13th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2009, Hammamet, Tunisia, 16-21 October 2009

AUTOMATIC DESIGN OF TECHNOLOGICAL PROCESS OF FORGING

Mirlind Bruqi
Mechanical Engineering Faculty
10000, Prishtina
Kosova

Avdyl Bunjaku
Mechanical Engineering Faculty
10000, Prishtina
Kosova

Lutfi Zharku
Ministry of Trade and Industry
10000, Prishtina
Kosova

Arben Gjukaj
KEK
10000, Prishtina
Kosova

ABSTRACT
We can get items of different configuration from the simplest to the most complex shapes.
In order to gain an optimal technologic forging process and to avoid losses of a larger scale, an appropriate choice of the rounding ray and of the forging inclination is needed.
So far these parameters chose by graphic and analytic methods.
Further in this paper is given the procedure of automatic calculation of these parameters by computers.
Key words: Forging, forging inclination, rounding rays, automatization.

1. INTRODUCTION
Methods for manufacturing using forging, are mostly utilized in mass serial production. The benefit of using forging is the minimum of discarded material and minimal finnishing proccess using cutting or without it, and their quick assembly into machinery. These methods of manufacturing with deformation, are applicable in different sectors of industry, such as automotive industry, railcar industry, farming equipment, household equipment etc.
There is a large number of factors to be considered when selecting rounding rays and forging inclination such as:

- Type of technological process,
- Type of material to be machined,
- Quality of the surface of the tool,
- Work surface of the work piece,
- Deformation temperature,
- The speed of deformation,
- Lubricant, etc.

2. FORGING INCLINATION
While building the forged parts, you should take under consideration it's geometrical shape, because of the specifics of the forging process, selection of the correct material and raw material, preparation of the thermal treatment, method of forging based on the mechanic-technological properties of the part, and also the construction technology of the part in connection with the most economical way of finishing the forging and finishing process of the part.

Forging inclination are necessary in order to be able to extract the forged part from the tool. They should be designed in such a manner as to allow, the extraction of the forged part without any special extraction tool.
The angle of inclination should be proportional to the friction coefficient, and the compression tension of the material, in the engraving of the press.
Friction force Fμ which holds the forged part in the engraving will be dependent on the friction coefficient μ, material compression tension p, contact surfaces of the forged part in relation to the tool and the angle of engraving coefficient, Figure 1.

Friction force is:

$$F_{\mu} = p \cdot \mu \cdot \cos\alpha \ [daN] \qquad \ldots (1)$$

Where:

μ friction coefficient which depends on the type of material, temperature and the current state of the contacting surface;

p [daN] – compression tension;

A [mm^2] – surface of contact friction.

The usage of forged inclination is as follows:

1°, 3°, 5°, 7°, 9°, 12°, 15°, or

1°, 3°, 6°, 9°, 12°, 15°.

The size of forged inclination is dependent upon the on the relation between the masses of the hammers upper die against the bottom. If this relation is small then the angles of inclination are small too. If the report between the upper die and bottom part is 0.05, then the angle of inclination is $\alpha = 7° \div 10°$. If relation is 0.03, then angles of inclination are $3° \div 5°$.
In practice we should take care that the forging angles be as small as possible. Difference between inner and outer inclination should be a minimum of 2° in order to ease the extraction of the part for cooling.
All forged inclination is standardized because the much smaller assortment of cutting tools to be used (mills) for making the engraving.
When working on parts with over pressure, the inclination angle is $0 \div 1°$.
Research shows that by decreasing the angle during all other similar conditions also decreases the deformation force. Increase of the deformation force is expressed during angle change to 5° (1° ÷ 5°). Continual increase of the angle produces a lower intensity of force increase.

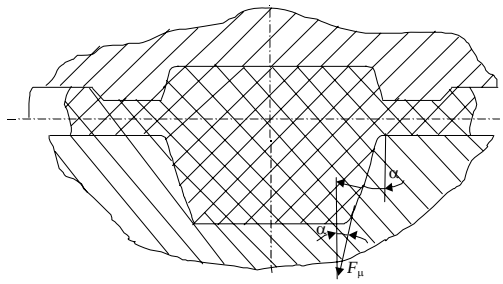

Figure 1. Friction force during material flow on the die

If the forged inclinations are smaller then the mechanical processing goes down for about 20%.
How to lower the forged inclination?
This can be achieved by:

- Combination of hammer forging – horizontal forging machine;
- Increasing of preparation engraving;
- Combination of hammer forging - press;
- Using of special tools for removal of angles and using of calibration;
- Intensive use of lubrication device.

In real life all these combinations are possible, that is why utilization of inclination is still not researched enough.

Besides the methods we discussed earlier, forged inclination can also be calculated automatically by using a computer. For this method a certain algorithm has to be devised, which is programmed using computer Figure 2.

3. CONCLUSIONS

- The development of automatic forging inclination and rounding rays, allows for shortening of the time It takes to acquire these parameters, and also the overall technical preparation;
- This time of automation, defines a higher productivity, lower usage of materials, better production characteristics, lower qualification manpower, in other words all elements which are functional, even for low serial production.

4. REFERENCES

[1] S. Kalpakjan.: Manufacturing Engineering and Technology, Practice Hill, 2006
[2] M. Roosi.: Stampaggio a caldo dei metalli, Hoepli, Milano, 1984.
[3] G. Oehler.: Lavorazione della lamiera, Tehniche Novve, Milano, 1986.
[4] A. Berruti.: Stampagio e presse, Torino, 1964.
[5] E. Bugini.: Principi per la lavorazione plastica dei metalli, Capelli, Bolgna, 1964.
[6] G. Galili.: Tehnologia Meccanica – Lovarazione plastiche, Milano, 1979.
[7] B. Musofia.: Obrada metala plasticnom deformaciom, Svjetlost, Sarajevo, 1988.

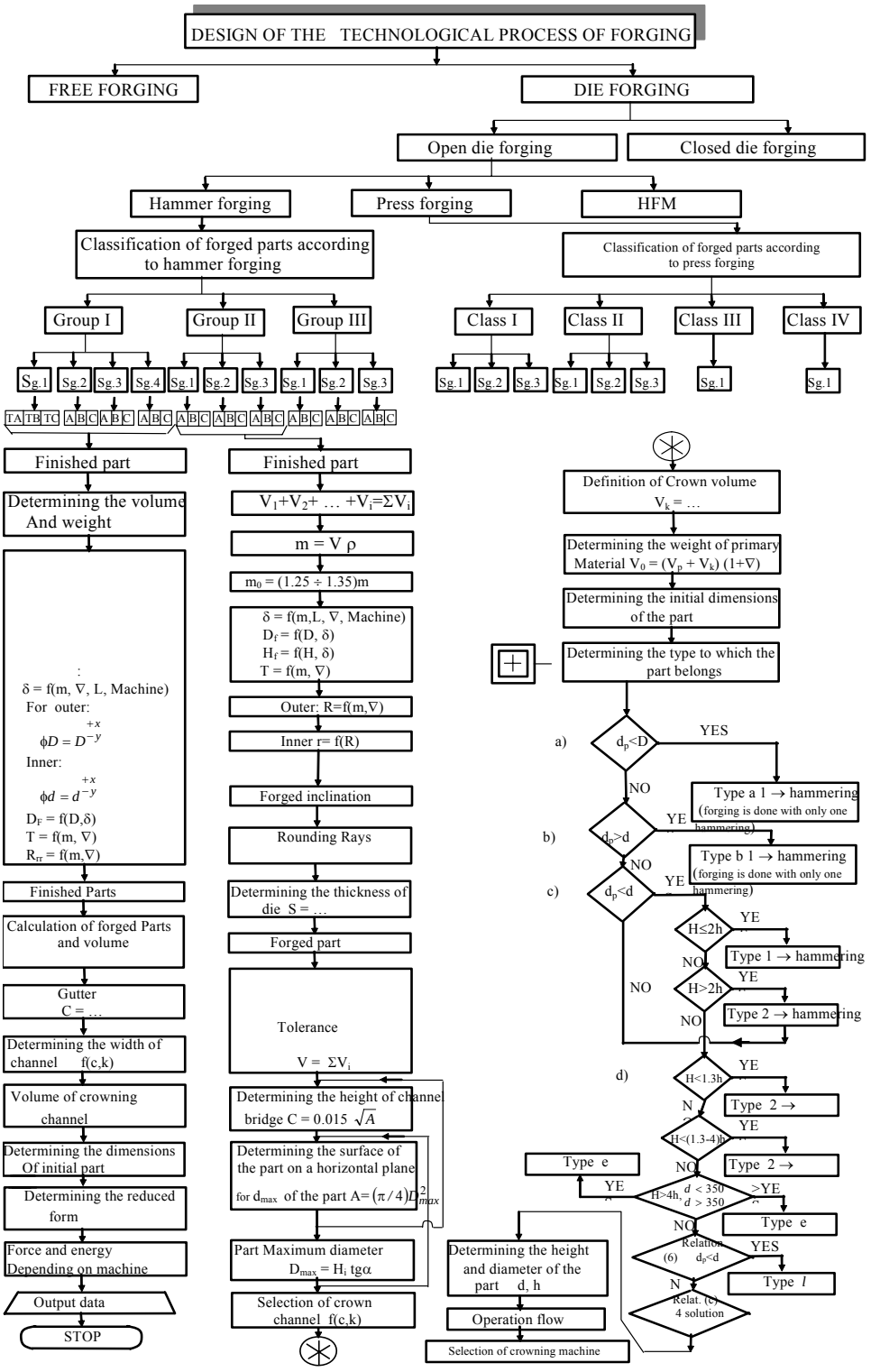

Figure 2. Algorithm for construction of forging technology.