

# Do You Understand Simulation?

## *The Developer of Faser Solver, Prof. Tucker, Describes the Phenomenon of Injection Molding Simulation at the Moldflow User Meeting "Connect!"*

The fifth European Moldflow User Meeting "Connect!" on June 3 and 4 in Frankfurt, Germany, not only discussed the basics but also gave users some pointers for the future. Everything hangs on the question of how the precision of the simulation results can be further improved – without overloading the computation. The variety of approaches and optimization processes is conspicuous.

"That's it!": Prof. Charles Tucker gives a talk about the eternal contradiction between computing time and precision, and welcomes the contributions to the discussion from the plenum

(figures: Rottig)



It had already been announced at the fourth Moldflow User Meeting "Connect!" in June, 2013 that the founder of the fiber orientation model, Prof. Charles Tucker, University of Illinois, would say a few words at the small anniversary in June 2014. A total of 174 guests (including exhibitors) from 18 nations accepted the invitation from MF Software GmbH, Darmstadt, Germany, and traveled to Frankfurt to learn about the basics of injection molding simulation and, perhaps even more importantly, gain an overview of the latest developments in the field of

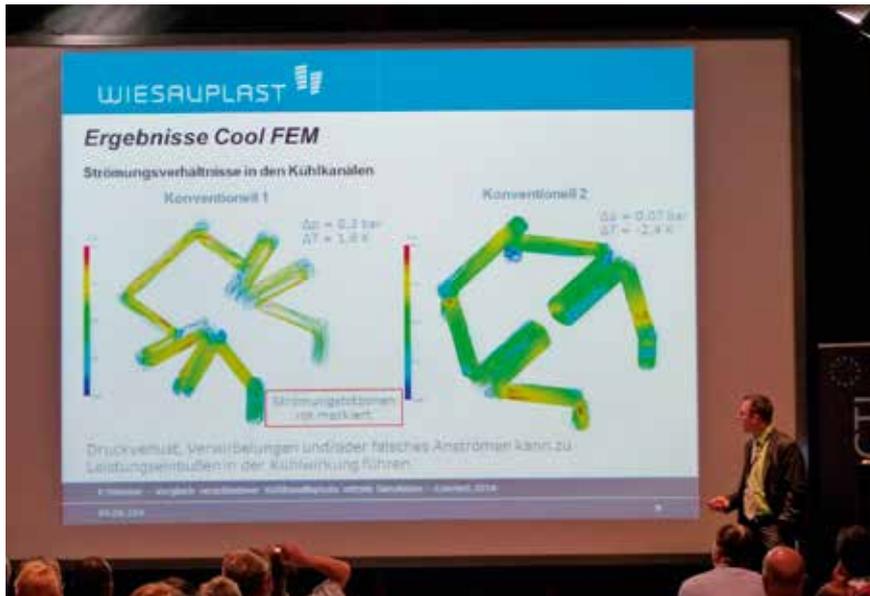
making predictable forecasts, as well as about the effectiveness of the Solver for a wide range of different applications. A total of 22 theoretical and practical lecture topics (see the link in the info box) provided plenty of material for discussion and exchange of ideas over two days.

### *The Art of "Calculated Inaccuracy"*

The eagerly awaited talks by Prof. Tucker, who had traveled specially from the USA, brought light into the darkness of theoretical mathematics with the analysis of

the behavior of fibers – rods, in a geometrical sense – in the melt stream. It was not a matter of understanding complex formulas. Rather, the university lecturer from the home of Moldflow formulated it with brilliant simplicity, making it clear that there are narrow limits on the theory. Today, one limit is the computation time, which, in view of the desire for greater precision, increases exponentially and can rapidly lead to response times that are no longer acceptable

"There is a lot that can be modeled more accurately," Tucker continues, but



Practical Examples: Philip Hammer of Wiesauplast shows how cooling designs can be optimized by simulation



More fluid than fluid: Prof. Jozef Gabor Kovacz from Budapest demonstrates racetrack effects due to irreversible molecular chain shortenings in the outer layer of the hot-runner manifold

the required computation times would mean neglecting the residual accuracies. But where? The art of the mathematician here is in his ability to make clever simplifications, of "calculated inaccuracy" at the right place in order to process most applications "as fast as possible, but taking as long as necessary."

The different experiences placed on this effort were made clear in several talks

from industry and research, which compared the computational results according to the Folgar-Tucker model with those of the more recent RSC (reduced strain closure) model, to which the guest speaker from Illinois has also made a significant contribution. There was general agreement that the RSC model provides better predictions of fiber orientation, particularly near to the gate, which is important for calculating part failure, though less so for simulating warpage – the old model was good enough for that.

"Communicating the different experiences with Moldflow to as many users as possible is one of the most important functions of Connect!," stressed the organizer Thomas Wittmann. He greatly appreciated the fact that many representatives from industry were so willing to make their experience available. But researchers and academics also provided important results and ideas.

### *Is Moldflow Opening Up for New Material Laws?*

As an example, the Moldflow expert Wittmann quoted the talk by Prof. Jozef Gabor Kovacz from the University of Budapest. The Hungarian university lecturer's research group has been working intensively on material degradation in manifold systems. It was known that the plastic melt heats up at the runner wall due to friction and shear, leading to a temporary

viscosity change and therefore to racetrack effects (Melt Flipper), which the Moldflow simulation also takes into account. Kovacz has now found that the molecular chains are permanently shortened by the shearing (irreversible degradation) and as a result stronger racetrack effects take place in the manifold system than are simulated by Moldflow. And the greater the number of cavities in the system, the greater the differences may be.

The determined distribution of the viscosity change was surprising. Only roughly 30% was due to reversible effect caused by temperature change, 70% on the other hand was the result of permanent shortening of the molecular chains. Kovacz was not satisfied with that, but demonstrated that this shear-dependent phenomenon could also be simulated by modifying the viscosity model according to his stipulations. Dr. Franco Costa, Moldflow development manager and an attentive listener to all the talks, picked up Kovacz's idea and, in his closing address – with reservations for reasons of corporate law – stated that he is ready to open up Moldflow in individual cases so that development partners can store or program their own material laws.

### *Research and Routine*

This reaction to findings by users and researchers is typical of Autodesk in the »

## The Author

**Heinz-Jürgen Rottig** is a freelance journalist with an office in Dinslaken, Germany; rottig@p4bnet.net

## Topics from the Community

Further information on talks and speakers can be found at

- » [www.connect.moldflow.eu/topics2014.html](http://www.connect.moldflow.eu/topics2014.html)

## Service

### Digital Version

- » A PDF file of the article can be found at [www.kunststoffe-international.com/881790](http://www.kunststoffe-international.com/881790)

### German Version

- » Read the German version of the article in our magazine *Kunststoffe* or at [www.kunststoffe.de](http://www.kunststoffe.de)



First ask the customer: Caroline Dorin, principal user experience designer, discusses beta versions of innovations and extensions with experienced users of Moldflow

opinion of Sven Theissen, CEO of MF Software. The reason there were so many decision makers from the Moldflow parent company present was that Connect! has now become an international forum for exchange at various levels, from the theoretically feasible, through the wide range of practical applications to efficient use and operation of Moldflow. It is left to the participant to decide how best to make use of this offering.

As an example, Theissen quotes the topic of cooling, which Prof. Kovacz had picked up from the point of view of the researcher and developer in his talk on novel inserts produced rapidly and inexpensively by rapid tooling methods and used for prototypes and small series. The injection molding process and cooling are optimized with the aid of simulation in order to prolong the service life of these inserts.

That is the proven theory. Practical experience about cooling was contributed by Philipp Hammer from Wiesau-

plast Deutschland GmbH & Co. KG, Wiesau, Germany, with his talk "comparison of different conformal cooling concepts by simulation." The academic plastic expert offered practically oriented guidelines in design and simulation to a wide audience. What is the benefit of cooling pins? 3-D simulation? Where do the dangers lie? How can I change or modify the design rapidly and effectively? And anyone wanted to know how far 3-D printing had already made inroads into mold construction and the field of mold inserts could gain an overview from the exhibitor Stratasys – and receive professional advice – during the breaks.

### *Keeping in Contact with Questions*

In a similar way, the organizer also presented the topics of fiber behavior and orientation, organic sheet, networking with various solvers, and much more in Frankfurt. But what would a user meet-

ing be without training sessions? "Customer support is very important to us," stresses the event manager Claudia Jehn, and this year, besides training and experience sessions – in this regard, Maik König with his tips and tricks captured the full attention of the participants – there was a new offering from Autodesk employee Caroline Dorin, principal user experience designer.

In small groups, Dorin offered information on new programs and extensions, such as Sundance or the Nastran Solver, but not without carefully observing where the customers' wishes lie and whether they can be harmonized with the ideas of the Moldflow developers. It is not surprising that she was fully booked out, and concluded with a long wish list. When asked whether she more hoped or more feared that a new record for the visitor numbers would be set in the coming year, Claudia Jehn responded with a charming smile: "Every guest is welcome." ■