EUREKA PROJECT E!1983- METALTEST

1. General description

Project	E! 1983- METALTEST	**Status**	Finished- 15-Apr-2003
Title	**High-Strength Materials For Cold Volume Forming - An Assortment Of Wires And Rods.**		
Class	Project	**Technological area**	Environment
Start date	03-Apr-1998	**End date**	03-Apr-2001
Duration	36months	**Total cost**	0.59Meuro
Partner sought	No		
Summary	Development Of Technology For The Manufacturing And Processing Of Wires And Rods Designed For The Manufacturing Of High-Strength Pressings In Strength Class 800-1200 Mpa (Mega Pascals) Without Final Heat Treatment.		

Budget and duration

Phase	Budget(Meuro)	Duration (Months)
Definition phase	0.05	4
Implementation phase	0.54	32
Total	**0.59**	**36**

Member contribution

Member	Contribution	Position	Since
Czech Republic	**70.30%**	**Notified Finished**	**15-Apr-2003**
Ukraine	3.50%	Notified Finished	15-Apr-2003
Poland	26.20%	Notified Finished	15-Apr-2003

Participants

Company	Country	Type	Role
Vuhz A.S. Dobra	**Czech Republic**	**SME**	**Main**
Academy Of Sciences/Inst. For Problems Of Materials Science	Ukraine	Research Institute	Partner
Form, Spol S.R.O.	Czech Republic	SME	Partner
Politechnika Slaska, Katowice	Poland	University	Partner

2. Project outline

Project description

The aim of the proposed project is development and optimisation of technology for production and processing of materials (in assortment of wires and rods) designed for manufacture of high-strength pressed pieces in strength class 800-1200 MPa (one strength degree 800-950 MPa and one degree 950-1200 MPa) without final heat treatment.
The end-targeted technology of production and subsequent processing of materials would ensure the required final strength in the interval given above, together with guaranteed cold formability (ductility A5 minimum 15% or 12% and contraction minimum 30 J/cm2 up to -30 degrees Celcius and stability of the given parameters also at elevated temperatures of up to 300 degrees Celcius.
In the course of the project solution there will be analysed influence of structure and sub-structure character of the input material. Impact of the size and character of cold deformation will also be investigated. The influence of individual parameters will be verified in pilot and in industrial operation conditions and subsequent determination of permissible interval for production of individual strength degrees in the above mentioned range.
A programme will be developed for modelling of the cold volume forming process, including development of individual strength plastic characteristics and fatigue characteristics. The aim of this programme is the computer design of manufacturing technology on the basis of knowledge of final construction with respect to the required final parameters.
Considering the fact that in the course of manufacture of most components there is uneven distribution of deformation in material, the final material (product) is also non-homogenous from the viewpoint of final strength-plastic parameters after cold volume forming. In case of conventional production technology, final properties in volume of material are homogenised at final heat treatment.
Owing to the fact that the proposed technology does not comprise thermal treatment it is necessary to propose, with the use of mathematical modelling, optimal parameters of input material and technology of its cold forming.
Technological processes obtained in this manner will be experimentally verified both by pilot and industrial scale testing. On the basis of experimental results the production technology will be corrected and a mathematical model developed to reflect given chemical composition and dimension assortment of wires and rods. During all experimental tests emphasis will be on research of service non-standardised properties of the mentioned materials and specific machine parts made from these materials.
Properties specific for individual products will also be investigated. Knowledge of the whole complex of strength plastic and service properties is absolutely necessary for application of material for production of individual machine parts, namely components for the automotive industry. It is presumed that the developed material and technology of its production would also be applied,in certain cases, to the manufacture of safety components for the automotive industry. In the course of solution,

resistance to fatigue, ageing of material, material brittle fracture properties at temperatures to minus 30 degrees C and stability of properties in the course of ageing will also be investigated in detail.
Tests of basic strength plastic parameters will be investigated in laboratory conditions. Service characteristics will then be studied on testing machines in manufacturing plants - always on specific machine components. At the same time mutual links between strength plastic and structural characteristics of hot-rolled wires and rods and between cold ductility will be verified experimentally.
At production of concrete fastening and joining parts and other machine components it will be necessary for successful implementation of the developed manufacturing technology to process this material (and possibly the technology) and to prepare relevant standards (corporate, Czech, ESN, DIN, ISO).
Keywords: hot rolling, cold drawing, cold forming.

Technological development envisaged

In the first stage, investigation into the influence of individual technological parameters of the controlled rolling and cooling from rolling temperatures, i.e. parameters which have decisive impact on development of structure of hot-rolled material and, thus, to other mechanical properties and cold ductility of material. Influence of individual technological parameters will be evaluated exclusively from the viewpoint of structure and sub-structure in hot-rolled state. Evaluation will focus particularly on grain size and share of co-existing phases.
In the second stage of cold processing technology, there will be investigation into the influence of size of reduction in pass, or of inter-operational annealing with respect to mechanical properties of semi-finished product for cold pressing. During this stage distribution of deformation in individual structural components will be investigated with use of mathematical modelling and share of phases and grain size will be optimised from the viewpoint of optimal deformation distribution between individual phases and generation of optimum strain magnitude at the inter-phase boundary. According to initial presumptions, properties of individual phases and change of properties of these phases in the course of cold processing, are the decisive parameters influencing notch toughness and resistance to fatigue.
In the third stage there will be investigation into the behaviour of materials at cold pressing with respect to final strength, plastic and brittle fracture characteristics of the final product. Mathematical model for description of cold forming would help optimisation of the whole process in such a way that maximum homogeneity of distribution of strength plastic characteristics is achieved in the volume of final products.
Mechanical and service parameters of final products will be assessed under laboratory, pilot and industrial conditions. In this way it will be possible to obtain whole complex of parameters of final machine parts and fastening and joining components which are necessary for their operational application.

Markets application and exploitation

The developed manufacturing technology will be applied, namely at production of high strength components (machine parts and joining and fastening parts), manufactured with use of cold volume forming. Decisive volume of parts manufactured in this way will be applied directly in the automotive industry or with its sub-contractors.
Application of this technology will eliminate final heat treatment and will thus bring substantial savings on energy and production costs. The indirect effect of successful solution of the project will be its contribution to environmental protection - reduction of emissions into the atmosphere - with full preservation of existing final stength plastic and service properties.
According to existing assumptions and results of introductory marketing research, is is possible to consider the use of these materials with a realistic overall annual volume of 10,000 tons in the CZECH REPUBLIC and 20,000 tons in POLAND.

Project codes

BSI

M	control and computer technology
T	materials
U	metallurgy

NACE

2731	Cold drawing
2734	Wire drawing
2840	Forging, pressing, stamping and roll forming of metal; powder metallurgy

3. Main participant

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Organisation type SME
Participant role Main

Contribution to project

Coordination of whole project, development of wire + hot rod rolling and drawing automation technology with respect to final parameters of the pressed products. Verification of parameters in pilot plant and industrial conditions.

Expertise

Twenty years' experience in the given topical area, the results of which have been published in many professional journals and presented at numerous conferences.

4. Partner

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Organisation type Research Institute
Participant role Partner

Contribution to project

Study of effect/plastic deformation on structure/mechanical properties of materials in various production stages in pilot plant/industry. Study of Mechanical properties micro- (hardness, hardness, tensile testing) of deformed materials.

Expertise

There are highly qualified specialists in the field of structural investigations of deformed materials in the scientific team. The equipment and experience of employees will offer scope to fulfil investigations of materials at the highest level.

4. Partner

Company

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Organisation type SME
Participant role Partner

Contribution to project

Application of test results of the material of strength grades 8 + 9 in pilot and industrial conditions. Strength and fatigue tests. Preparation of draft amendment to the standard DIN regarding bolts produced without heat treatment

Expertise

Rich experience in pressing machinery components with complicated shapes. Possibilities to test in pilot and industrial conditions. Numerous publications concerning curves of cold deformation resistance.

4. Partner

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Organisation type University
Participant role Partner

Contribution to project

Determination of technological characteristics of material's plasticity for voluminal cold forming. Development of the required methodology.

Expertise

Twenty years' experience in the given topical area with results published in many professional journals and presented at numerous conferences.