The ProFoam process, a recent IKV development, allows the easy and reliable moulding of foamed injection moulded parts. The efficient production of high-quality parts with a cool-touch surface is made possible by the back moulding of sheet metal with integrated forming.

### Injection mould technology

Injection mould technology is an integral research topic at IKV. In the field of mould cooling, a systematic selection procedure is being developed that helps find the right mould cooling technique for every application. Innovative process and mould technology increases the functionality of injection moulded plastics parts.

A new type of injection moulding allows the production of super-hydrophobic plastics surfaces in one single processing step.

The optical performance of plastics lenses is further enhanced by an adjustment unit that centres the two mould halves to each other with an accuracy of less than 5 µm.

### Polyurethane technology

In the field of polyurethanes, IKV looks at the development and optimisation of processing technologies as well as the structure and failure analysis of parts.

Current areas of research include the development of a permanent release coating for PU moulds and the physical foaming of PU using $CO_2$.

## Composites

**Contact:** Dipl.-Ing. Kai Fischer
Telephone: +49 (0) 241 80-23884, E-mail: fischer@ikv.rwth-aachen.de

### Large series manufacture of structural composites

IKV is investigating new process chains for the automated large series production of continuous fibre reinforced composites with a fibre volume

content higher than 50 percent in a cycle time below ten minutes. For this purpose, the two process steps "impregnation" and "forming and curing" are separated and parallelised. Two innovative impregnation processes, Resin Transfer Prepregging and Resin Spray Prepregging, are used for the impregnation of net-shape preforms. The forming and curing of the impregnated preforms is done by a new type of compression moulding.

### High performance in high-volume production

Because of the need for lightweight high-performance CFRP parts and the concurrent lack of production technologies capable of high-volume production, these technologies are the subject of intensive research.

The AVK innovation jury presented an award to the gap impregnation technology (developed at the IKV) in 2009, which could be a future key technology for the production of such parts. Actually cycle times below five minutes are achieved for plastic parts with continuous fibre reinforcements at a fibre volume ratio of 50 percent. Therefore, the parts offer high mechanical properties suitable for structural automotive applications.

### Thermoplastic Composites

In the field of long and continuous fibre reinforced thermoplastics, IKV is developing new techniques for the processing of in-situ polymerising

thermoplastics. Especially the processing of CBT®, a cyclic butylene terephthalate oligomer, by the RTM process and the resin infusion process are being analysed in detail.

IKV is also investigating the manufacture of complex shaped preforms from hybrid yarns in the 3D fibre-spraying process. The hybrid yarns already contain the reinforcement as well as the matrix as filaments and can therefore be directly thermoformed to produce a consolidated part. The chopped fibres can be orientated along the expected direction of force and therefore provide high potential for lightweight applications.

At the IKV the diaphragm forming process is being further developed in order to allow the processing of thermoplastic prepregs with high-performance polymer matrices. The upper limit of the processing temperature has already been increased from 250 °C to at least 320 °C and therefore now allows the processing of fibre reinforced PPS.

## Part Design / Materials Technology

**Contact:** Dr.-Ing. Tim Arping
Telephone: +49 (0) 241 80-28359, E-mail: arping@ikv.rwth-aachen.de

### ■ CAE – virtual part design

At IKV, many different simulation methods for thermoplastics and elastomers are being developed and validated.

The temperature-dependent long-term behaviour of thermoplastics can be completely mapped for the first time with a closed model. For the simulation of short fibre-reinforced thermoplastics, the method of integrative simulation has been used at IKV for several years and has been constantly subjected to further development.

In another project, a calculation concept is to be implemented for predicting the stresses exerted on injection-moulded parts during demoulding. Strain rate-dependent material models are used.
In another project at IKV, hyper-elastic material models for elastomer materials are being developed to enable improved reproduction of multiaxial stress states.

### Joining of plastics

In plastics processing, joining processes are often used to create a functioning system from individual components.

IKV has been working for many years in the field of joining technology and has consequently built up a considerable amount of expertise. A typical research project at IKV is focused on the laser transmission welding of large-sized parts.

A current research project at IKV is examining the use of intermediate layers in laser transmission welding, which should make it possible to weld together different materials. In another project planned for the future, the possibility of IR preheating is to be investigated to avoid fuzz generation in ultrasonic welding.

### Plasma technology

The plasma/surface technology working groups at IKV are looking primarily into the development of processes for the functionalisation of plastic parts.

In the past, many different processes have been designed and researched at IKV on the coating of bottles. The main target here is to improve the barrier properties of hollow articles of PET or alternative materials, (e.g. PP, PLA) by means of plasma-polymer barrier layers.

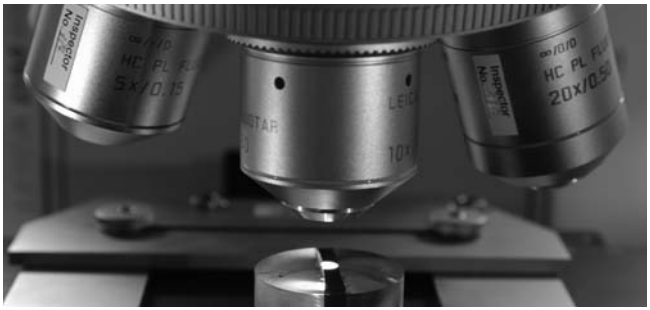
Furthermore, methods have been developed for the online quality assurance of plasma processes through the use of plasma-diagnostic tools.

## Centre for Analysis and Testing of Plastics

**Contact:** Dr. rer. nat. Rainer Dahlmann
Telephone: +49 (0) 241 80-25928, E-mail: dahlmann@ikv.rwth-aachen.de

### Main areas of activity and expertise

The activities carried out by the Centre for Analysis and Testing of Plastics (KAP) extend from the characterisation and testing of materials, through fault and damage analysis to the development of quality assurance concepts for plastics products. This naturally also includes direct cooperation with industrial partners.



### Damage analysis of plastics products

A systematic procedure for fault and damage analysis – especially in complex cases – allows rapid localisation of the possible causes. According to the damage characteristics, attention is focused on parts of the product lifecycle that could be responsible. In this way, specific measures can be taken to eliminate the problem.

### Analysis and testing methods

The wide range of testing and analysis facilities at the KAP provide for considerable flexibility. Equipment is available for microscopic, thermal, rheological, physical and spectroscopic analysis as well as mechanical testing.

## Training and Further Education

**Contact:** Dipl.-Ing. Leo Wolters
Telephone: +49 (0) 241 80-93830, E-mail: wolters@ikv.rwth-aachen.de

The Institute's Training and Further Education department has been coordinating the plastics processing activities in the skilled crafts for the last 60 years.

In cooperation with the plastics industry and Germany's federal and state economic ministries, the department offers a wide variety of further training options in the skills of plastics machining and processing in Germany.

Because plastics have such a wide range of attractive properties, they are being increasingly used as substitutes for traditional materials. This means that people involved in the skilled crafts must be constantly trained in working with this still relatively new material.

At K 2010, the IKV Training and Further Education department will present a "living workshop" together with the project "PLENET NRW" on the joint stand of the Ministry for Economic Affairs, Energy, Building, Housing and Transport of the state of North-Rhine-Westphalia in hall 6/stand D76.

# IKV

IKV – the Institute of Plastics Processing at RWTH Aachen University – is one of the largest institutes engaged in this field of research. The Institute has more than 300 staff working on the challenges encountered during the processing of the many different types of plastics that are now available.

## Studies

IKV's excellent contacts with industry, together with its outstanding facilities, ensure that students benefit from a comprehensive, practically oriented course of study. Plastics engineering graduates from IKV are thus sought-after experts in industry. Around 50 percent of German plastics engineers with a university degree have received their education at IKV.

## Organisation

In organisational terms, IKV is divided up into the four specialist departments of Injection Moulding and PU Technology, Extrusion and Further Processing, Part Design and Materials Technology, and Composites. The Institute also takes in the Centre for Analysis and Testing of Plastics, and the Training and Further Educationdepartment.

## Association of Sponsors

It is run by an Association of Sponsors, which currently has a membership of about 250 plastics companies from all over the world. The members of the Association of Sponsors make use of their cooperation with the Institute to ensure that they benefit from new developments at a particularly early stage.

## Head of the Institute

Professor Dr.-Ing. Dr.-Ing. E.h. Walter Michaeli is Head of the Institute and Managing Director of the Association of Sponsors. He also holds the Chair of Plastics Processing at the Faculty of Mechanical Engineering at RWTH Aachen University.

**Contact IKV:**
Institut für Kunststoffverarbeitung (IKV)
an der RWTH Aachen
52056 Aachen, Germany
Telephone: +49 (0) 241 80-93806
Telefax: +49 (0) 241 80-92262
E-mail: zentrale@ikv.rwth-aachen.de

**Office address**
Pontstr. 55
52062 Aachen, Germany

**Campus Melaten**
Seffenter Weg 201
52074 Aachen, Germany

**www.ikv-aachen.de**