

COST 526 - 'Automatic Process Optimization in Materials Technology' – (APOMAT)  
**Final Report – 31 July 2005**  
**Summary sheet**

Project Code Title	PL1 "Optimization of Tool Shape in the Tests Aiming at Identification of Models Describing Rheological and Mechanical Properties of Metallic Alloys"
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**Funding Situation** (for the whole project)

Amount of money received specifically for COST **6** kEuros

Other resources partially used for the project **100** kEuros (project Mnil, No. 3 T08A 071 26)

**International Collaboration** (mention group and type of work done in collaboration during the whole project)

Collaboration with the CZ 2 (Dr. Jaroslav Horsky, Technical University of Brno). Different experimental capabilities, which allow compression of semi-solid cylindrical samples, were the motivation of the collaboration. The data from hot upsetting test for cylindrical samples, performed in The Technical University of Brno (Czech Rep.), has been used to verify the proposed numerical model using the Inverse analysis. A short term technical visit of Petr Kotrbacek from Brno at AGH-UST was completed.

Collaboration with the CZ 4 group (Dr. Tomaz Žák, Czech Academy of Sciences in Brno). The objective was the optimal filtering of the thermo-magnetic data curves. New methods of filtering of experimental data curves, based on the artificial neural networks and the wavelet analysis were used.

**Industry participation** (mention name of companies and work done in collaboration during the whole project)

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<b>Meetings, visits, exchange of scientists, short term scientific missions</b> (mention main events during the whole project)	Location, date
WG Meeting 1	Saint-Die des Vosges, May, 2002
WG Meeting 2	Budapest, Nov., 2002
WG Meeting 3	Brussels, May, 2003
WG Meeting 4	Kraków, Nov., 2003
WG Meeting 5	Angers, May, 2004
WG Meeting 6	Brno, Nov., 2004
WG Meeting 7	Morschach, May, 2005
STSM (Petr Kotrbacek, Brno University of Technology)	Kraków, Oct., 2003

<b>Main Outcome of the project</b> (mention only the major points)
<ul style="list-style-type: none"> <li>- Application of parameter sensitivity analysis and optimization techniques to dies design (shape characterized by maximal sensitivity to materials rheology and friction conditions).</li> <li>- Comparison of extrusion test with ring compression test was performed. It was proved that in certain conditions the extrusion test is even more efficient than ring compression (e.g. high contact pressures, which are common in industrial processes).</li> <li>- Application of optimization techniques to testing of materials and in the field of semi-solid deformation. The inverse analysis was used for interpretation of performed plastometric tests.</li> <li>- Methodology of identification of the rheological parameters on the basis of various tests and the values of these parameters for selected alloys in the semi-solid state.</li> <li>- Design of the equipment and experimental procedure for testing semi-solid materials. Obtained results were satisfactory and proved that the 'double-cup' extrusion is an effective test for determination of material properties in hot conditions, which is often impossible using standard plastometric tests.</li> </ul>

<b>Publications related to this project</b>
<p>Published:</p> <ul style="list-style-type: none"> <li>A. Żmudzki, R. Kuziak, M. Papaj, M. Pietrzyk, Identification of friction model in extrusion, <i>Obróbka Plastyczna Metali</i>, 3, 2004, 69-78.</li> <li>A. Żmudzki, J. Gawąd, J. Kusiak, M. Pietrzyk, Application of Sensitivity Analysis to Die Shape Design for Inverse Analysis of Two-Phase Materials. Proc. 7th Int. Conf. on Computational Plasticity COMPLAS VII, Barcelona, Spain, 2003, CD-ROM.</li> <li>A. Żmudzki, M. Papaj, R. Kuziak, J. Kusiak and M. Pietrzyk, Optimum Die Shape Design for Evaluation of Material Properties. Proc. 6<sup>th</sup> Conf. on Material Forming ESAFORM, ed., V. Brucato, Salerno, 2003, 139-142</li> <li>A. Żmudzki, J. Gawąd, M. Papaj, R. Kuziak, J. Kusiak, M. Pietrzyk, Proposition of experiment for evaluation of material properties of metal alloys deformed in semi-solid state, Proc. 7<sup>th</sup> Conf. on Material Forming ESAFORM, ed., S. Storen, Trondheim, 2004, 667-670.</li> <li>M. Pietrzyk, A. Żmudzki, D. Szeliga, R. Kuziak, Sensitivity of Parameters of Forward-Backward</li> </ul>

Extrusion Test on Material Properties and Friction, Proc. Conf. Materials Science & Technology 2004, New Orleans, Louisiana, 2004, 403-411.

A. Żmudzki, M. Papaj, R. Kuziak, J. Kuziak, M. Pietrzyk, Validation of the direct-indirect extrusion test, designed for evaluation of flow properties of metal alloys deformed in semi-solid state, Proc. 10<sup>th</sup> International Conference METAL FORMING 2004, Kraków, Steel Grips, nb.3, 2004, 541-545.

A. Żmudzki, M. Pietrzyk, P. Kotrbáček, J. Horský, Various plastometric tests for semi solid materials and their numerical simulations, Proc. 10<sup>th</sup> International Conference METAL FORMING 2004, Kraków, Steel Grips, nb.3a, 2004, 735-739.

A. Żmudzki, M. Pietrzyk, R. Kuziak, M. Papaj, Identification of material model for aluminium alloy using forward-backward extrusion test, Proc. First Invited COST 526 Conf. APOMAT, eds., D. Büche, N. Hofmann, Morschach 2005, 183-192.

A. Żmudzki, J. Kuziak, Neural Networks based optimization in Inverse analysis, Proc. First Invited COST 526 Conf. APOMAT, eds., D. Büche, N. Hofmann, Morschach 2005, 236-241.

A. Żmudzki, J. Gawąd, M. Papaj, R. Kuziak, J. Kuziak, M. Pietrzyk, Propozycja eksperymentu do wyznaczania parametrów reologicznych stopów metali odkształcanych w fazie półciekłej, Mat. 11 Konf. Informatyka w Technologii Metali KomPlasTech 2004, eds. F. Grosman, A. Piela., M. Pietrzyk, J. Kuziak, Zakopane, 2004, 83-90. (in Polish).

Rauch Ł., Talar J., Żak T., Kuziak J., Filtering of Thermomagnetic Data Curve Using Artificial Neural Network and Wavelet Analysis. Proc. ICAISC 2004 Conf., 2004, 1093-1098.

T. Zak, Ł. Rauch, J. Talar „Mathematical Processing of Termomagnetic Curves”, 5th International Conference on Measurement, Smolenice, Slovakia, 2005.

Submitted for publication:

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In preparation:

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Will you continue the actual cooperation with your partners after the end of the action?



Yes



No

Would you participate in a possible “spin-off” action continuing the present one?



Yes



No

Will you continue your present work/collaboration with another European action?



Yes



No