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HYDROFORMING PROCESS

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ABSTRACT

Until recently hydro forming of sheet and tube was not considered for automotive manufacturing due its high cycle time. However, advances in hydraulics and intelligent press design over the time have reduced cycle time considerably making it attractive for automotive manufacturing. In addition, hydro forming of sheet and tub e offers benefit s such s a) low tooling cost, b) better properties (dent resistance and energy absorption) of part after forming, c) ability to form complex shapes and integrated structures (hydro formed tube may replace an assembly from several stampings). These reduce assembly cost and time thereby represents an attractive alternative to stamping in the current market trend towards smaller batch size of new models.

Metal forming using liquid media is classified as shown in Figure 1. It is broadly classified into sheet And tube hydro forming depending on the input pre form. Further, sheet hydro forming is classified into hydro mechanical deep drawing and high pressure sheet hydro forming depending on the male or the female die that has the shape/impression to be formed. High pressure sheet hydro forming is further classified into hydro forming of single blank and double blank depending on number of blanks being used in the forming process. This paper provides an overview on the advances in press (machines) & tools, tests for material and lubrication selection and strategies for process design through FE simulation in all the areas of sheet and tube hydro forming. Also, warm hydro forming of magnesium and aluminum alloy sheet is briefly discussed.

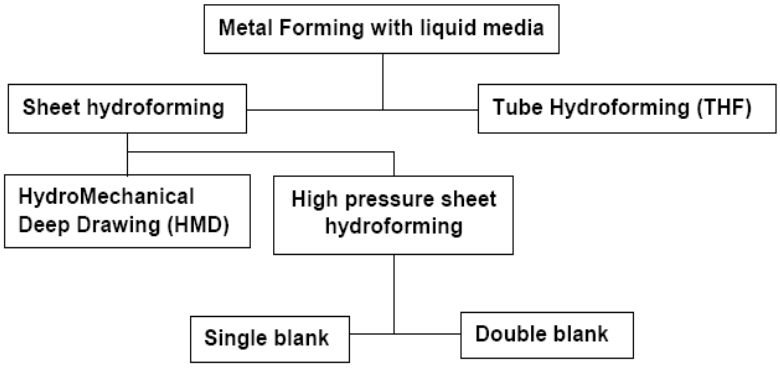

Fig. Tree dia of hydro forming

I. INTRODUCTION

LITERATURE SURVEY

LIN ZHOU:- He had discovered the process of flexible hydro forming is a combination between the hydro forming and the mutipoint flexible forming, which allowes synergy of the advantages of two process.

J.C.GELIN, C.LABERGERE,S.THIBUD:-They had discovered the paper is concentrated on the last developments related to process design for sheet and tube hydroforming.

AHMENTOGLU .MALTEN:-He had discovered provides comprehensive detail of increasingly preferred hydro forming process. Learn how to successfully implement hydro forming ,the manufacturing process that brings together low cost, low mass, improved structural performance and improved quality.

A.EI HAMI, B.RADI AND A.CHEROUT:-They had discovered increasing application of hydro forming techniques in automotive and aerospace industries is due to its advantages over clasical processes as stamping or welding ,particularly tube hydroforming with various cross sectional shapes along the tube axis is well known and widely used technology for mass production.

Types Of Hydro Forming:

There Are Four Main Types Of Hydro Forming

1. Hydro forming of tubes, usually at low pressure, is the most widely used technology at present, with hydro formed tubular parts offering improved integrity and structural performance

2. Low pressure hydro forming simply re-shapes tubes, producing a very good shape, but is not as useful if better cross-section definition is required.

3. High-pressure hydro forming totally changes the tube shape and alters the length to circumference ratio by up to 50%. It gives very good tolerance control, being a highly robust process.

4. Panel hydro forming at high pressures is used in the aerospace industry, and is expected to be used for applications in the automotive industry in which hydro forming is needed to get the right material flow.

Lubrication Selection:

In THF, depending on the deformation mechanism, the entire deformation area can be classified as guiding zone, transition zone and expansion zone. In guiding zone the tube is subjected to compressive axial stress due to feeding from either sides resulting in thickening of the tube and contraction of the surface of the tube on which lubricant is applied. In expansion zone the tube is subjected to biaxial tensile stress resulting in thinning and surface expansion. Transition zone mark the intermediate stage. Thus, a good lubricant in THF should be able to perform well in all the three zones. ERC/NSM has developed a)Guiding zone test b) Transition zone test and c) Expansion zone test emulating the deformation mechanism and the contact pressure in respective zones to screen the commercially available lubricants for THF.

Press And Tooling :

THF press design plays a dominant role because it significantly influences the cycle time and the economics of the process. Figure 6 shows three basic press concepts for THF

a) conventional design (long stroke design concept),

b) new design (short stroke design concept), and

c) similar to concept (b) without any locking mechanism.

Among the basic concepts, concept (b) is used widely because a) it reduces cycle time with long stroke cylinder that is used mainly to move the top die up and down fast with less fluid pressure, b) Short stroke cylinder requires less volume of fluid to generate the required high pressure thereby reducing cycle time,

and c) Mechanical locking of top die eliminates the high pressure hydraulic system for top die thereby reducing cost and making design more compact. Figure 7 shows the different types of presses available in the market that has adapted the three basic concepts. They basically differ in either the structure of press frame or typing of mechanical locking mechanism used.THF press with modular design concept. The benefits of this design area)

useful for a design that requires several step of production (performing –hydro forming) and b)multiple ram can be locked together in order to form a large part.

II. THEORY

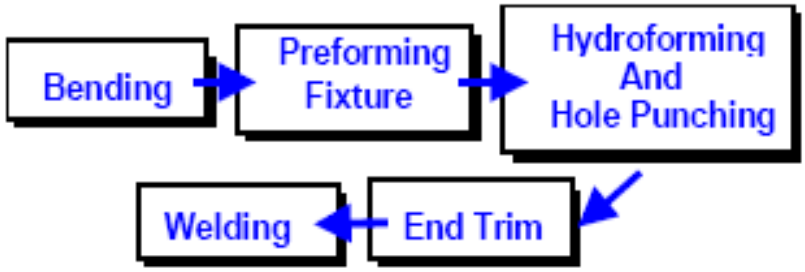

Fig7. PSH Process Layout

III. HIGH PRESSURE HYDRO FORMING (HPH)

This process avoids pinching by intentionally designing the tube periphery to be smaller than the desired finished product. This pressure is significantly higher, typically 60to80 percent higher than that used in single-stage pressure sequence hydro forming (PSH). The maximum pressure needed for PSH is 7000 psi, compared with 35,000 psi used in HPH.

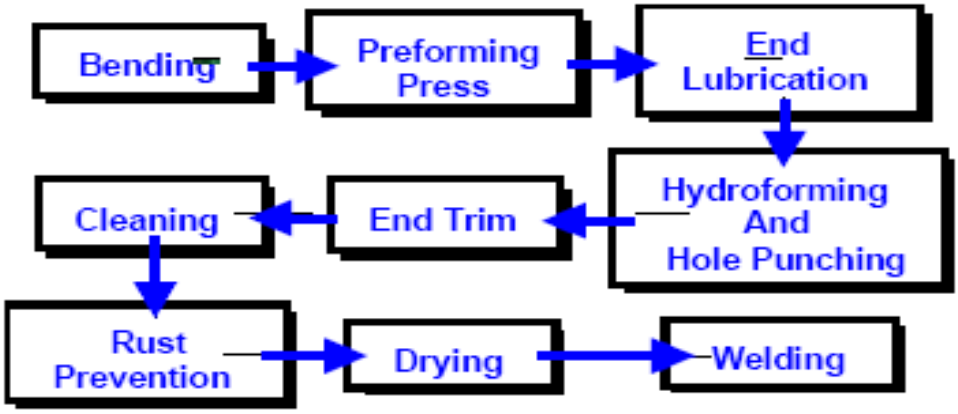

Fig8.HPH Process Layout

IV. HYDRO FORMING PROCESS CONTROL

A typical hydro forming system would include a press capable of developing necessary forces to clamp the die valves together when internal pressure acts on fluid; a high pressure water system to intensify water pressure for forming component, looking including aerial cylinder and punches, depending on component and a control system for process monitoring. Since the entire process of operation takes place inside a closed die, one cannot see what actually happens during forming. Therefore the controller plays a vital role in displaying, monitoring and controlling the different parameters of forming in real time.

ADVANTAGES

Hydro forming tubular components offer several advantages, including

1. Part consolidation.
2. Weight reduction through more efficient section design and tailoring of the wall thickness.
3. Improved structural strength and stiffness.
4. Lower tooling cost as a result of fewer parts.
5. Fewer secondary operations.
6. Tight dimensional tolerances and low spring back.
7. Reduced scrap.

DISADVANTAGES:

Hydro Forming Also Has Some Drawbacks, Including

1. Slow cycle time.
2. Expensive equipment.
3. Lack of extensive knowledge base for process and tool design

FACTORS AFFECTING THE HYDRO FORMING PROCESS

As hydro forming becomes more widely used, several issues must be addressed to increase the implementation of this technology in the stamping industry. These issues include:

1. Preparation of tubes, which involves material selection and quality of the incoming tube.
2. Pre form design and production method.
3. Part design for hydro forming.
4. Welding and assembly of hydro formed components that is, fixturing and joining.
5. Crush performance and joint stiffness.
6. Selection of a lubricant that does not break down at high pressures.
7. Rapid process development.

V. CONCLUSION

Hydro forming offers the potential to improve performance and reduce cost and weight simultaneously. It is not automatic, easy or obvious how to design and make the most efficient part. As with any other technology there are many ways to misapply it. The best way to ensure best application is to learn as much as possible about different methods to allow logical judgment of the merits of each approach.

Research and investigation of hydro forming of tube in industry and universities during the last decade have led to a) Improvement in accurate determination of material properties using tests that emulate the reality in production, b) Development of better test methods to screen the lubricants, c) Advances in press design that resultedin less expensive and compact presses with reduced cycle time. d)Continuous improvement in tool design to increase the scope of applications of hydro forming and e) Development of virtual manufacturing tool through FE simulations to design the process and estimate the optimum process parameters. These developments lead to reduced process development time and enable sheet and tube hydro forming processes to

compete with traditional stamping. Currently warm hydro forming of tube and sheet is being investigated to increase the application of lightweight Mg and Al alloys that are less formable at room temperature.

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