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HYDROFORMING TECHNOLOGIES

Edina Karabegović
University of Bihać Technical of Engeenering
Dr.Irfan Ljubijankić bb, Bihać
Bosnia and Herzegovina

I. Karabegović, M. Mahmić, E. Husak
University of Bihać Technical of Engeenering
Dr.Irfan Ljubijankić bb, Bihać
Bosnia and Herzegovina

ABSTRACT
Hydroforming is classified in unconventional processes of the metal forming that are used for forming metal sheet and tube thinwalled elements, as other spatial elements. Technological forming processes by fluid are: deep drawing, stretching, bending, extruding, tube forming, etc. In the paper basic characteristic of some hydroforming technologies of sheets and tubes are given.
Keywords: new technologies, deformation, hydroforming, fluid, sheet metal, tube

1. INTRODUCTION
Development of hydroforming technology started at the end of 40-ies of the last century. Previous researches have shown that there exists an evident advantage accomplished with these technologies compared to the conventional metal forming processes, which gives the main reason for their wider application in industry. Forming of thin walled elements such as metal sheets and tubes were developed according to the needs of automotive and airplane industries [1,2,3,4].

2. HYDROFORMING
Hydroforming is technology which is based on influence of fluid under high pressure to the inner or outer side of workpiece wall. Implementation success of hydroforming process depends of a correct election of: die, material, fluid pressure and other process parameters. Hydroformig process should be implemented by using optimal parameters of the forming process that would allow stable and successful hydroforming process [1,3,4].

2.1. Hydroforming of sheet metal
Sheet metal forming by fluid under pressure is applied in deep drawing, stretching of sheet, hydroforming of welded sheets, hydroformig with metal heating etc.
The basic tendencies of development of sheet metal forming process by fluid under pressure are: improvement of sheet deformability, improvement of tribological forming conditions, optimization of forming process, development of new forming processes and new materials, automation of forming process, application of flexible tools, and implementation of flexible and intelligent systems.

2.1.1. Deep drawing
With deep drawing processes by fluid can be formed parts with complex shapes. Some of advantages of deep drawing processes by fluid are: reduction of the number of operations, cheaper processes (fewer tools), simple die, forming complex shapes, reduction of friction during process, higher surface quality. Figure 1 shows example of sheet forming by deep drawing [1,2,4].

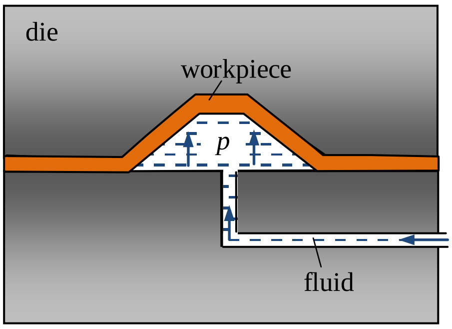

Figure 1. Sheet metal deep drawing by hydroforming

With technology of deep drawing by fluid higher ratio of drawing are achieved, number of required operations and dies are reduced and manufacturing costs by part is reduced. Process is suitable for sheet metal forming and large dimension parts and complex geometrical shapes.

2.1.2. Stretching of sheet metal

Forming of sheet metal by stretching process implies sheet metal tension by grippers and then stretching and bending over mould. By fluid application in stretching of sheet metal, friction is significantly reduced and quality of formed parts is increased. Drawing of sheet metal starching process by fluid is showed on Figure 2.

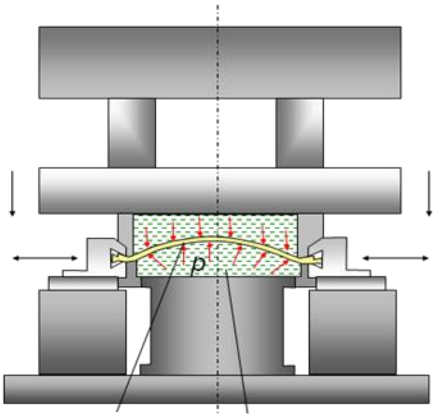

Figure 2. Sheet metal stretching by hydroformig

Application of stretching of sheet metal to form parts for automotive or an airplane industry is mostly used in combination with deep drawing process [3,4,5].

2.2. Hydroforming of welded sheet metal

Hydroforming process of welded sheet metal is applied in manufacturing of welded tanks, automobile doors and etc. Figure 3 shows an example of hydroforming of welded sheet metal [3,6,7,8].

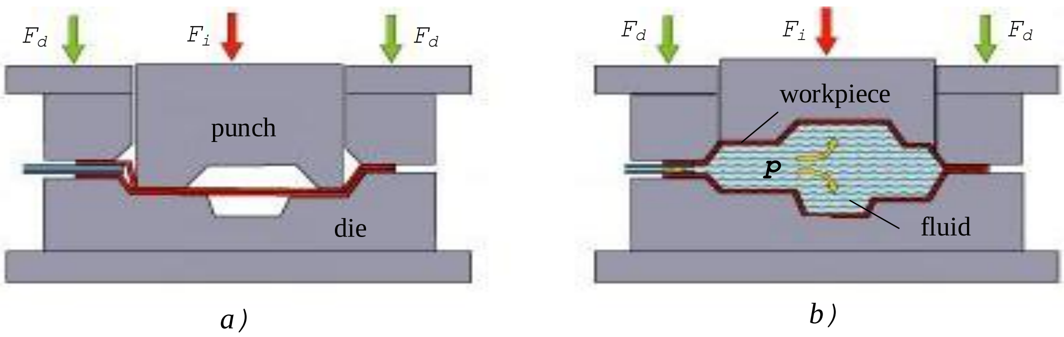

Figure 3. Hydroforming of welded sheet metal

Hydroforming process of welded sheet metal comprises following phases:

a) Positioning of welded sheets in mould and filling space between sheets by fluid under pressure, (performing phase).
b) Workpiece hydroforming to final shape (calibration phase).

Parts formed by this technology is showed on Figure 4.

Figure 4. Parts formed by hydroforming of welded sheets

2.3. Hydroforming of tubes

Hydrofoming process of tubes is carried out in following phases:

a) workpiece positioning (tube) into die,
b) sealing by axial punchers (closed die),
c) tube filling by fluid under pressure (closed die),
d) axial displacement of punchers-performing (closed die),
e) synchronized influence by fluid pressure and axial punchers - calibration (closed die),
f) finished forming process (open die).

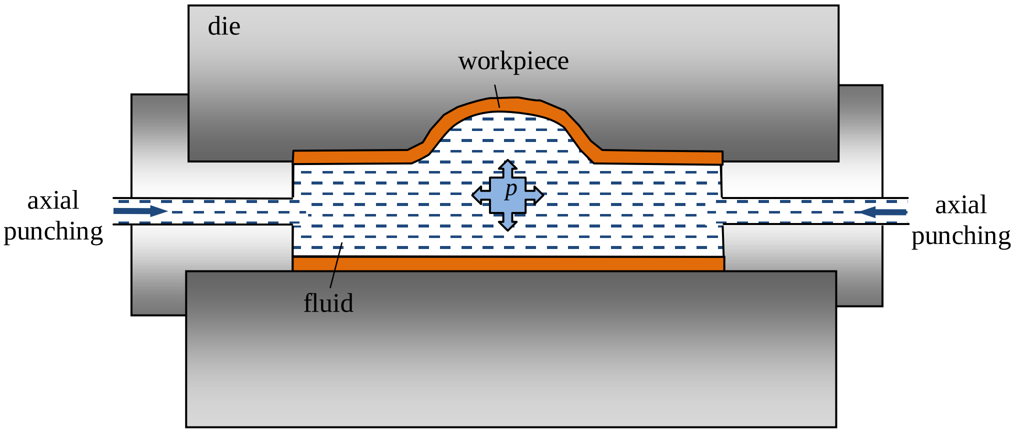

Figure 5. Hydroforming of tube

Advantages which are obtained by application of hydroformig processes of tubes are: better mechanical and structural characteristic of parts, saving material and energy, possibility to form parts with complex geometry [4,5,6].

2.4. Hydroforming of metal by heating

In order to increase the deformability of aluminum and magnesium alloys heating of workpiece before hydroforming process starts is performed. Temperature influence to hydroforming process for results has enhancing the ability of metal forming. Figure 6 shows an example of temperature influence (150°C, 200°C i 250°C) to part forming ability [10,11].

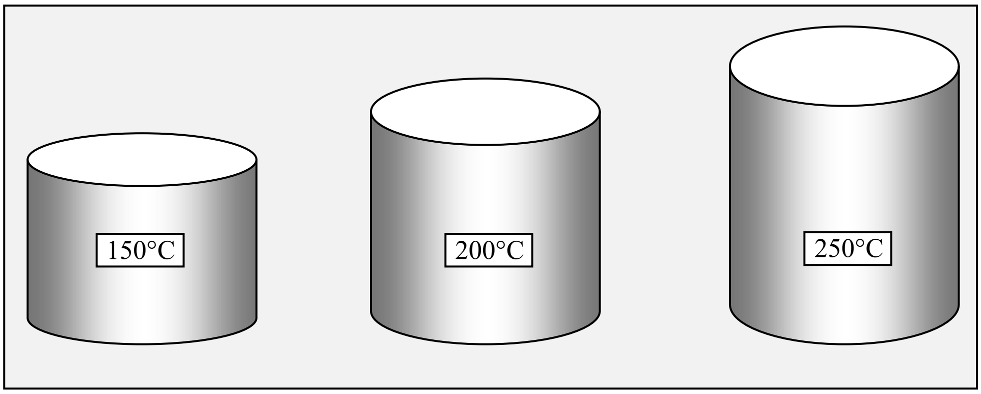

Figure 6. Parts formed by heated Hydroforming

Application of magnesium alloys is significant for electro industry (digital cameras, computers, mobile telephone apertures parts, etc.)

3. CONCLUSION

Justification of the application hydroforming process is in advantages and characteristics which this process offers compared to the classical processes of sheet and tube forming. Quality of product is higher compared to the classical methods, because tribological conditions of plastic forming are significantly better. Process is not to demanding, tools are cheep, material utilization is better, possibility of automation and application to wide variety of products. Hydroforming is used for forming parts by metal sheets and tubes, larger dimensions and complex geometrical shapes, especially for forming tubular elements which could not be formed by other classical forming processes.

4. REFERENCES

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