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BRIEF OF FORGING PROCESS DESIGN OPTIMALIZATION ACCORDING TO AUTOMATED PRODUCTION PREPARATION AND GROUP TECHNOLOGY

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ABSTRACT
The paper is focused on the optimization of the design process by means of the information systems tools and group technology principles in aspect to automatized technological production preparation of forging. This stage can by successfully realized by choice of the respectable instruments that are selected from databases handling area, cognitive systems area, etc.
Keywords: technological production preparation (TgPP), group technology (GT), information technologies, expert systems

1. INTRODUCTION
In forging process a given material of a simple geometry such as a billet or bar is transformed under controlled application of energy or power.
Production components often have a complex properties and geometry therefore it is necessary correctly to define shape, size, accuracy and tolerance zone, strength, hardness, roughness, etc.
Forging operations comprises /affected/ all the input variables such as semiproduct (billet, bar, ...) and die properties, the conditions at the die - workpiece interface, the mechanics of the shape change in the work space and the characteristics of the process equipment.
Key technological parameters /factors/ in designing and developing of the forging process:

- Final product properties, customer requirements,
- Semiproduct properties: shape and size, chemical composition and microstructure, flow properties under processing conditions (flow stress as function of the strain, strain rate and temperature), thermal and physical properties,
- Tool (dies, anvils,...): geometry, surface conditions, material and hardness, surface coating, stiffness,
- Interface conditions: lubrication, friction, heat transfer, rigidity,
- Production rate /batch/,
- Power and energy capability of shaping machines,
- Worker skills and firm equipment.

2. RATIONAL PRODUCTION PROCESS DESIGN CINDITIONS
In design of the forging production process it is possibly to use various instruments and principles of the automated TgPP with a view to optimalization, for example:

- suitable user environment (implicit help to all relevant problems, …),
- maximum full database containing all information (it is possible probably only relatively, except specifically problems) and suitable data management ,

- optimal tools for information database management (SQL language,sorting, filtering, clustering, ...),
- expert systems application for the experiences and digital information transformation to knowledge and their using as input to IT systems for instance (Fig. 1),
- group technology /GT/ principles application and their using for optimalization of the process design (Fig.2,3) ,
- genetic algorithms application – global extreme of the functions researching (problem can be determination of the fitness function),
- optimal interaction of the IT systems (CAPP, CAE, CAQ, DB…) and human thinking ,
- using of the quality management tools throughout design process (FMEA, SPC ...) etc.

Many of tasks can be realised by means of the common tools as MS EXCEL, MS ACCESS, for example sharping /precising/of the calculation, data sorting and filtering according to using of the table /database/ parameters, etc.

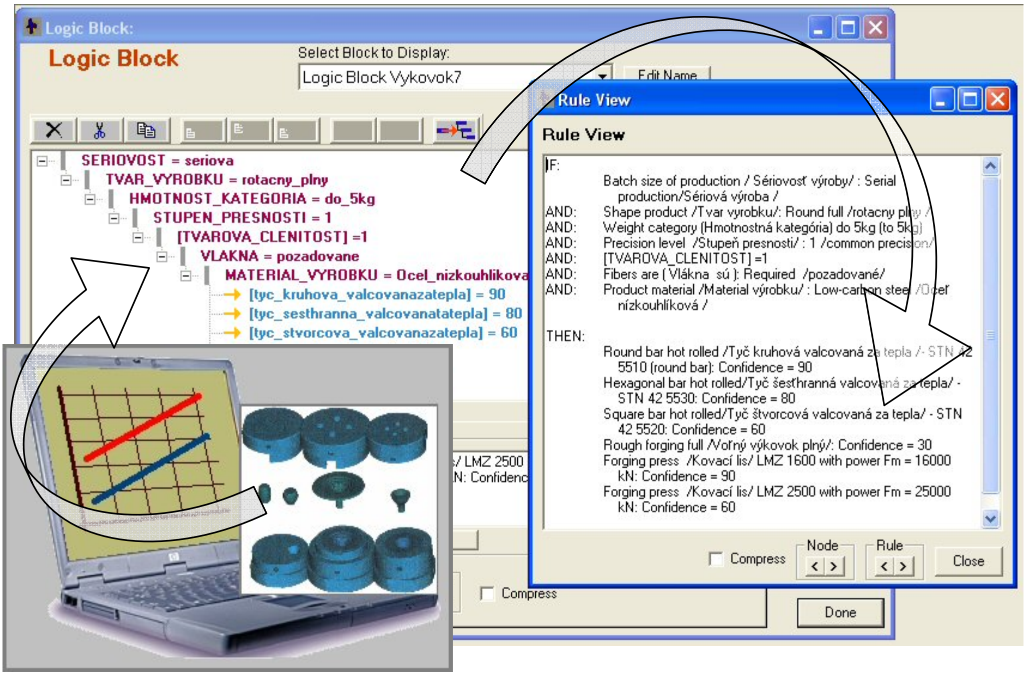

Figure 1. Example of expert system using – rules definition

3. FORGING CLASSIFICATION IN TECHNOLOGICAL PREPARATION FRAME WITH ASPECT TO PARAMETERS CORRECTION

In further will be analysed the determination of shape coefficient of the forging and corrections of the power and energy parameters of forging process. For that can be applied energy /*forging power*/ correction by means of the forgings shape classification according to STN EN 10243-1 (Fig.2.), forgings shape classification following ČSN 42 9002 or VUTS Brno forgings class map (Fig.3.).

Example of steps GT application with aspect to optimalization of the forging machine choice:

- Accomplishment of the forged piece shape classification code items (*group, sort, class*) transformation to numeric form (*natural number*),
- Functional expressing of the shape complexity coefficient dependence on the forging shape change,
- Correction energy and power value by shape complexity coefficient,

- Graphics presentation of the corrected parameters (Fig.3.),
- Forging machine (*press*, *hammer*) choice.

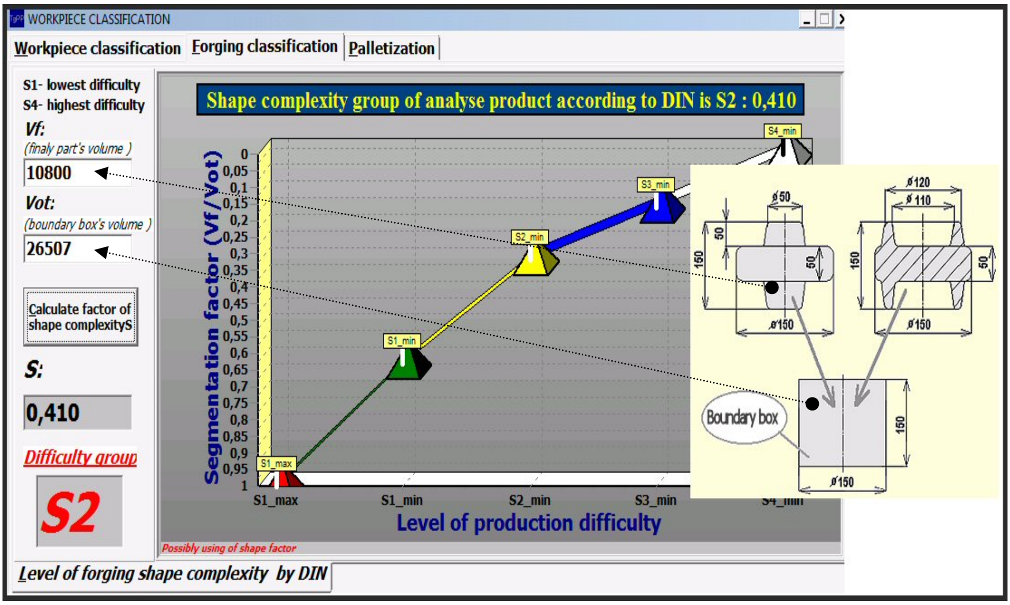

Figure 2 Example of forging shape classification according to EN, DIN standard

On the ground of the picture (Fig.2.) it is possible to deduce that in such a way (STN EN 10243-1) of the shape complexity code (*factor*) determining does not expressly describes reality.
For that it probably is suitable application of the conjuction multiple approachs to forging energy↔power parameters analyse and correction.

The brief illustration of the forging shape classification , power computing and power correction according to ČSN / *STN*/ 42 9002 standard:

The classification code → (XXDT XS XP XT) accordance "Classification of drop forgings shape complexity standard":
XXDT – sort and class,
XS – group,
XP – subgroup,
XT – technological aspect (*parting plane position, …*).
The classification code has to be transformed to the natural number before the mathematical /*calculating*/ operations application.
The brief description of determination functional expressing dependence of shape complexity coefficient on shape complexity:

- Shape complexity coefficient = F (shape complexity),
- Shape complexity coefficient = F [f1(XXDT); f2(XSXPXT)],
- Force, energy = F (shape complexity coefficient...).

4. CONCLUSION

It is naturally that optimal using of the computer (*IT*) support can be conditional with suitable information database and its data handling, expert systems, adequate measure of the knowledge and erudition. The design process rationalization consists in convenient applying of the computer technique /software/ and constructive interaction of the technician ↔ system. The illustration pictures in the article are output of the education software created and used on Department of Automation and Production Systems.

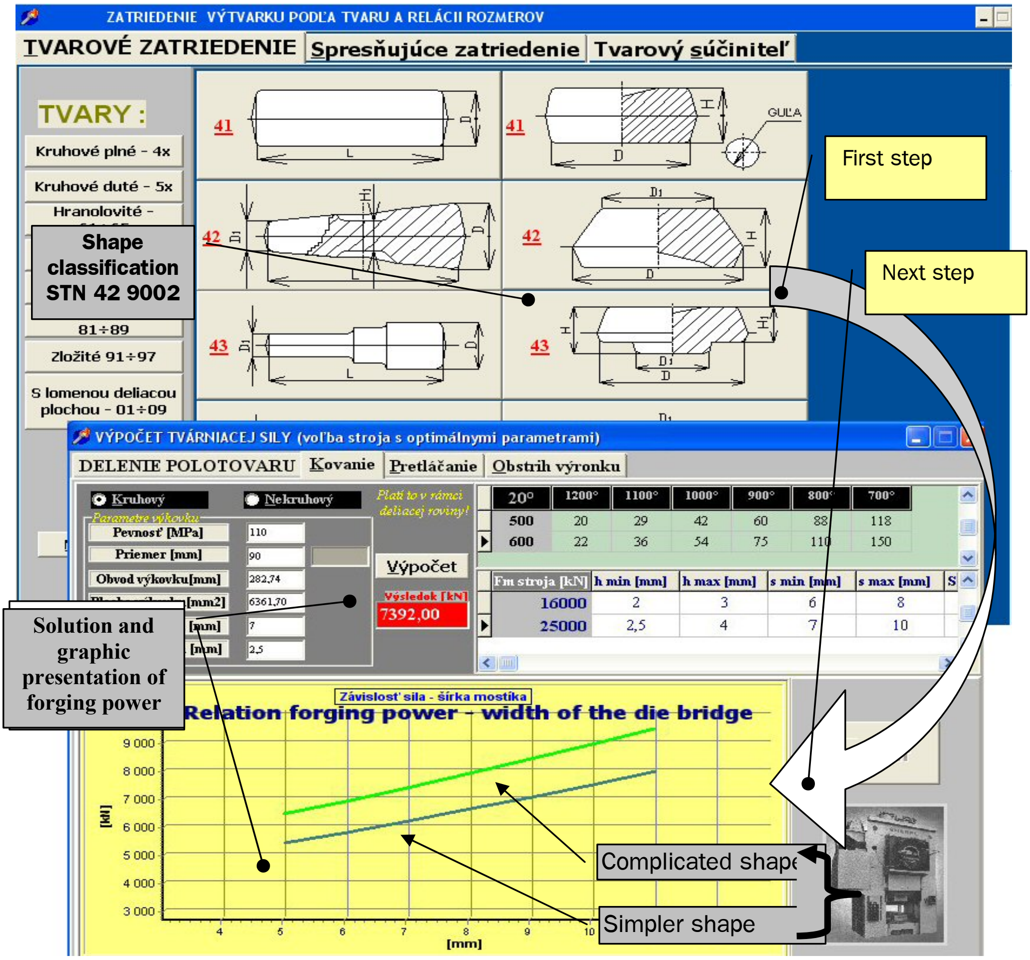

Figure 3. Example of the relation of the forging shape classification - forging power

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