Winter, 2007

Volume 5, No. 1

DEFORM™ News

Events:

- May 1 & 2: The Spring DEFORM Users Group Meeting in North America is being planned at this time. Details should be available this month. Please mark your calendar.

Training:

- January 23 & 24, 2007: DEFORM-2D training (includes DEFORM-F2) will be conducted at SFTC in Columbus, Ohio.
- January 25 & 26, 2007: DEFORM-3D training (includes DEFORM-F3) will be conducted at the SFTC office.
- August 22 & 23, 2007: The annual Die Stress Analyis Workshop will be conducted at Marquette University in Milwaukee, Wisconsin.

DEFORM™

Design Environment for FORMing

Die Wear Modeling

FormTech Industries, formerly part of Metaldyne, is a Tier One supplier of automotive parts. FormTech forges a precision spindle, which experienced excessive punch wear.

One of the most commonly used wear models, applicable to forging dies, is the Archard model:

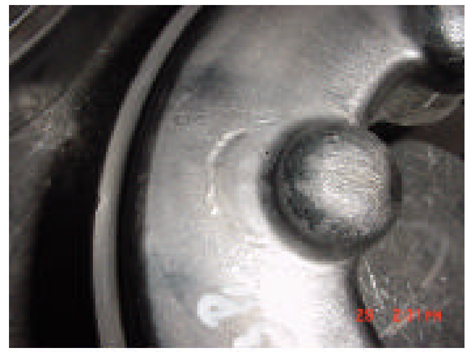
$$W = \int K \frac{p^a v^b}{H^c} dt$$

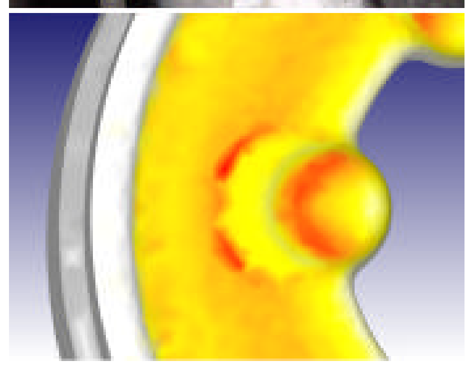
In this model, tool wear (W) is a function of the interfacial pressure (p), the sliding velocity (v) and hardness (H). a, b, c and K are experimentally calibrated coefficients.

Using this wear model, FormTech staff evaluated different preform shapes to determine the impact on die wear.

In production, the spindle (shown below) was formed in three stations, using what FormTech described as a “standard” preform. The second station did the majority of the deformation. The punch from this operation exhibited very high wear.

The simulation accurately predicted the wear pattern seen in production (red is higher wear - below). The wear on the protrusion would be intuitive to most experienced forging designers. On the other hand, the half-moon shaped wear is less intuitive.





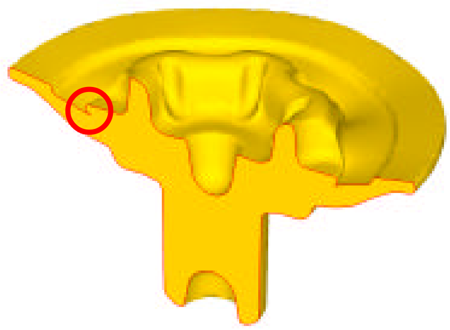
From a productivity standpoint, the production process offered room for improvement. The large deformation in the second station resulted in a high forging load. This prevented parts from being formed in stations 1 and 3 at the same time.

In an attempt to decrease the amount of tool wear, a “cone” preform was investigated. Only two stations were required for this design, with increased productivity if successful.

Unfortunately, the simulation showed that the wear in the final station was worse than that seen in production using the standard preform.

In spite of enticing productivity enhancements, the cone preform was not implemented. This design moved the problem to a different die rather than solving it for the entire process.

The next iteration was based on a "round" preform. This process offered the same press productivity as the original process. The primary objective remained wear reduction. This became a non-issue when DEFORM-3D predicted a serious fold in the final station.

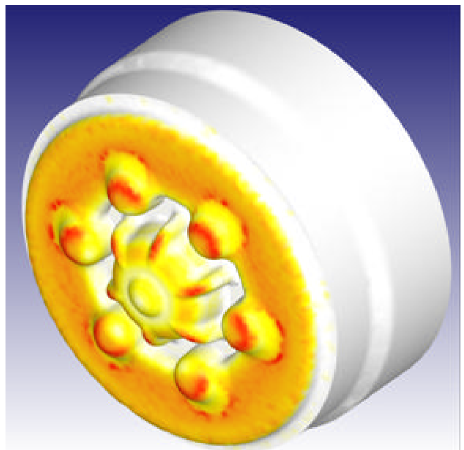


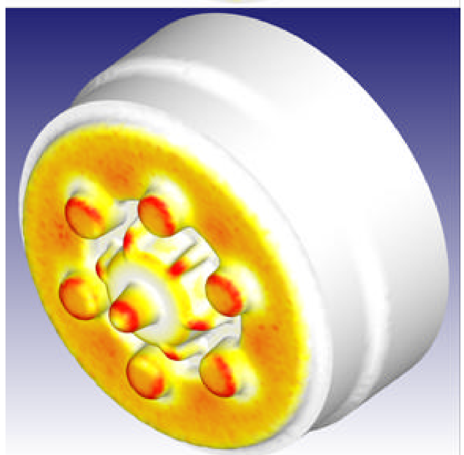
A modified "round" preform was developed to eliminate the lap. The simulation results were very promising. There were no defects, die fill was as expected and the die wear was reduced significantly.

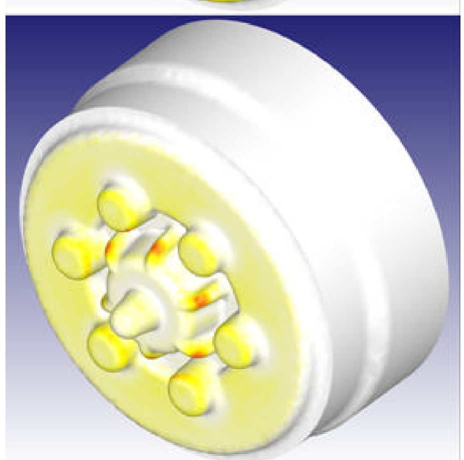
When the tools from the three different preform simulations are compared, it is easy to see that using the round preform significantly reduced the amount of wear in the tools. The original preform (top right) depicts the highest wear areas in red. The second iteration (right center) shows a higher wear in critical regions. The wear in the final design (right bottom) is significantly improved.

In addition to solving the problem at hand, FormTech engineers gained additional insight into the process through this project. It was clear that an opportunity remained to enhance productivity, as well as reduce die wear, which can be the subject of further design and development.

Existing die wear models are emperical in nature. While this is a limitation to the purist, they can be calibrated to provide reasonable results in a production environment. With a reasonable model, DEFORM can be used to optimize tool life for various preform designs. Die life and failure analysis can contribute to very significant cost savings.







Releases:

During 2006, DEFORM-2D and DEFORM-F2 version 9.0 were released. DEFORM-3D and DEFORM-F3 version 6.0 were also distributed.

During 2007, we are finalizing a very aggressive development plan. The current plan will start with a DEFORM-3D version 6.1 beta in the early spring. This will be followed by a formal release in the early summer. DEFORM-3D version 6.1 beta will include:

- the prototype ring rolling system;
- 3D induction heating (FEM only);
- the first release of local remeshing (3D);
- improvements in parallel computing, and
- the machining (cutting) preprocessor will include enhanced capabilities in defining drill geometry.

Additional developments in 2007 will include:
- shape rolling;
- coupled die stress;
- speed and functionality in parallel computing and
- 2D to 3D integration, to name a few.

Ongoing microstructure developments will continue throughout the coming years. Scientific Forming Technologies is partnering with customers, research institutes and government agencies to push the 'state of the art' in microstructure and machining distortion modeling to new levels over the next few years.

For a complete list of all the improvements, please refer to the release notes on the DEFORM User Area.

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