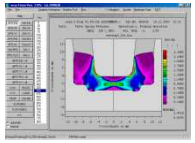
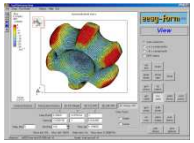
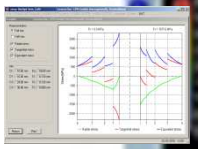




CPM Gesellschaft für Computeranwendung, Prozeß- und Materialtechnik

Simulation as a tool to help to improve lubrication systems

Dr. Gerhard H. Arfmann, Dr. Michael Twickler
CPM GmbH, Herzogenrath,Germany

Simulation as a tool to help to improve lubrication systems

Abstrakt:

Today simulation is state of the art in the design of cold forging processes.

The simulation results may be used as well to optimize the lubrication systems used in cold forging.

This presentation shows how simulation method may be systematically used to realize and optimize lubrication systems.

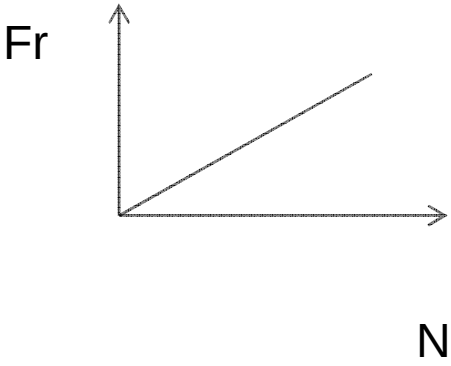
Simulation as a tool to help to improve lubrication systems

In simulation you consider the lubrication situation by using a friction law.

Coulomb friction law

Coulomb: $F_r = \mu * N$

Fr: Friction load
μ: Friction factor
N: Normal load



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Max Shear stress law

$$\tau = m * k$$

τ: Shear stress

m: friction factor

k: max shear stress

Combined friction law

Both friction laws mentioned above have different areas of application.

Therefore some simulation codes use so called combined friction laws.

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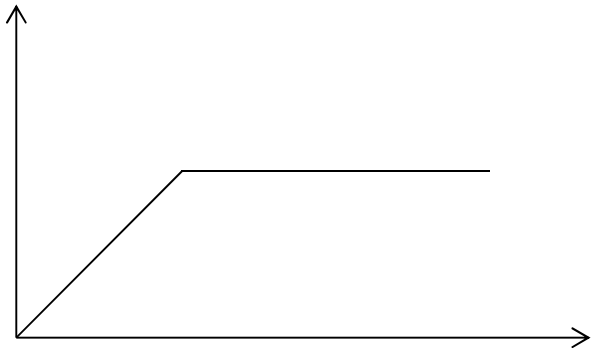

Simulation as a tool to help to improve lubrication systems

Influences on friction factors

- local pressure
- local temperature
- enlargement of surface
- relative velocity
- surface quality
- lubrication
- lubricant carrier
- …….

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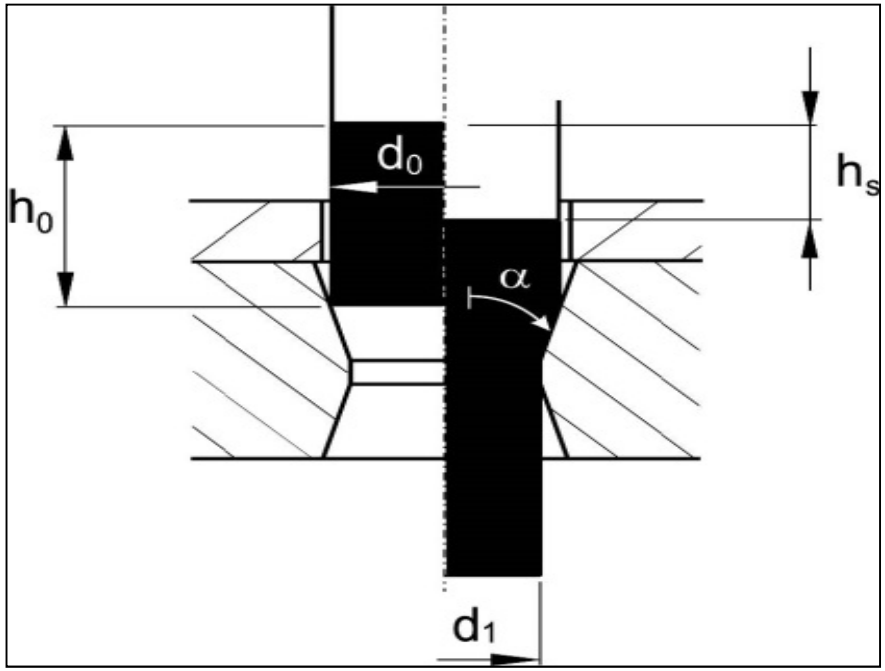
µ and m in practical use

Given “normal” lubrication conditions the factors are not very much variing.

A lot of processes can be simulated very relaiable using standard friction factors.

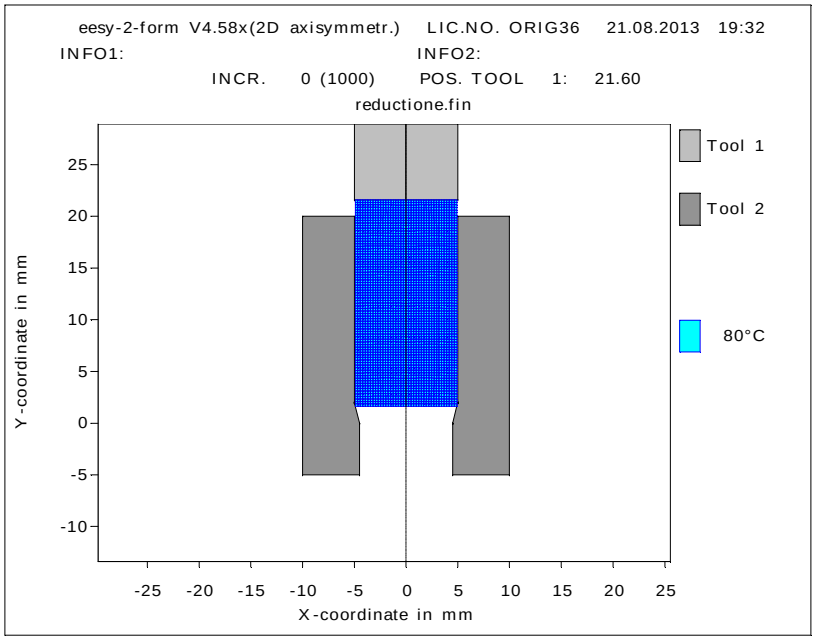
It becomes difficult if you come to difficult forming or if you come to technical limits.

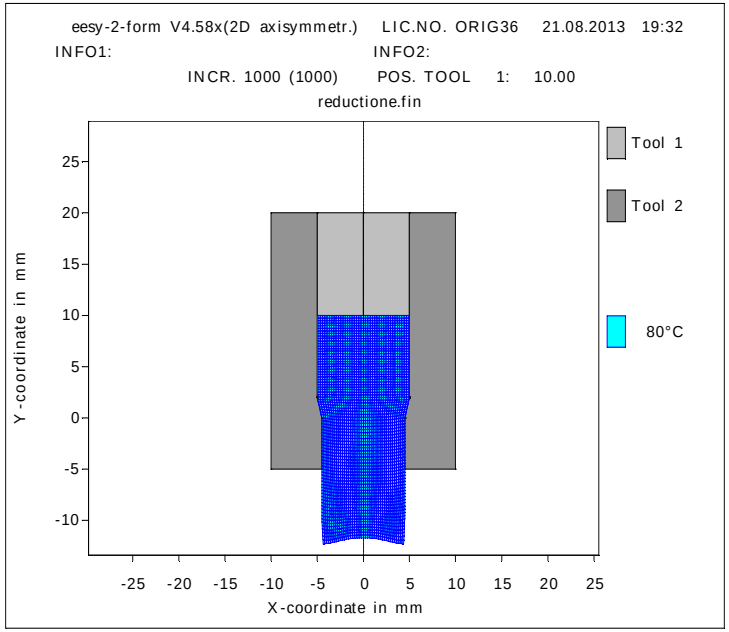
Simulation as a tool to help to improve lubrication systems



Principle of reduction

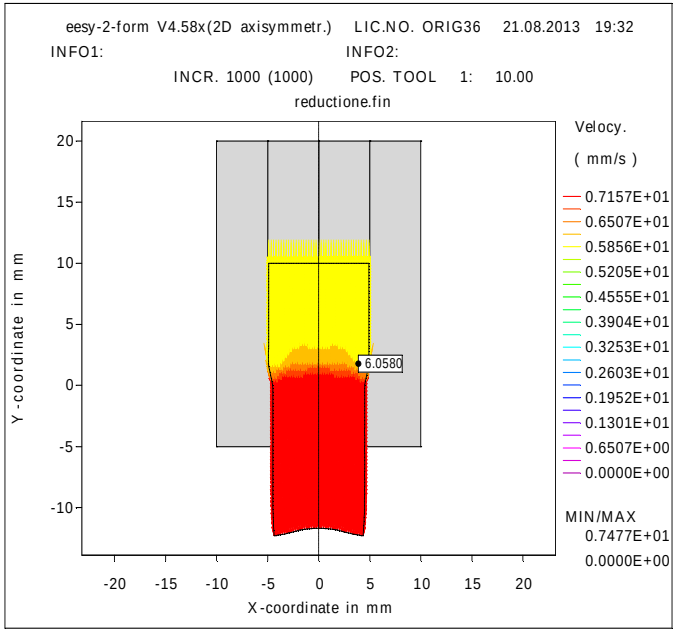
Simulation as a tool to help to improve lubrication systems

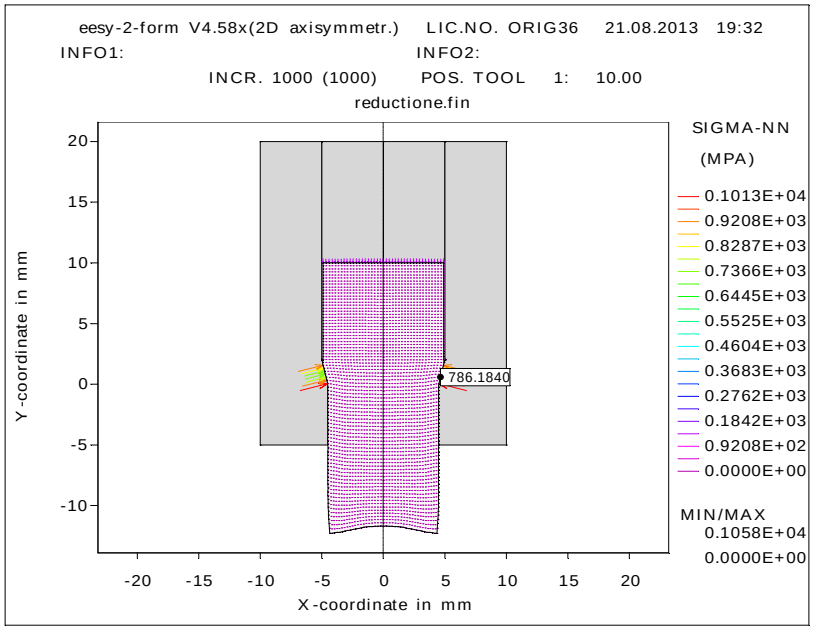




Reduction

Simulation as a tool to help to improve lubrication systems





Reduction

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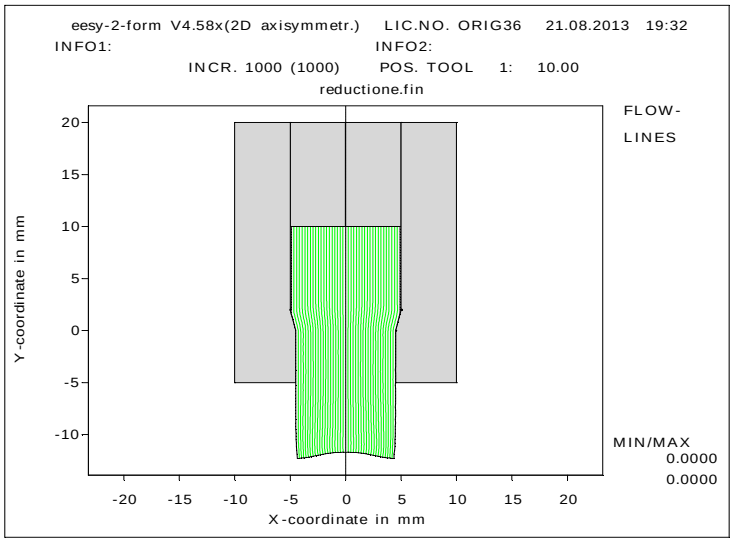
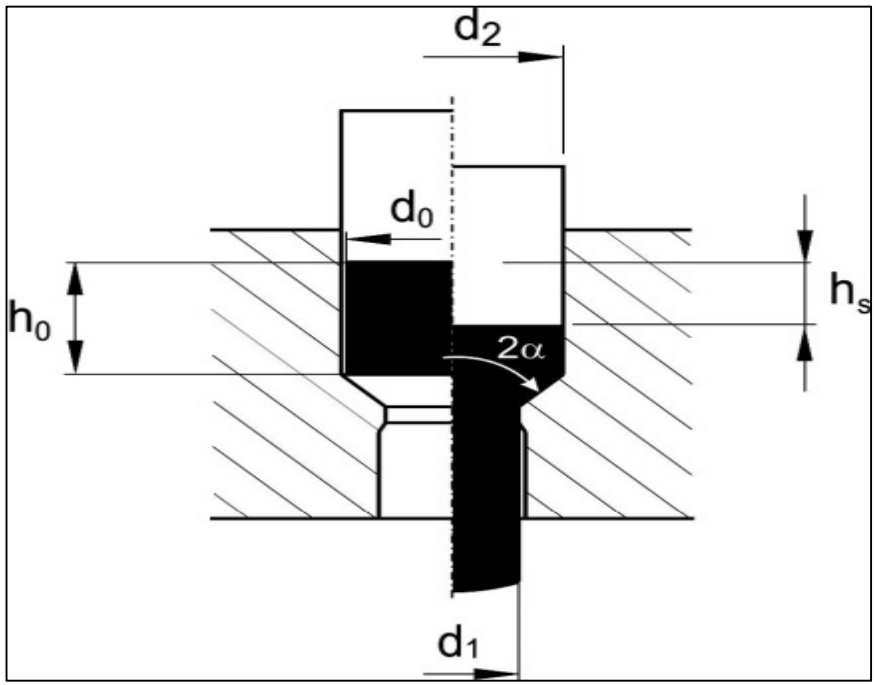


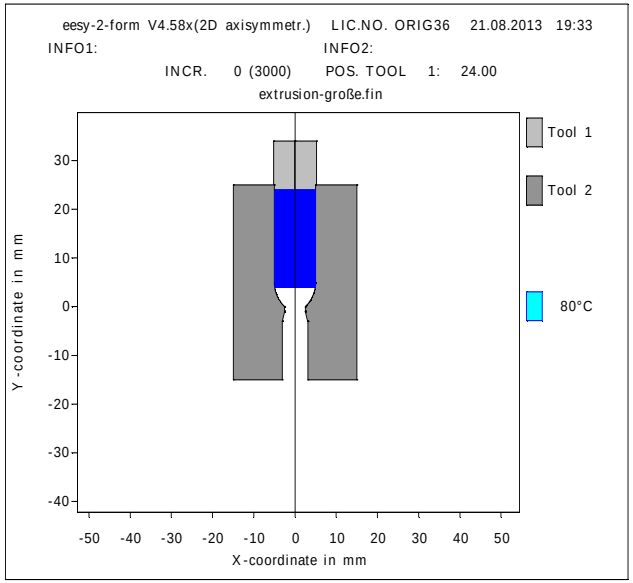
Reduction

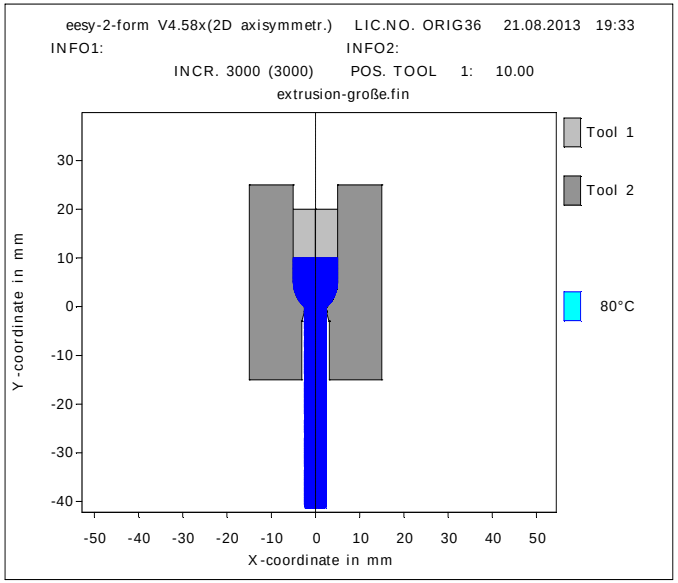
Simulation as a tool to help to improve lubrication systems



Principle of extrusion

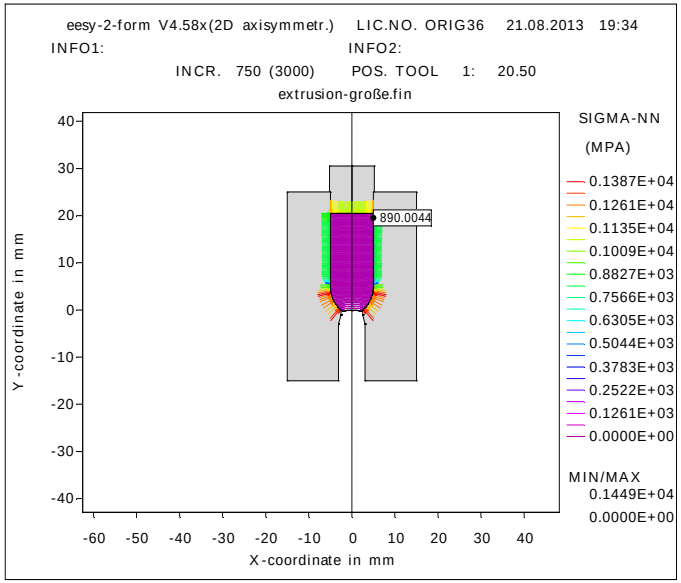
Simulation as a tool to help to improve lubrication systems

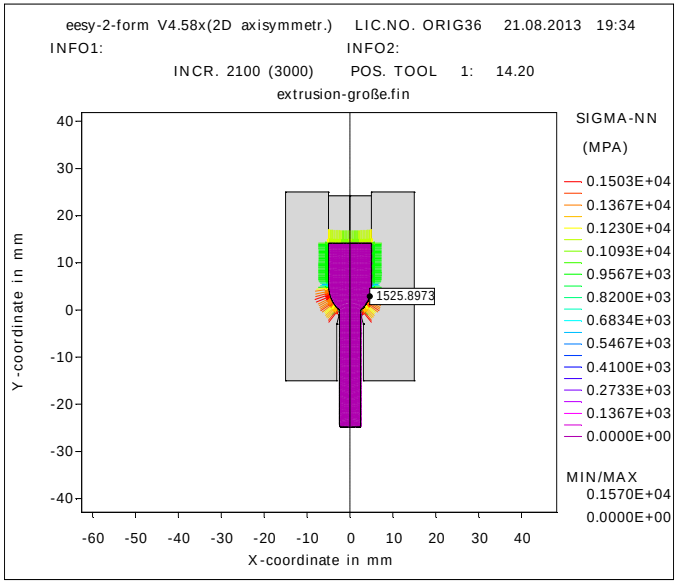




Extrusion

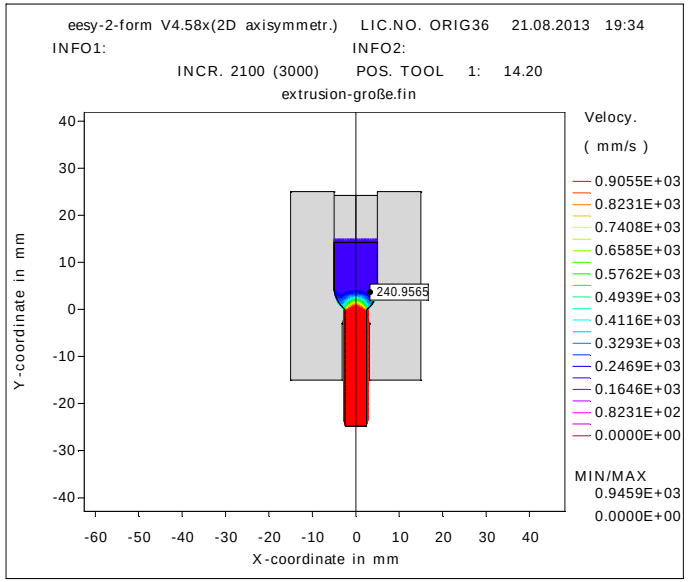
Simulation as a tool to help to improve lubrication systems

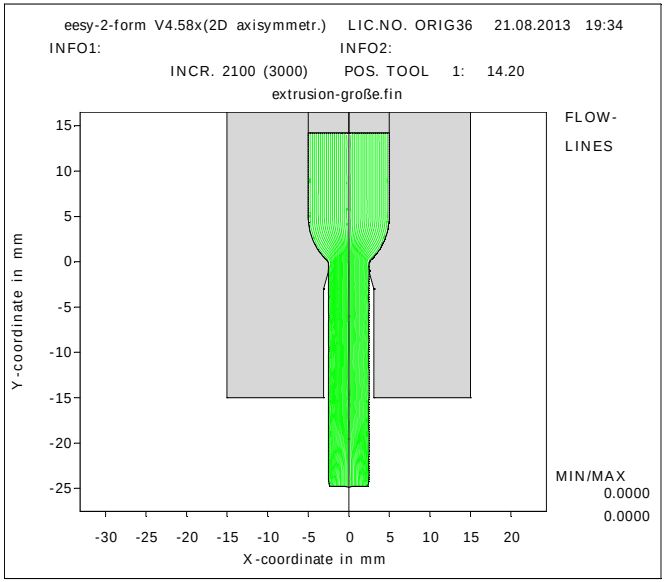




Extrusion

Simulation as a tool to help to improve lubrification systems





Extrusion

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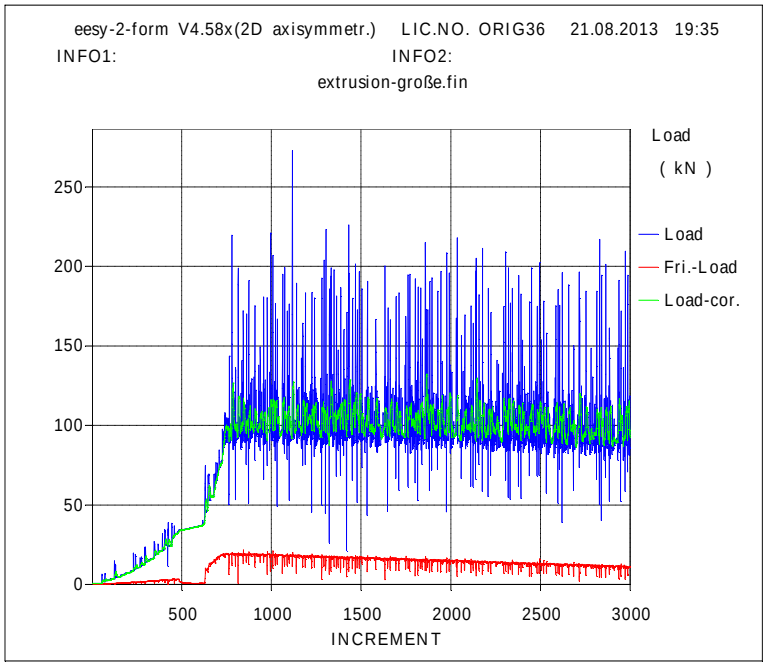
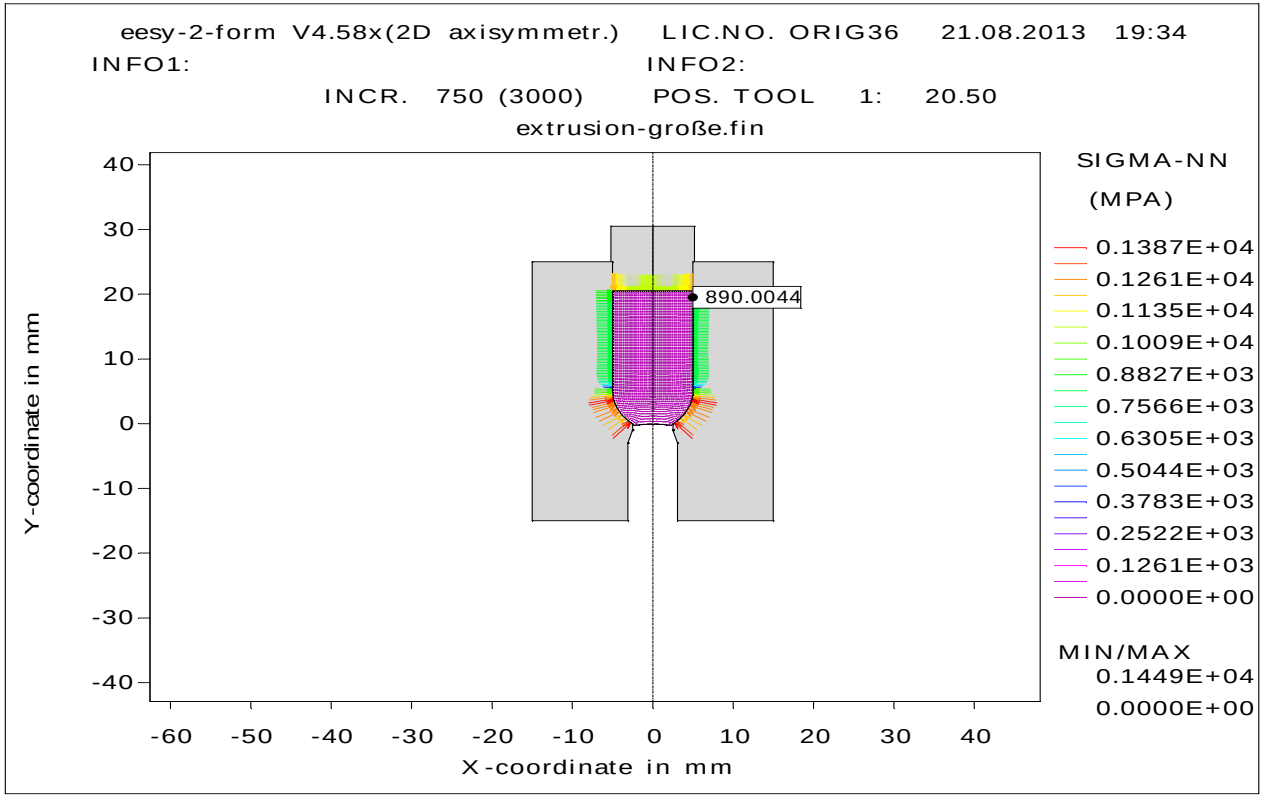


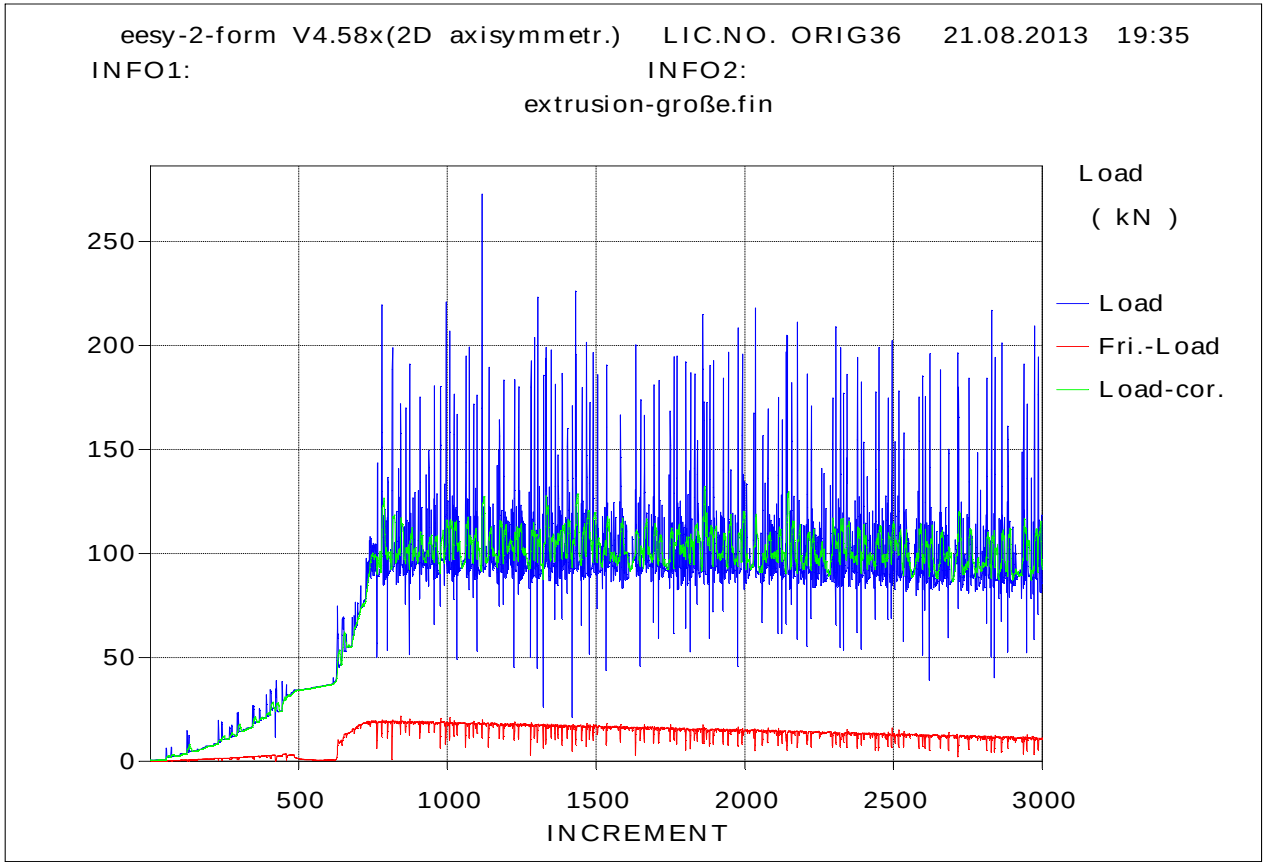
Extrusion

Simulation as a tool to help to improve lubrication systems



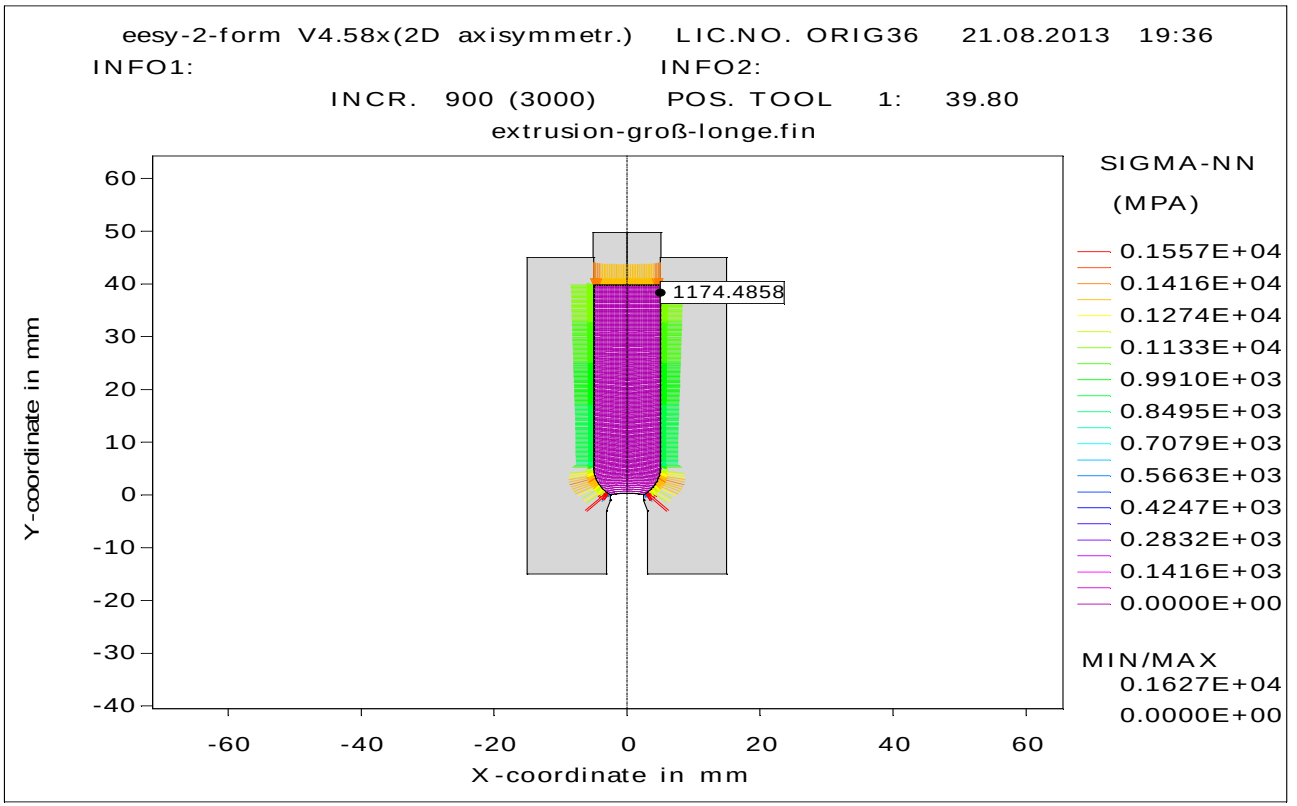
Inner pressure - short part

Simulation as a tool to help to improve lubrication systems



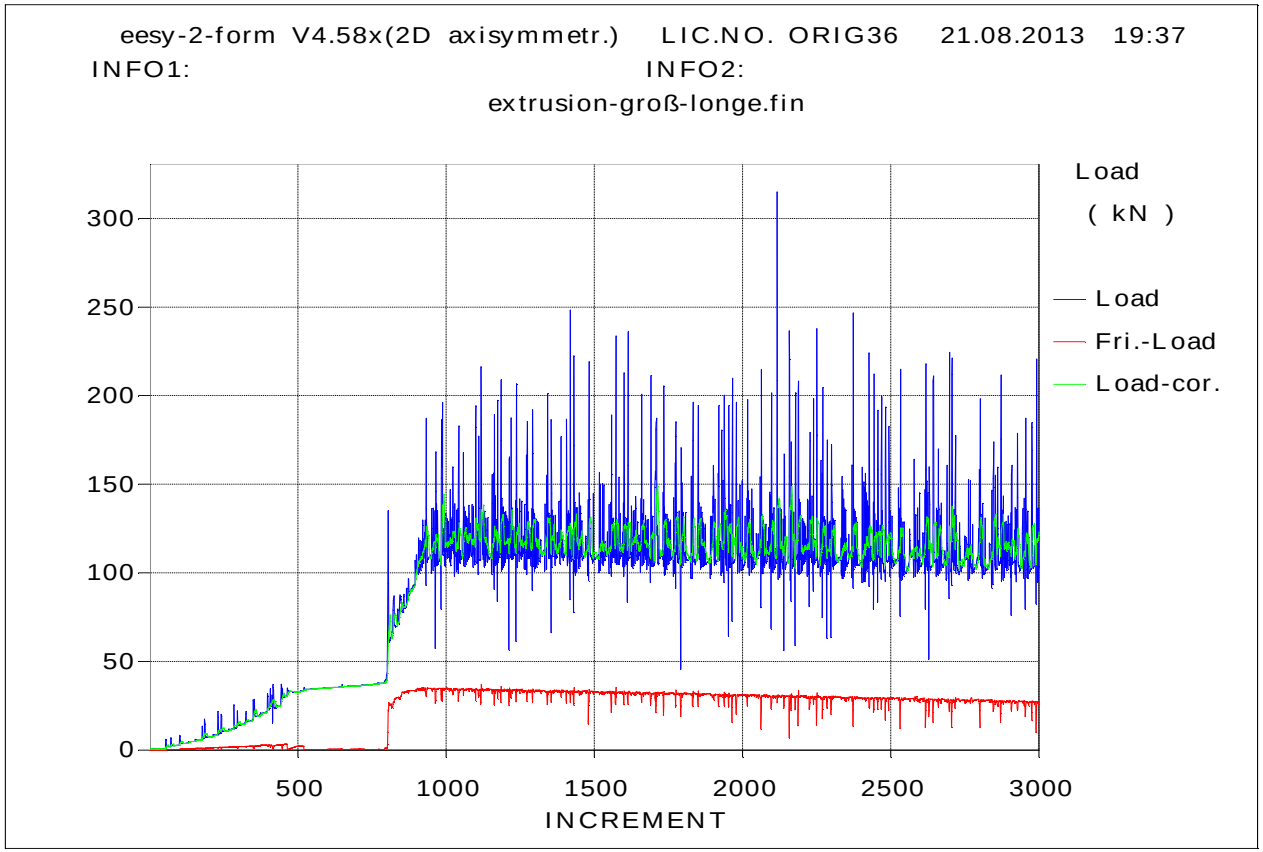
Load during extrusion – short part

Simulation as a tool to help to improve lubrication systems



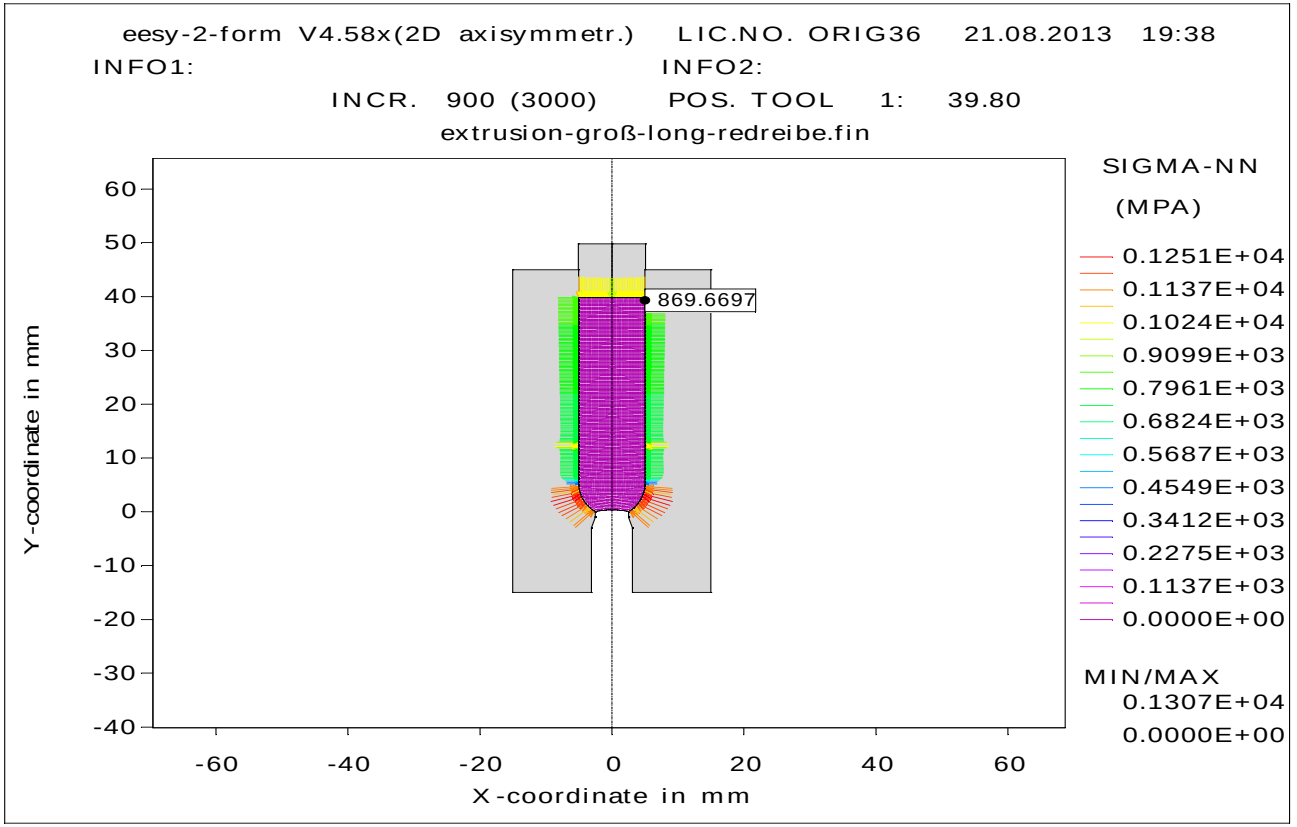
Inner pressure - long part

Simulation as a tool to help to improve lubrication systems



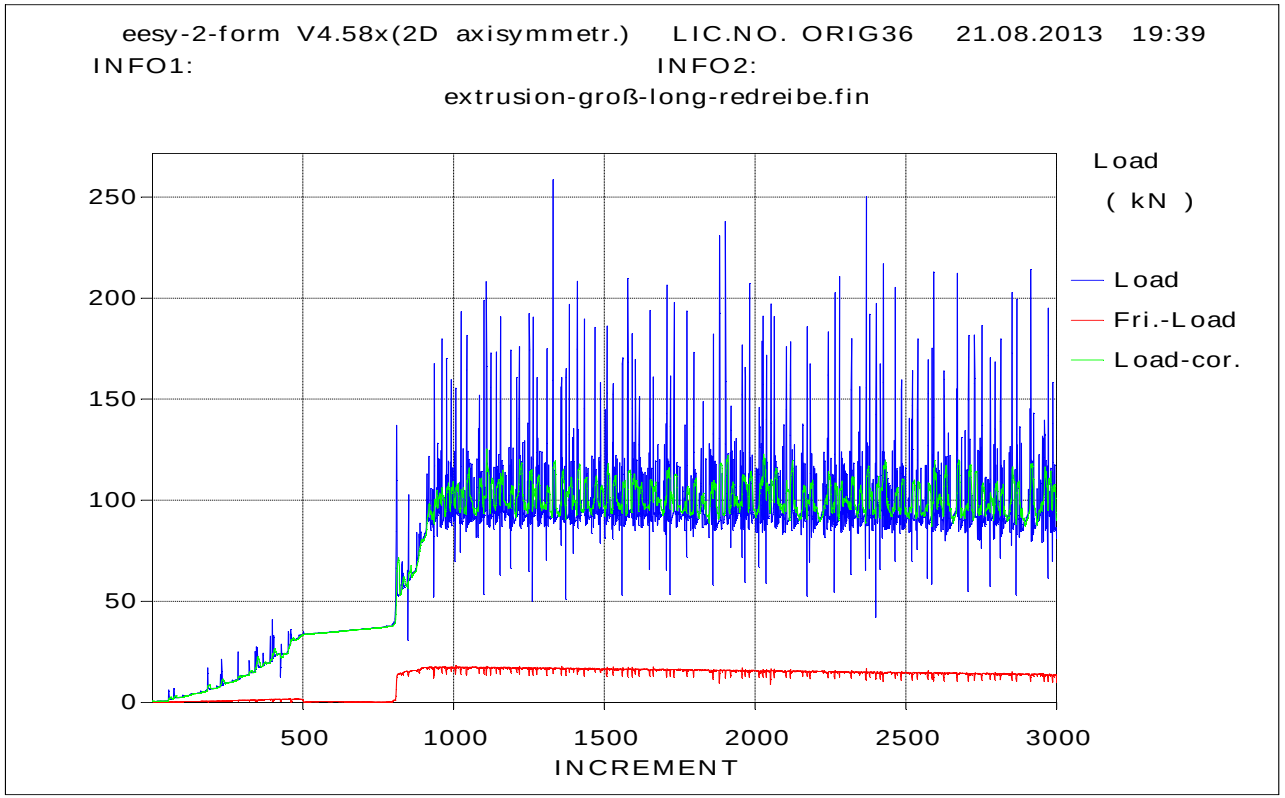
Load – long part

Simulation as a tool to help to improve lubrication systems



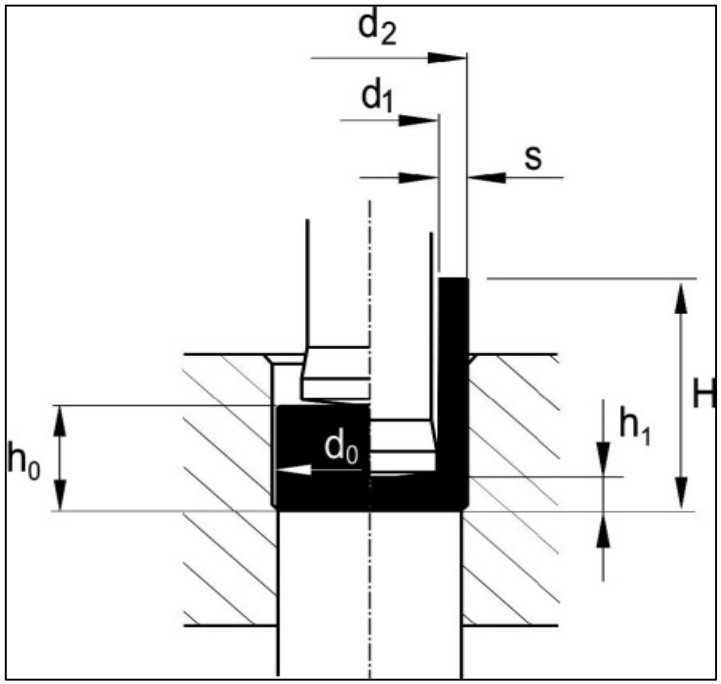
inner pressure – long part – reduced friction

Simulation as a tool to help to improve lubrication systems



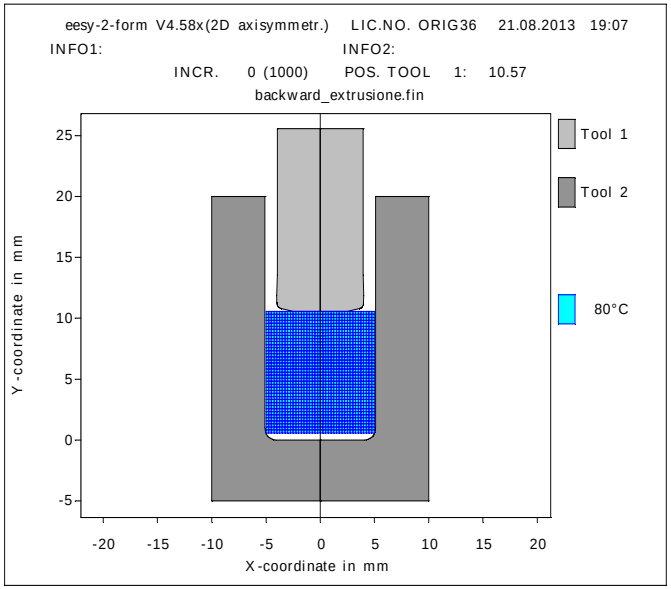
Load – long part – reduced friction

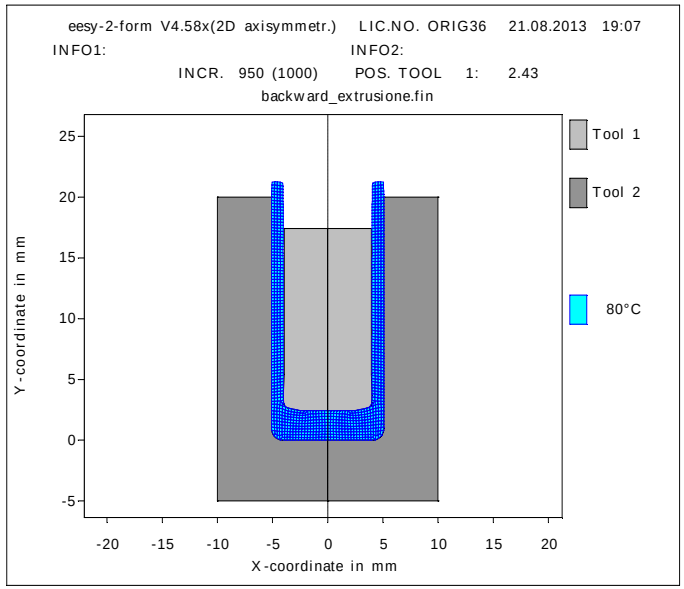
Simulation as a tool to help to improve lubrication systems



Backward extrusion

Simulation as a tool to help to improve lubrication systems





Backward extrusion

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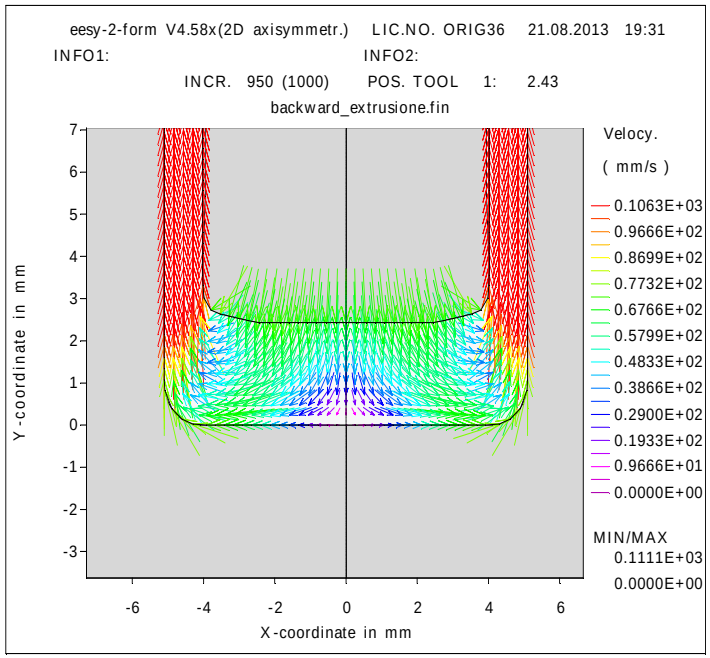
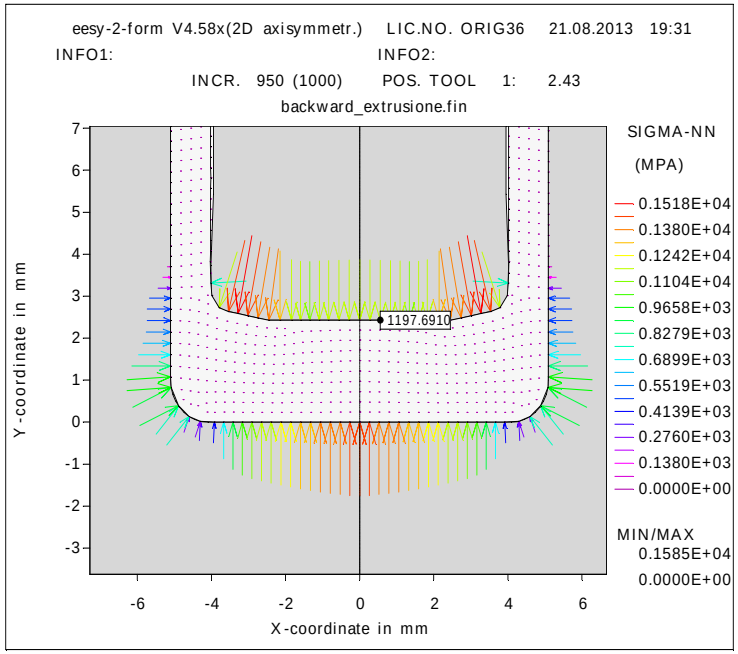
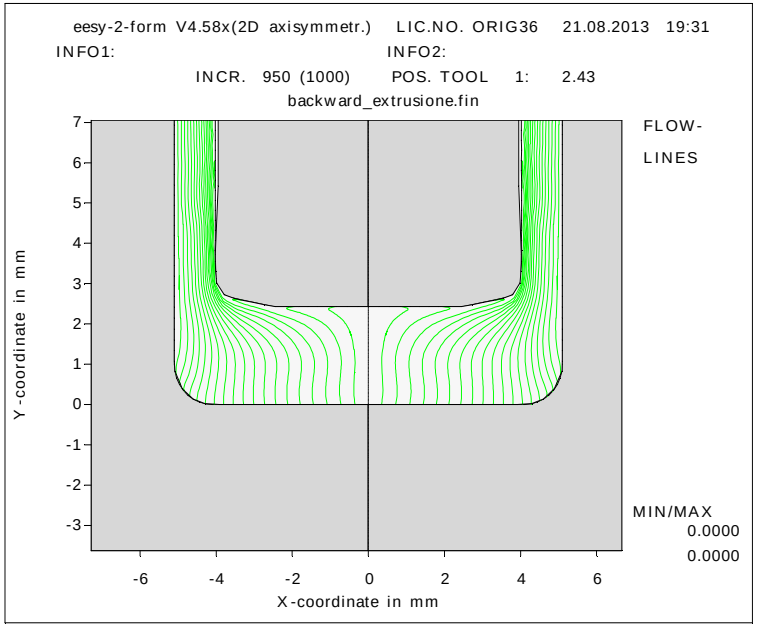




Backward extrusion

Simulation as a tool to help to improve lubrication systems



Backward extrusion

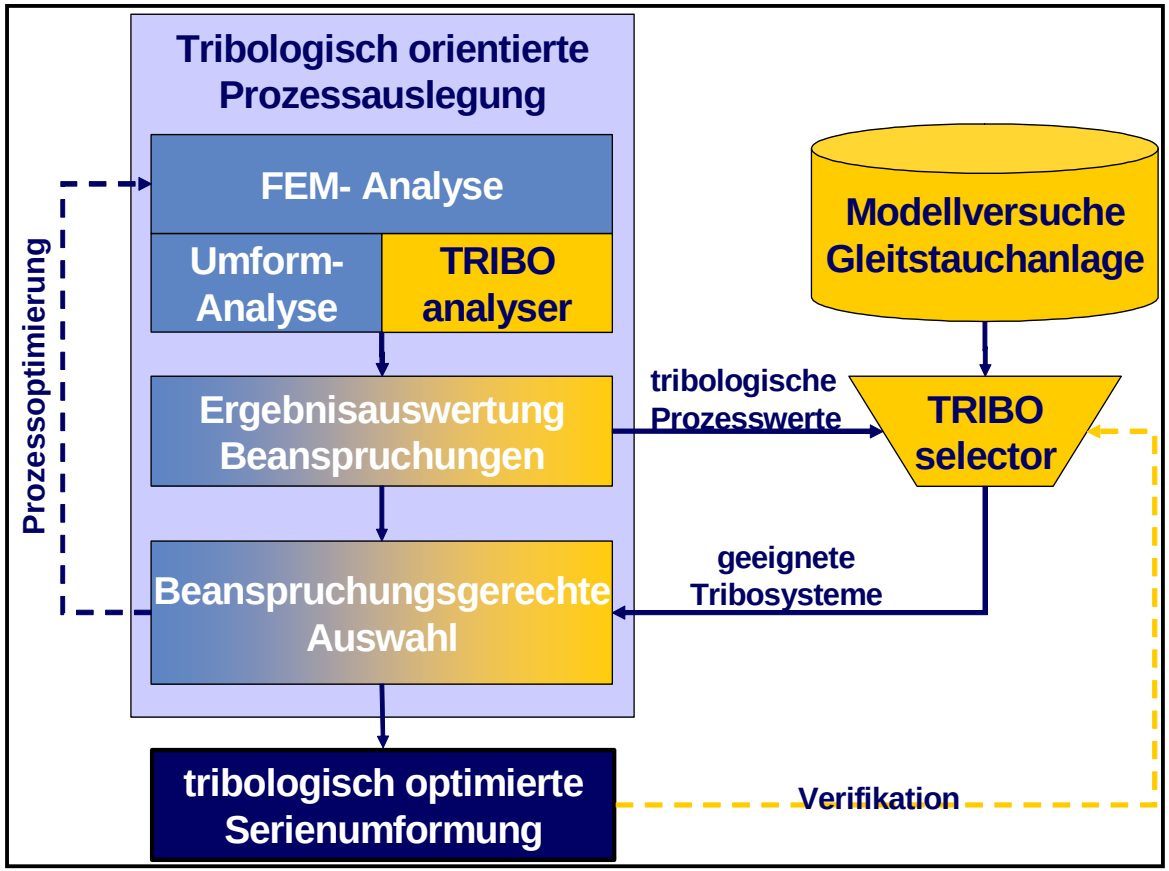
Simulation as a tool to help to improve lubrication systems

Research approach to allow a systematic chose of a lubrication system

There are approaches to used sets of results of simulation to systematically chose an appropriate lubrication system.

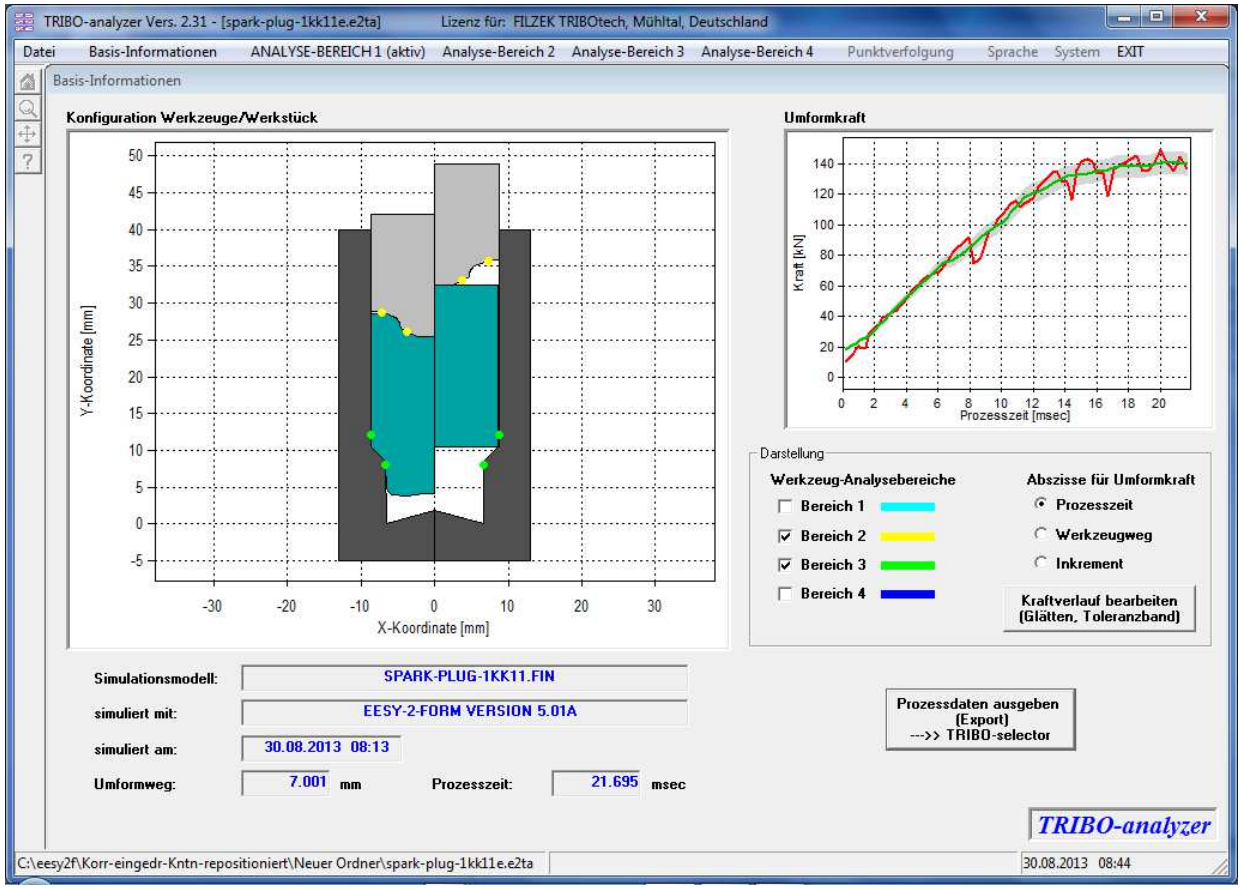
One examples of such an approach is the project Triboanalyser/Triboselektor of Tribotec in co operation with CPM, University of Darmstadt and further industrial partners.

Simulation as a tool to help to improve lubrication systems



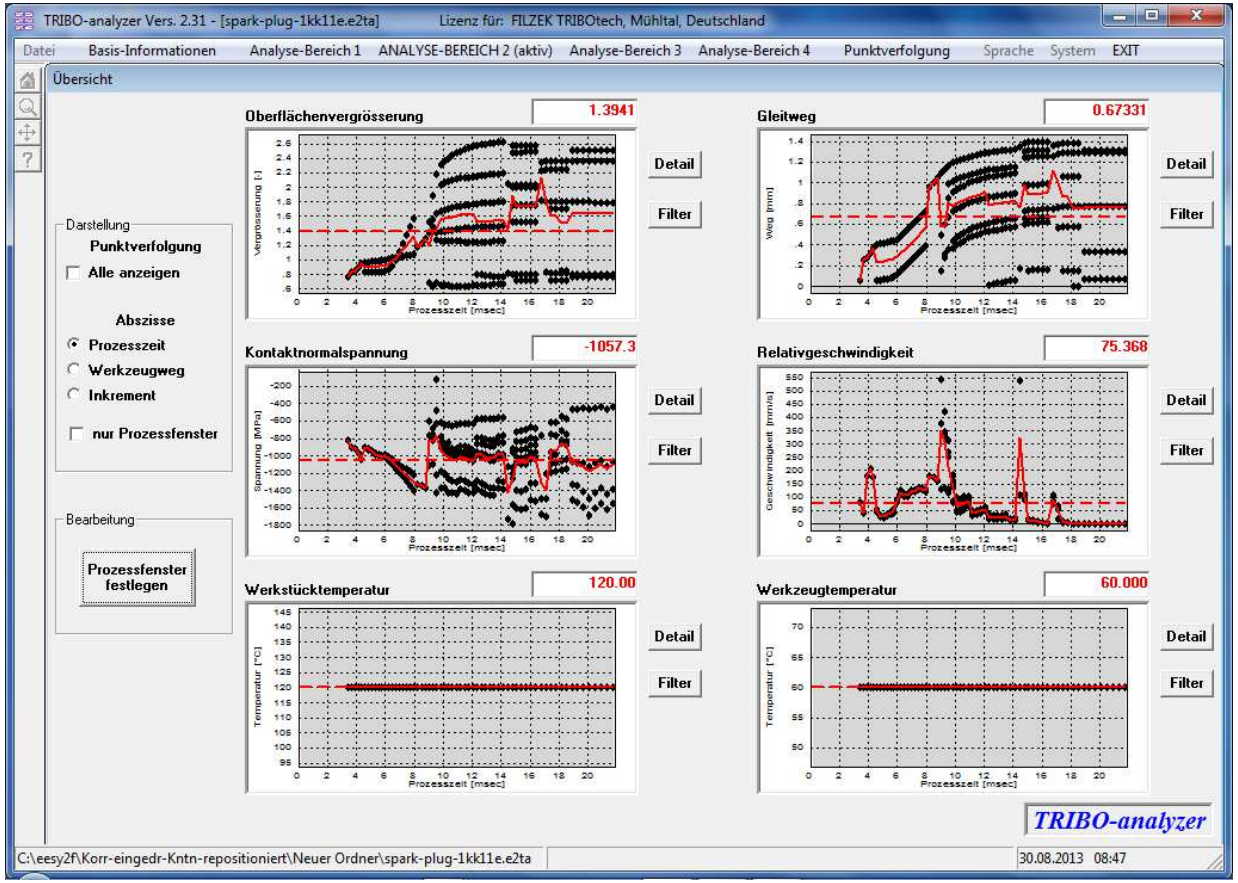
Principle of the tribologically optimized process design /1/

Simulation as a tool to help to improve lubrication systems



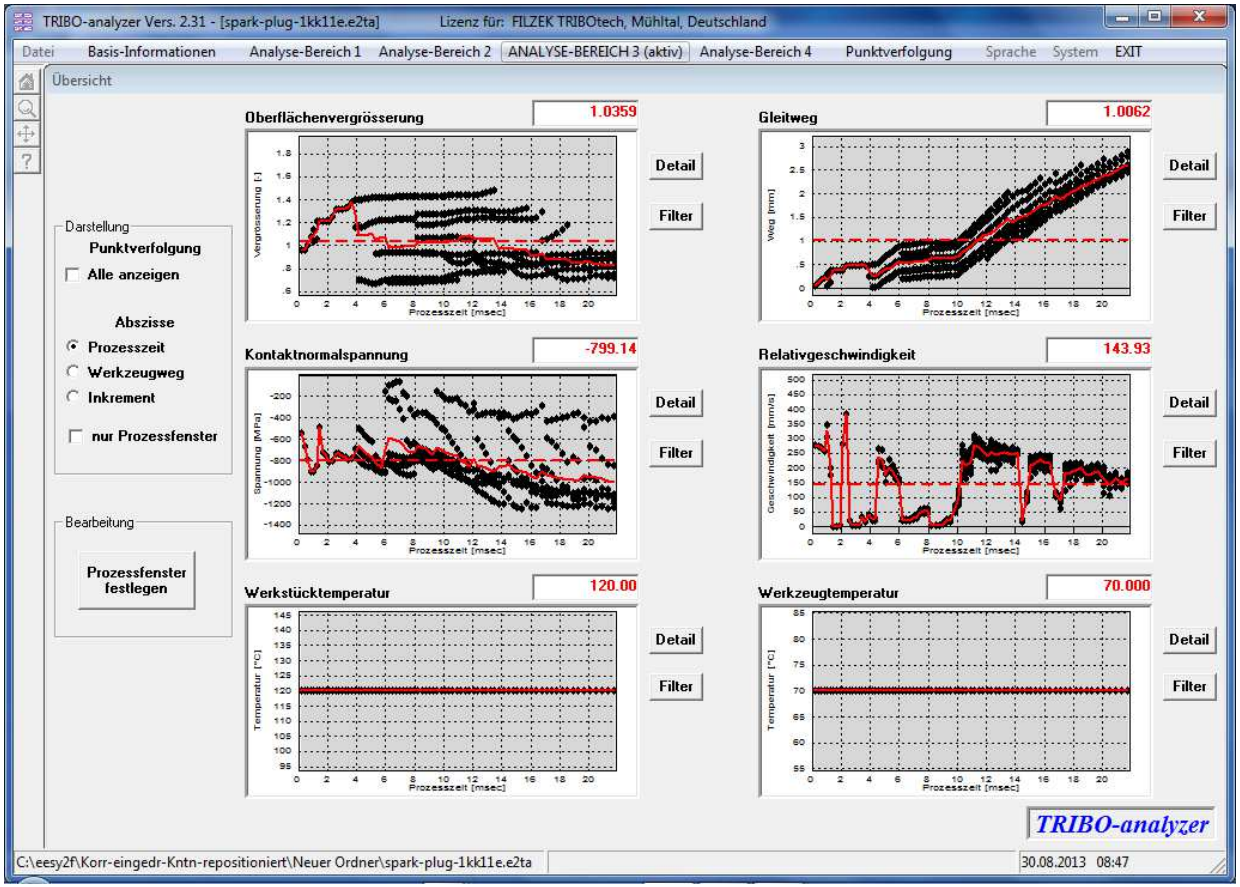
Example Triboanalyser /1/

Simulation as a tool to help to improve lubrication systems



Examplel Triboanalyser /1/

Simulation as a tool to help to improve lubrication systems



Beispiel Triboanalyser /1/

Simulation as a tool to help to improve lubrication systems

But further influences have to be considered…..

Als Beispiel sei hier ein Fall erwähnt, in dem rostfreies Material mehrfach reduziert werden sollte. Es war die Frage zu klären, ob das mit dem Material gemacht werden kann und spezielle Beschichtungen und/oder Öle erforderlich sind.

Durchgeführte Simulationen zeigten, dass die Prozesse grenzwertig waren (das Material stauchte während den Reduktionen geringfügig auf, reduzierte jedoch noch wie gewünscht). Beratungen mit den Materiallieferanten und einem Tribospezialisten ließen hoffen.

Zu Sicherheit wurde beschlossen Tests im Labor durchzuführen, um zu sehen, ob sich das Material unter Verwendung des gewählten Tribosystems wirklich reduzieren lassen würde.

Und es tat es tatsächlich – im Labor……

Simulation as a tool to help to improve lubrication systems

In der Praxis ließ sich der Prozess jedoch nicht realisieren und musste aufgegeben werden.

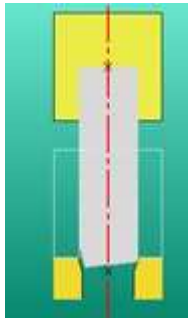
Der Grund war die Unmöglichkeit die Werkzeuge in der Produktionsmaschine in der erforderlichen Genauigkeit auszurichten oder einen ausreichen guten Abschnitt herzustellen. Nach der ersten Reduktion war das Bauteil „etwas“ krumm.

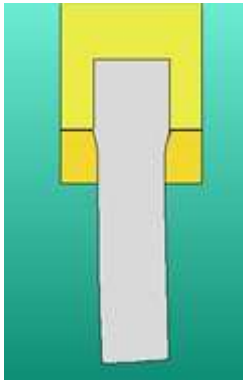
Das genügte allerdings, um in der folgenden Operation eine korrekte Reduktion zu verweigern.

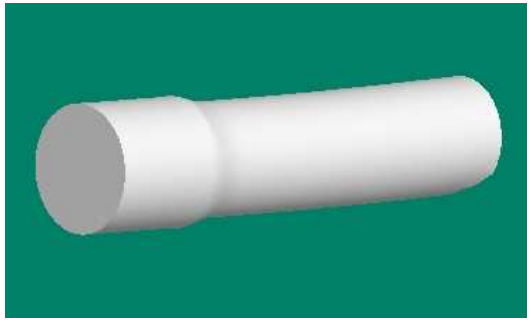
Solche Spezialfälle treten in der Praxis immer wieder auf. Deshalb ist es erforderlich mit ausreichendem Übersichtswissen an ein Projekt heranzugehen.

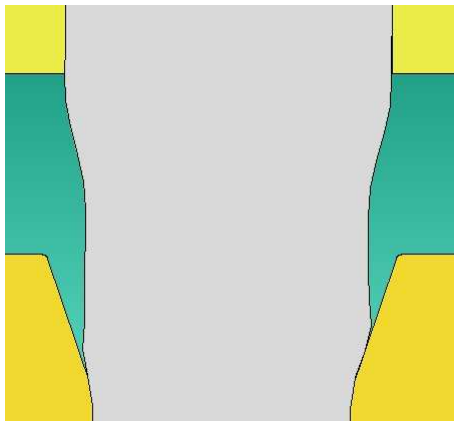
Simulation as a tool to help to improve lubrication systems

Study of wrong adjustment in 3D.









Simulation as a tool to help to improve lubrication systems

Conclusion

In general simulation is a good tool to provide neccessay information to the lubrication specialist to help him to optimize his lubrication system.

Basic test have to be performed to find out the influences of the parameters coming form the simulation on the lubrication systems.

Simulation as a tool to help to improve lubrication systems

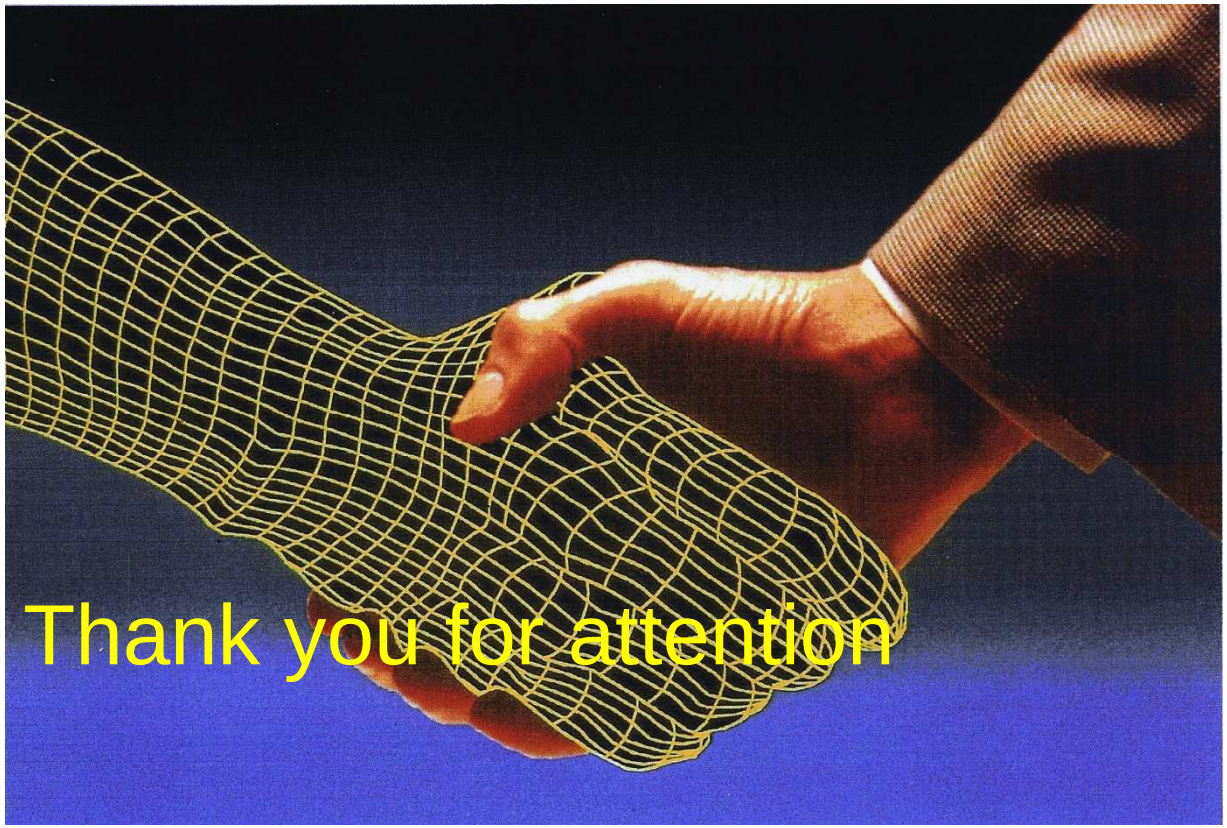
Literature

/1/ Reduzierung der Umweltbelastung in der Kaltmassiv-umformung von Stahl durch Vermeidung von Phosphatierungen bei minimiertem Schmierstoffeinsatz
Abschlussbericht über ein Forschungs- und Entwicklungs-projekt, gefördert unter dem Az. 12125 von der Deutschen Bundesstiftung Umwelt
Fuchs Schraubenwerk GmbH, Siegen, 2002

/2/ Entwicklung grundlegender innovativer Methodiken zur Qualifizierung tribologischer Systeme der Kaltmassivumformung auf Basis von Laborversuchen und computerunterstützten Analyse-Tools
Zentrales Innovationsprogramm Mittelstand (ZIM),Arbeitsgemeinschaft industrieller Forschungsvereinigungen „Otto von Guericke“ e.V., Berlin, 2010

/3/ Eesy-Software
CPM Training Material
CPM GmbH, Herzogenrath, Germany, 2012
CPM@CPMGMBH.COM

Trust in “eesy” simulation



Customers are happy to solve their daily problems with simulation