19h International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2015, Barcelona, Spain 22-23 July 2015

ANALYSIS OF THE SEMI-PRODUCT CHOICE IN DIE FORGING PROCESS

Jozef KUBA Ing., PhD.
KAVS, SjF, ŽU Žilina,
Univerzitná 1, 010 26 Žilina.
Slovakia

Ján Moravec, Doc. Ing., PhD.
KAVS, SjF, ŽU Žilina,
Univerzitná 1, 010 26 Žilina.
Slovakia

ABSTRACT
The article describes problem of the semi-product design optimalization according to input parameters in forging process realization, especially die forging. The paper also analyses attributes influencing material consumption standard. One is focused on boundary conditions determination and digitalization of rules related to optimal material utilization.
Keywords: semi-product choice, die forging, material consumption standard, process analysing

1. INTRODUCTION
One of key matter of the industry practice is gaining of lowest material consumption in production process frame. In case of forging process the semi-product entering to this process can have various realizations according to final product. The semi-product is influencing by final forging parameters but also the operating conditions production company. The input material is possibly to order not only on base of shape and dimension parameters of the cross-section i.e. round bar, square bar (rolled or drawn), but also according to the total length and the length limit deviation. The length tolerances range in different scales and that depends on agreement between supplier and consumer, that tolerance zone will be accepted. The important fact is that with decreasing value of tolerance zone scale of the supplied semi-product length its cost (price) is increasing, according to the possible applying of percentage surcharges from supplier.

2. DATA PROCESSING
On the basis of the above-mentioned facts it is possible to state, that exists quantum variations of cross relation presented parameters(total length, length tolerance zone, price surcharge).

$$L_{opt} = f(l_n, tp_l, cp),$$
$$Ms_{opt} = f(L_{opt}, S, \rho),$$
$$Q_{opt} = f(Ms_{opt}, Mc).$$

L_{opt} – semi-product optimum length,
Ms_{opt} – optimum gross weight,
Q_{opt} – material consumption level,
Mc – forging dry weight,
S – semi -product cross section
ρ – material specific weight,
l_n – length of semi-product,
tp_l – length tolerance zone of input semi-product,
cp – price surcharge relative to tolerance zone reduction of semi-product length.

Except these factors too another factor influence on L_{opt} , for example length of bars ends treatment jig length of dividing machine / press, saw/, and also limitation according to cell furnace dimensions - hot dividing condition (Fig.1.).

3. PROCESS ANALYSING ACCORDING TO SEMI-PRODUCT

The semi-product ends alignment length is affected by its cross section (*the smaller cross-the smaller alignment length*) and also by semi-product forging technology.

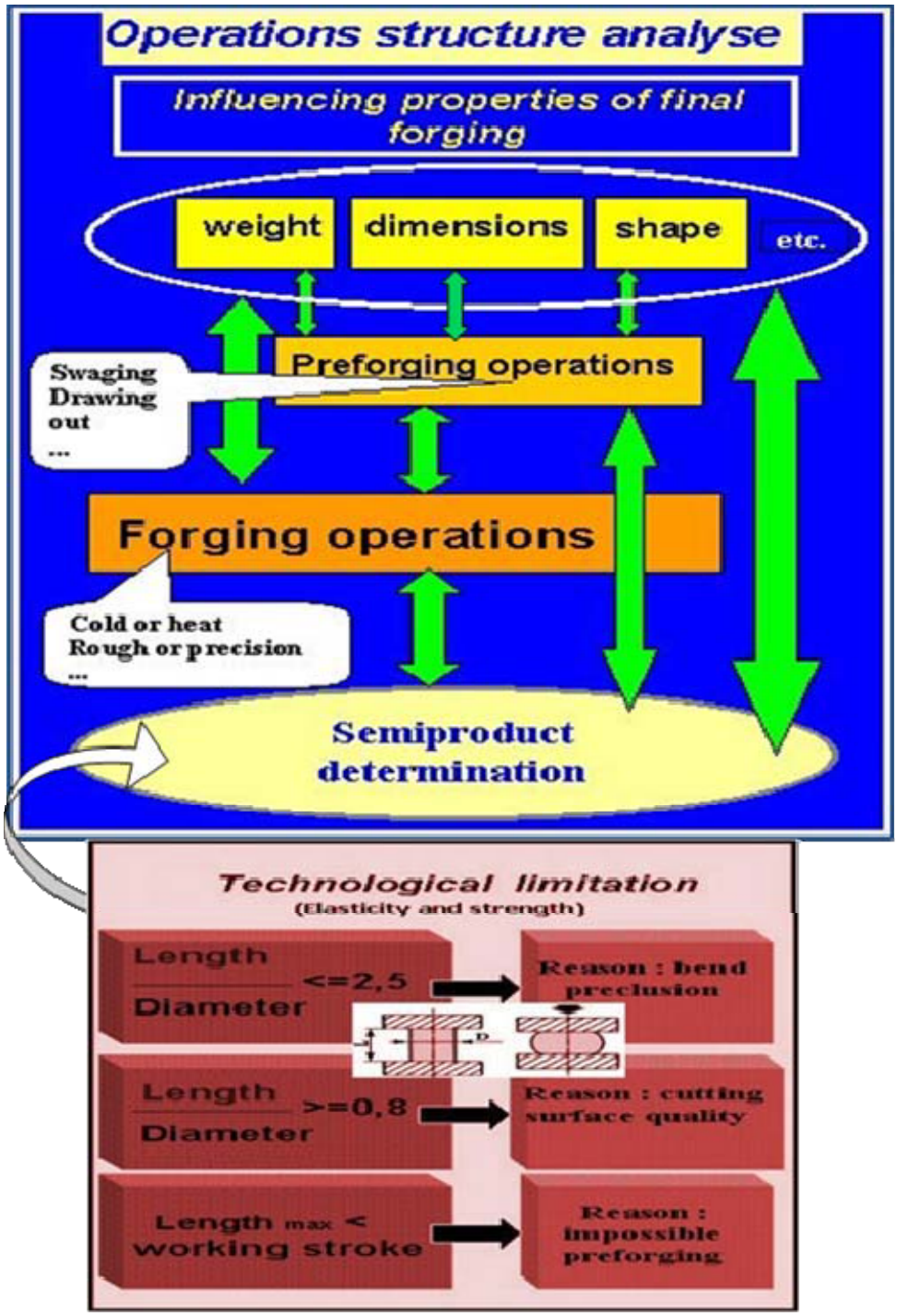

Fig.1 Relation semi-product- final product and technological limitations

In case of the longitudinal forgings- horizontal working, when it is warranted that the defects of the semi-product end run to the flash space and become the waste part in cutting flash, we can alignment to ignore. Scheme on Fig.1 represents the semi-product determination affected by final product shape, its precision, walls thickness, size of the production and available machinery. The character of applied roughing, forging operations and specific technological limitations in term of the forming theory also have to be considered.

Already mentioned determination of the suitable semi-product alignment has key function. It is

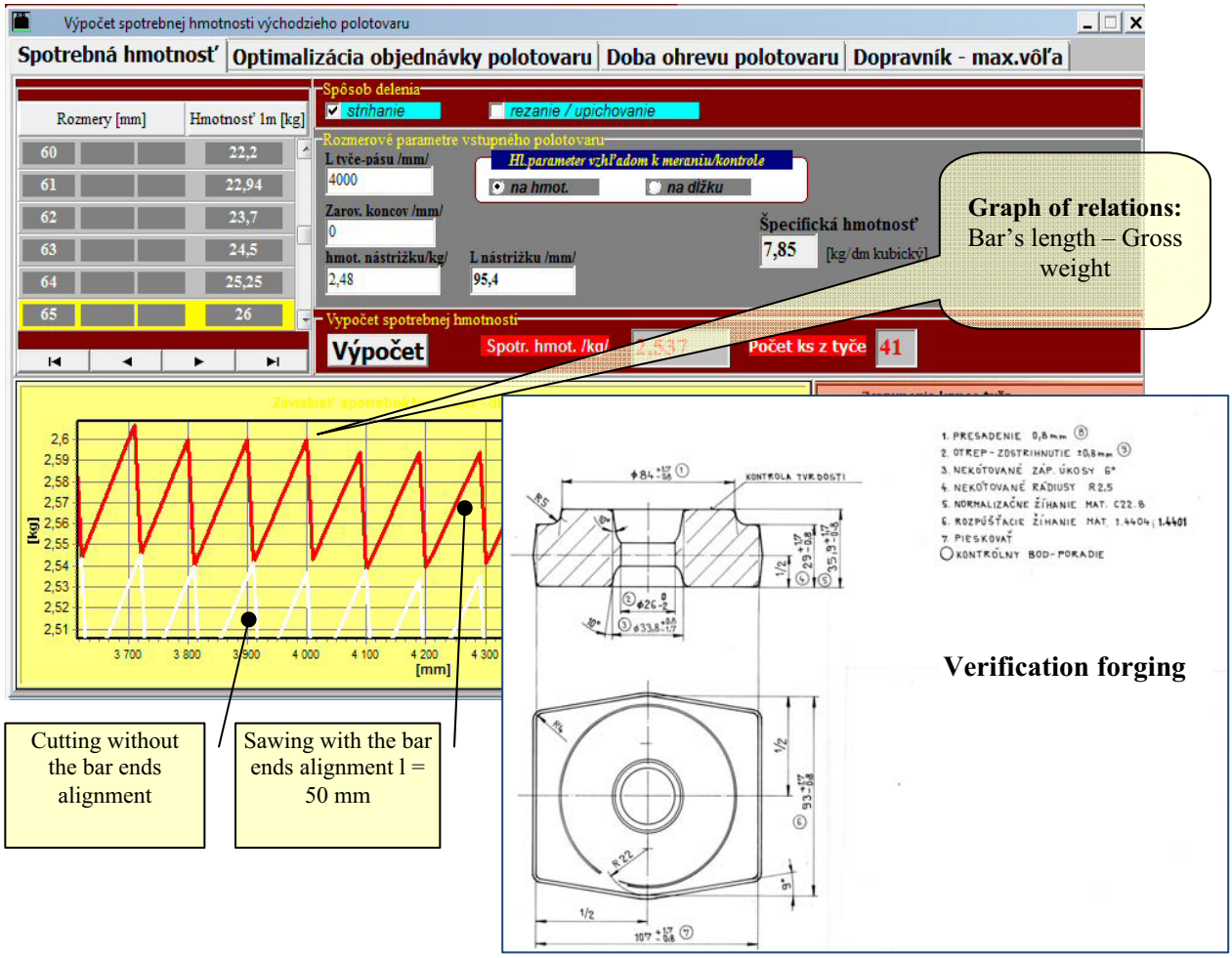

Fig.2. Illustration example of gross weight determination

obviously that substantial measure influences on gross weight how it results from graph lines (*Fig.2.*).

The primary problem is not only development of the suitable algorithm for determination if the optimal input semi – product dimensions that would be universal applicable. Important mater also is the correction for actual conditions according to specific requirements of the production plant. That is already mentioned limitation in term of specific parameters, e.g. fastening length dividing equipment, dimensions heating equipment at hot cutting of the input material, etc. That should have been implied in algorithm in form of by user's modifiable variables.

According to the meaningful computer support application in choosing of input semi-product for die forging process that also has effect the certain classification based on group technology principles (*application of coding e.g.*). It is necessary to define a lot of attributes that indicate geometrical properties as well as non-geometrical properties of the input semi-product (*Fig.3.*).

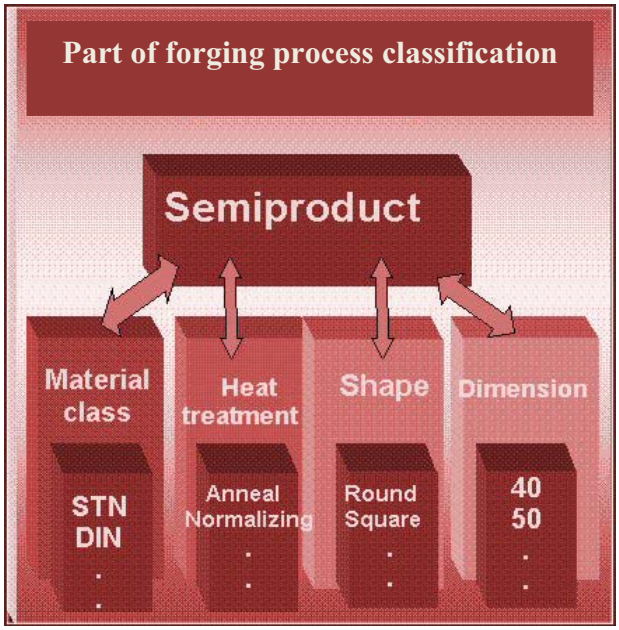

Fig.3 Example of input semi-product classification

This approach supports possibility adequate SQL language utilization in frame of the semi-product (*bars, billets*) high capacity database filtration or sorting on base suitable defined sequention of SQL commands (*select, order, etc.*) .

Illustrative example relative to Fig.2.:

SELECT * FROM name_table WHERE field_name = expression;

SELECT * FROM tablename WHERE field1= '65' and field2= 'C 22.8';

(That command selects all information of the database about round bar Ø= 65 mm produced from material C 22.8)

4. CONCLUSION

It is possibly to state that total automation of the digital analysing and design of the input semi-product can be in specific cases complex problem exigent completion multi-factor analysis.
That is made relatively great number of interconnected parameters in frame of the die forging process in relation the semi-product and final product that would satisfy consumer requirements.

5. REFERENCES

[1] KREITH, F., GOSWAMI, Y.: Handbook of Mechanical Engineering, , CRC Press LLC, USA, 2005, ISBN 0-8493-0866-6

[2] KOSTKA, P.: Metal Forming, STU Bratislava. ISBN 80-227-1801-7

[3] KUBA, J. MORAVEC, J.:Brief of the non-cutting process design optimatization and its using in sight of the automation technology production preparation, Terotechnologia 2009, Kielce, October 2009, ISSN 1897-2683.

[4] STN EN 10243-1 –Steel die forgings, June 2000

[5] DELPHI and C++Builder, Start Tutorial, Embarcadero Technologies, Inc, 2010

[6] Infoware, Digital Visions, s.r.o., Data quality, Február 2005, ISSN: 1335-4787

The article was created in frame of VEGA 1/0551/14