

## Sheet Metal Forming By Water Hammering Machine: A Review

\*Khatrri Nirav Girishchandra<sup>1</sup>,Shah Milan Anjankumar<sup>2</sup>,Patel Milan Girishbhai<sup>3</sup>,Shah Dharini k<sup>4</sup>.

<sup>1</sup>(Student,Mechanical engineering, Vadodara Institute of Engineering, nirav.khatrri16@gmail.com)

<sup>2</sup>(Student,Mechanical engineering, Vadodara Institute of Engineering,milanshah18893@yahoo.com)

<sup>3</sup>(Student,Mechanical engineering, Vadodara Institute of Engineering,patelmilan1507@yahoo.com)

<sup>4</sup>Assistant Professor,Mechanical department,Vadodara Institute of Engineering,  
dharini\_mech28@yahoo.co.in )

**Abstract:** In automotive industry with increase in demand to reduction in weight and manufacture complex parts easily without compromising in strength there for the hydro forming process carried out. The aim is to construct the complex part of non uniform cross section with the help of fluid pressure under different operating condition to achieve optimum value of input parameters from which parts is manufacture. The pressurized fluid serves several purposes: (1) Supports the sheet metal from the start to the end of the forming process, thus yielding a better formed part, (2) Delays the onset of material failure and (3)Reduces wrinkle formation.

**Keywords-** Water Hammering, Sheet Metal Forming, Polar Height, Impact Load.

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### I. INTRODUCTION

Hydro forming is a specialized type of die forming that uses a high pressure hydraulic fluid to press room technical and economic potential to sheet metal manufacturers. The achievement of beneficial component characteristics using this process is only possible where temperature working material into a die.[1] Hydro forming allows complex shapes with concavities to be formed, which would be difficult or impossible with standard solid die stamping. Hydro formed parts can often be made with a higher stiffness-to-weight ratio and at a lower per unit cost than traditional stamped or stamped and welded parts. Virtually all metals capable of cold forming can be hydro formed, including aluminum, brass, carbon and stainless steel, copper and high strength alloys. Hydro forming is a cost-effective way of shaping ductile metals such as aluminum, brass, low alloy steel, and stainless steel into lightweight, structurally stiff and strong pieces. One of the aims of the sheet-metal processing industry is the minimization of costs and the optimization of its products concerning weight, strength characteristics and rigidity. In search for alternative production processes, hydro forming – the manufacture of hollow bodies with complex geometries by means of fluid pressure – has been shown to offer an interesting component and process configuration is selected by considering the overall system design.

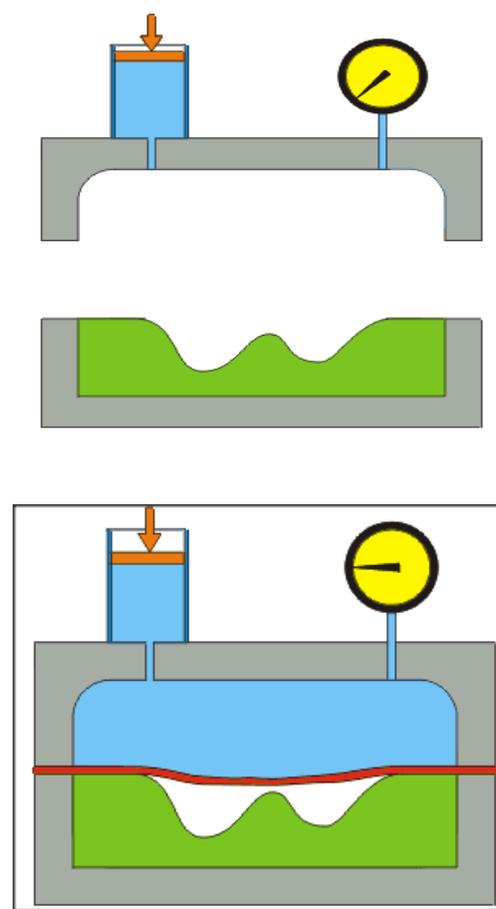


Fig.1 Sheet Hydroforming Process

## II. APPLICATION

One of the largest applications of hydro forming is the automotive industry, which makes use of the complex shapes possible by hydro forming to produce stronger, lighter, and more rigid unibody structures for vehicles.[1] This technique is particularly popular with the high-end sports car industry and is also frequently employed in the shaping of aluminum tubes for bicycle frames.



Fig.2 Shapes To Be Form

## III. LITERATURE REVIEW

### A. ANALYSIS OF WATER HAMMER FORMING ON THE SHEET METAL(2011). (Ravinder Kumar et al., 2011)

Here In this paper Ravinder Kumar et al. considers relationship between the energy applied and extent of Deformation as Well as the variations of the radial strains, hoop strains along the radius under Different Hydraulic mediums are studied. They perform one experiment on cup to analysis the Relation between energy applied and deformation takes place. From the experimental data and Graphs for radial strains it is observed that the radial strains and hoop strains are almost Negligible in the flange region of cup compared to the region near to the center. they provide Different suggestion to overcome the stretch effect in center of cup. They suggested that step Should be machined in the die holder. The cylinder should rest directly only on the step Machined on the die holder and the sheet metal gets effective sealing and contact only through The rubber “O” rings arranged at the bottom of the pressure cylinder.[2]

### B. DEVELOPMENT AND MODELING OF HYDRO-FORMED CIRCULAR SHEET USING NEURAL NETWORKS(April 2014). (Binayaka Nahak et al., April 2014)

In this paper Binayaka Nahak et al. used artificial Neural Networks. In recent time many technologies comes to make production of complex parts easily. Sheet hydro forming one of them. Author used neural network to predict the dome

height formation. They built a setup and perform experiment on the circular sheet to form a cup shape. They use copper and aluminum two different material. After performing experiment the data is used to train the neural networks. They make one neural network by making correlation Input data i.e., hydraulic pressure, thickness and diameter of work piece and output dome height of deformed product. Neural network model was able to predict the deformed dome height, thickness of circular sheet with good accuracy.[3]

### C. AN ECONOMIC EVALUATION OF SHEET HYDRO FORMING AND LOW VOLUME STAMPING AND THE EFFECTS OF MANUFACTURING SYSTEMS ANALYSIS (February 2003). (Seward E. Matwick, February 2003)

In this paper Seward E. Matwick gives the history that how the Hydro forming comes into production. They tell that at what extent the sheet hydro forming is advantageous compared to stamping operation. Generally matwick tells that the hydro forming is use at the low volume production up to thirty thousand but for more than this the stamping operation is economical.[4]

### D. RECENT DEVELOPMENT OF HYDRO FORMING-A REVIEW(2015). (F. Forouhandeh et al., 2015)

In this research paper F. Forouhandeh et al. gives review of hydro forming process. In this paper they provide types of hydro forming, principle used in process. Most of the papers reviewed here in relate to modeling and simulation of the process and the various issues such as process parameters, and experimental study of different alloys. In this paper, the review of various aspects of research on sheet and tube hydro forming process has been presented. Most of the papers reviewed here in relate to modeling and simulation of the process and the various issues such as process parameters, and experimental study of different alloys. In this paper, the review of various aspects of research on sheet and tube hydro forming process has been presented. they provide future scope of optimization on titanium and titanium alloy experimental study.[5]

### E. OPTIMIZATION OF THE PRESSURE PATH IN SHEET METAL HYDRO FORMING (April 2014). (Asghar Shamsi-Sarband et al., April 2014)

Here in this paper Asghar Shamsi-Sarband et al. provide the information about the fluid pressure which is very important parameter in sheet hydro forming. Research paper provide various types of sheet hydro forming types like (1) Hydro mechanical deep drawing (2)Hydrodynamic deep drawing 3. aqua draw process 4.hydro forming deep drawing. Authors perform experiment on FE modeling for optimization of

fluid pressure. By using FE modeling it is suggested that a two-stepped work piece can be manufactured in a single step which is a significant advantage compared to conventional sheet forming processes. genetic algorithm is used to calculate the pressure path and this will reduce the mo of trial give more accurate results. [6]

**F. SHEET HYDRO FORMING OF WOVEN FRT COMPOSITES: NON-ORTHOGONAL CONSTITUTIVE EQUATION CONSIDERING SHEAR STIFFNESS AND UNDULATION OF WOVEN STRUCTURE**(September 2015).  
(Woong Ryeol Yu et al., September 2015)

In this research paper Woong Ryeol Yu et al. gives information for simulation of sheet hydro forming for the shaping of woven fabric reinforced thermo-plastic (FRT) composites. For that non orthogonal constitutive model was developed based on a homogenization method by considering the microstructures of composites including mechanical and structural properties of the fabric reinforcement. from different calculation they could be concluded that shear stiffness from frictional behavior at the cross point of warp and weft yarns is the dominant resistance factor in shear deformation. [7]

**G. PROBABILISTIC APPROACH TO STUDY THE HYDROFORMED SHEET**(August 2015).  
(Mohammed Nassraoui et al., August 2015)

Here In this paper Mohammed Nassraoui et al. gives numerical results which are given to validate the proposed approach. To show the influence of uncertainties in the study process, we take some characteristics of the material as random and the probabilistic approach is done. The finding results are showing the effectiveness of the proposed approach. the finite element model is designed to simulate the hydro forming process. Based on numerical simulation to adapt a better approach to the contact between the die and the sheet it was found that the choice of contact type proposed by ANSYS has had a good influence on the numerical results just as the choice of the type of finite elements of the plate.[8]

**H. THE HYDRO MULTIPOINT FORMING PROCESS OF COMPLEX SHEET METAL PARTS**(2015).  
(Viorel Paunoiu et al., 2015)

Viorel Paunoiu et al. presents the concept of a new tool for the sheet metal blanks deformation which is based on the hydro-multipoint method. A critical review of the main hydro forming and multipoint forming methods is done. Then, a simulation model for the new hydro-multipoint forming tool is developed. Material thickness, stresses and part dimensions are analyzed. A mechanical hydro-

multipoint forming tool which was designed and manufactured based on the new concept is presented. Using this tool a number of experiments are done. The real parts are evaluated in terms of surface quality and parts dimensions. The experimental results come to validate the numerical ones. Finally, it was concluded that this new die concept could be used in manufacturing complex sheet metal parts. The paper presents a new tool concept for hydro-multipoint forming method. The main advantages of this type of equipment are the reduction of the setup process time in half, in comparison with the conventional digitized dies, and the combining of hydro forming and multipoint forming advantages. Based on this concept, a simulation model and an experimental mechanical tool were designed. [9]

**I. COMPARISON AND SUBSTITUTION OF CONVENTIONAL PROCESSES OF PLASTIC FORMING APPLYING HYDROFORMING**  
(2006).  
(E. Karabegovic et al., 2006)

In this paper the E. Karabegović et al. study and compare conventional forming process and hydroforming process. They provide various parameter and effect of that parameter on the sheet metal by conventional process as well as hydroforming process. They also provide various formula and graph to calculate the different types of forces to complete the operation accurately. Also provide various advantages of hydroforming over the conventional forming process.[10]

#### IV. CONCLUSION

In last few years, the world is shifting from conventional process to unconventional process. One of the advantages of hydroforming process over the conventional forming process is low tooling cost, there is no direct contact between work piece and tool i.e., no crater marks over the work piece, produce large shape in single sheet due to this it is widely used in the automobile industry, ship and military application. Due to liquid comes into picture; there are chances of leakages from the design set-up. To avoid this type of major issue, we have to use better sealing devices and improve the design set-up. Hence, by providing better advantages by hydroforming is now widely used over the conventional sheet metal forming process.

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