New Developments in Sheet Metal Forming

Edited by
Mathias Liewald
Papers of the
International Conferences on “New Developments in Sheet Metal Forming”
and “New Developments in Hydroforming”
in Fellbach (near Stuttgart) – Germany, held on May 10th and 11th, 2016.
Conference chairman: Univ. Prof. Dr.-Ing. Dr. h. c. Mathias Liewald MBA
Director of the Institute for Metal Forming Technology (IFU) of the University of Stuttgart, in cooperation with:
“Forschungsgesellschaft Umformtechnik mbH” (FGU, Stuttgart / Germany),
“Deutsche Gesellschaft für Materialkunde e.V.” (DGM, Frankfurt / Germany)

All contributions to these conference proceedings were published as submitted by the authors, who are fully responsible for the contents and the orthography of their papers.

© 2016 INVENTUM GmbH
Postfach 20 07 14, 53137 Bonn, Deutschland
All rights reserved

Printed in Germany
Preface – NEBU

The International Conference “New Developments in Sheet Metal Forming” held in Stuttgart / Germany is organised every second year alternatingly with the International Conference “New Developments in Forging Technology”. The main goal of both conferences is to gather engineers and experts from the industry as well as scientists from universities to discuss the current state of the art, and future tendencies and targets in research and development of new sheet metal and/or bulk metal forming technologies.

Annually, the Institute for Metal Forming Technology (IFU / Stuttgart / Germany) organises this event in collaboration with the Forschungsgesellschaft Umformtechnik mbH (FGU / Stuttgart / Germany). For many years, the concept of the conference was to focus on effectively transferring scientific results into value added chains of companies operating in the field of sheet metal forming and other market segments. Therefore, the topics of the papers selected to be presented at the conference should have a reference to current research activities in sheet metal forming, hot forming, and tool design in Europe, the United States, and Asia. Through the conference and its contributions it is intended to present strategic issues of rather general topics in the field of producing sheet metal components to external specialists and determine the recent state of the art on an international level.

During this two-day conference, experts from both universities and industrial companies will present their papers and discuss their newly achieved results with experts from all over the world. Conference topics include investigations performed at several European metal forming institutes, at companies from the industry, and at the Institute for Metal Forming Technology (IFU) of University of Stuttgart. Thus, a balanced mix of practical and theoretical contributions will be presented. In 2016, special attention was paid to present and publish modern practical solutions in hot and cold forming of sheet metal materials, modern concepts of material compositions, as well as heat treatment and new approaches in order to integrate modern sensors into the tool structure to control process development during serial production. Another priority of the conference was to identify potentials of lightweight materials, which are applied in engineering, transporting and mobile systems. Therefore, the opening presentations in particular pay attention to recent questions in metal forming technologies and near future manufacturing strategies! Furthermore, the technological potential of new material developments / alloys will be disclosed to make attendees able to respond easily to occurring questions when running their day to day business in the sheet metal forming industry, or when visiting companies of today’s system suppliers.
Company visits offered on Monday, May 9\textsuperscript{th}, 2016 and contributions from numerous international acting market players and different technological research institutions in Germany are objecting present and deep insight into current developments and research work in the field of sheet metal manufacturing. During the conference, the visitors and speakers are given the opportunity of contributing professionally, analysing and observing trends, exchanging ideas, and cultivating personal networks. Therefore, the conference programme includes visits to industrial companies and a welcoming evening at IFU on the day before conference, the gala dinner on the 1st conference day, and exhibitions throughout the entire conference.

I would like to thank all of the authors for contributing and inspiring this conference! I also am grateful for the support of Deutsche Gesellschaft für Materialkunde e.V. (DGM), Frankfurt / Main, Germany, who will attach these proceedings to its publishing programme. This collection of papers presented on May 10\textsuperscript{th} and 11\textsuperscript{th}, 2016 in Fellbach / Stuttgart in Germany will be distributed widely and will be available to all international experts involved.

Yours sincerely

Univ.-Prof. Dr.-Ing. Dr. h. c. Mathias Liewald MBA
**Table of Contents**

Preface

*M. Liewald*

Current Research Work in the Field of Sheet Metal Forming at the Institute of Metal Forming Technology (IFU)

*M. Liewald et al.*


**International Conference New Developments in Sheet Metal Forming**

**May 10th – 11th, 2016**

**Strategic Opening Lectures**

Transformation to a New Era – Roadmap for Suppliers

*B. Gottschalk*

Efficient. Networked. Innovative

*J. Früh, O. Beisel, R. Stauder*

New Developments in Servo Press Technology

*K. Aida, K. Rothenhagen, A. Papaioanu*


**Future Component Requirements and Product Analyses**

Multi-Material Lightweight Design for Electronic Vehicles – Challenges in Production

*G. Deinzer, F. Diebold, M. Kothmann*

Forming of Composite Materials for Technical Application

*P. Middendorf, P. Böhler, J. Fial, M. Engelfried*

Forming of AMAG 7xxx Series Aluminium Sheet Alloys

*T. Grohmann*


**Process Simulation in Sheet Metal Forming**

Current Trends in Die Engineering and Construction towards an Industrialized Production of Sheet Metal Forming Dies

*A. Emrich*

Automatic Die Face Engineering Using “Die-Starter”

*R. Narainen, H. Porzner, V. Chaillou*
Permanent Deformations of AA6016 Sheet Metal Parts after Paint Drying Processes in Car Manufacturing
J. Regensburger, C. Albiez, P. Ackert, J.-P. Nicolai, W.-G. Drossel

Systematic Process Improvement of Stamping Processes
B. Carleer, M. Stippak, I. Burchitz

Modern Lightweight Materials and Material Modelling

Large Scale Manufacturing of Composite Parts in Compression Molding
F. Henning, B. Thoma, B. Hangs, C. Keckl

Lode Angle and Strain Rate Dependent Ductile Fracture in Advanced High Strength Steel
C. Roth, B. Erice, D. Mohr

AHSS Development and Application Technologies for POSCO’s Solutions towards Automotive Industry
K. Chung, Y. Kang

Hot Stamping Process of Aluminium 7xxx Sheets, Simulative Investigation
A. Kraly, D. Vipavc, F. Grabner, N. Ross, M. Kumar

Tools and Process Technology

The Latest BRUDERER Machine and Strip Feed Solutions for Stamping and Metal Forming
G. Ebneter, A. Kuhli

New Methods for Sheet Metal Forming with Bihler Servo Technology
C. Schäfer

Simulation along the Process Chain in Sheet Metal Forming

Feasibility-Simulation and Systematic Process Improvement of Hot Forming Parts as well as Mapping of Results to Vehicle Simulation
M. Stillger, T. Brenne

Current Challenges in Forming and Joining Simulation
A. Werber, K. Wiegand

Optical 3D Metrology in Sheet Metal Development and Production
H. Friebe, M. Klein, A. Grube

Strength Simulation during Designing Phase of Critical Areas of Forming Dies
R. Pfitzenmaier, M. Sowada
Hot Forming of Sheet Metal

Development of Zink Coated Parts for Hotstamping
I. M. Gonzales, O. Straube 265

Press Hardening of Galvanized Steel Components for BIW Applications
R. Kelsch 277

Modern Tool Steels – A Prerequisite for Successful Hot Stamping of Steel Sheets
R. Rahn, I. Schruff 289

Material Characterisation

Advanced Material Characterisation of TWIP Steels
E. Billur, B. Çetin, R. Onur Uğuz, K. Davut, E. Arslan 303

HFQ ® – Making a Step Change in the Use of High Strength Aluminium Sheet
G. J. S. Adam, D. Foster, J. Sellors 319

Future Potentials of Process Technology when Forming Stainless Steels
P. Schmid, M. Liewald 325

Formability of Annealed AZ61 Magnesium Alloy at Elevated Temperatures
M. Ramezani, T. Neitzert 337

International Conference New Developments in Hydroforming
May 10th, 2016

IHP-Forming Solutions for Large-Scale Production

Hydroform Intensive Body Structure (HIBS II) with Advanced and Ultra High Strength Steels
D. Gearicke 353

Hydroforming in High-Volume Production
P. Freytag, J. Neubert, S. Kluge 365

Hydroforming, Advanced High Strength Steel, Springback, Reduced Weight, Series Production
H. Hänelt, H. Freydank 373
Sitzschienen geformt auf hydraulischen Tiefziehpressen

Hydraulische Tiefziehpressen eignen sich insbesondere für tiefe Teile, schwierige Formen und besondere Werkstoffe. Mit der Baureihe TZP sowie zahlreichen Optionen und Automatisierungslösungen bietet LASCO maßgeschneiderte Pressen und Anlagen für die Blechumformung.

www.lasco.com – Tel. 0 95 61/ 6 42-0
Sitzschienen geformt auf hydraulischen Tiefziehpressen

Hydraulische Tiefziehpressen eignen sich insbesondere für tiefe Teile, schwierige Formen und besondere Werkstoffe.

Mit der Baureihe TZP sowie zahlreichen Optionen und Automatisierungslösungen bietet LASCO maßgeschneiderte Pressen und Anlagen für die Blechumformung.

LASCO UMFORMTECHNIK
WERKZEUGMASCHINENFABRIK

www.lasco.com – Tel. 095 61/6 42-0