A Systematic Review of Sheet Metal Hydro Forming Process

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***Abstract*–Hydro forming technology is very useful for the light weight material include low carbon/mild steel for chassis and side rails, aluminium, and its alloy for automotive body, stainless steel for exhaust system part. There are many process Parameters like as hydraulic pressure, blank-holding force, die radius, material properties, and coefficient of friction affect thee sheet hydro forming process. Purposes of the study can be improve the competitiveness of sheet hydro forming by new setup to reduced various defects , increase the production rate of auto body parts at lower initial investment cost.**

***Keyword*– Hydro forming, sheet hydro forming, internal fluid pressure, hydro mechanical deep drawing, hydro dynamic deep drawing, setup development**

I. INTRODUCTION

Sheet Hydro forming technology is very useful for of complex part having high strength to low weight ratio for auto body parts and aerospace industries. It offers many advantages over conventional forming such as tooling cost, waste of material, joint free component, with better surface finish and low tolerance. This paper describes about different processes of sheet hydro forming that includes Hydro mechanical deep drawing, Double blank sheet hydro forming, Sheet hydro forming assisted by rubber as shown in fig.1. Proposed methodology for the present study can be development of experimental setup for sheet hydro forming process.

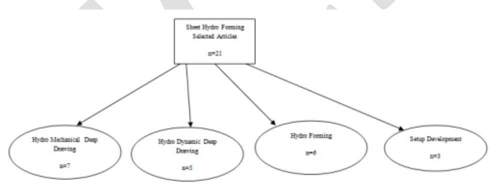

Fig.1. Preliminary thematic classification of articles included in the literature review.

II. RELATED STUDIES ON SHEET HYDROFORMING

Rongjing Zhang et al. (2015) [1] Show that the manufacture a complex, light weight and joint less component for aerospace and automobile structures fibre metal laminates was very difficult in stamp forming process for hemispherical structure on multilayer metal.

S. Bagherzadeha et al. (2015) [2] have represented the application of hydro mechanical deep drawing process for anisotropic laminated bimetallic sheet. Formability and limit drawing ratio of the aluminium/steel layup was better than the steel/aluminium layup.

Masoomeh Salahshoor et al. (2015) [3] have conducted experiment on hydro dynamic deep drawing for forming concave bottom cylindrical parts.

H. Sato et al. (2015) [4] have developed micro hydro mechanical deep drawing apparatus fabricate successful part if appropriate gap and counter pressure was maintained.

Bao Meng et al. (2014) [5] applied closed loop control for active pressurised hydro dynamic deep drawing system to control tears and wrinkle were manufactured.

William J. Embloma et al. (2014) [6] Describes development of micro scale strain measurement system for sheet bulge hydro forming on micro scale part or micro scale location on large part.

Bharatkumar Modi and D. Ravi Kumar (2013) [7] Have design and develop experimental hydro forming set up to deform the square cup of AA5182 alloy.

Farhang Pourboghrat et al. (2013) [8]) concentrated his research on limit drawing ratio and deep drawing of AA5754 aluminium in hydro forming process over conventional stamping

Jyhwen Wang and Cheng-Kang Yang (2013) [9] were conducted hydraulic bulge experiment to form by layered and sandwich blank into dome shape.

S. Bagherzadeha et al. (2012) [10] has focused on application of hydro mechanical deep drawing for light weight low formable aluminium-steel laminated sheet.

Abdolhamid Gorji et al. (2011) [11] have conducted experiment for pure copper and St14 conical-cylindrical cups in hydro dynamic deep drawing process.

Huiting Wanga et al. (2011) [12] introduced modified method named hydro dynamic deep drawing assisted by radial

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pressure with inward flowing liquid have drawing ratio 2.85 which is better than conventional forming process.

F. Djavanroodi and A. Derogar (2010) [13] has been investigated experimentally formability of high strength sheet metal Ti6Al4V titanium and Al6061-T6 aluminium alloys by Hydro mechanical deep drawing setup has assisted by floating disc.

Anup K. Sharma and Dinesh K. Rout (2009) [14] have conducted experimental work on sheet hydro mechanical forming for circular cup and develop finite element model by dynamic explicit commercial code.

XU Yong-chao et al. (2009) [15] have carried experiment on hydro forming using SA06 aluminium alloy. ls-dyna form software was used to establish the model and analyze the radial pressure.

Swadesh Kumar Singha and D. Ravi Kumar (2008) [16] have design and fabricated experimental setup for hydro mechanical deep drawing process on carbon steel.

Takayuki Hama et al. (2007) [17] performed experiments for elliptical cup by sheet hydro forming and conventional deep drawing process.

C. Bruni et al. (2007) [18] have performed experimental work on double sheet hydro forming setup for TRIP800 steel. Spring back effect was reduced at high fluid pressured, at low corner radius of die and high friction at blank holding force and Analysed the Residual stress by x-ray diffraction method was effective than the laser cutting technique.

Ch. Hartl (2005) [19] provides the information about lots of work was carried in the research and development of hydro forming.

Nader Abedrabbo et al. (2005) [20] were performed experimental work on sheet hydro forming process for deep-drawn hemispherical cup AA6111-T4 aluminium alloy. Wrinkle in flange and die corner area was generated due to pressure loss by pressure regulator/controller.

S.H. Zhang and J. Danckert (1998) [21] has represented hydro mechanical deep drawing features.

Table1. Articles included in the literature review

Articles no.	Auther(s)	Input Parameter	Response Variables	Database	Methodology
1	Rongjing Zhang et al. (2015)	Pre/cavity pressure, die binder gap	Thinning, spring back, thickness distribution	Springer	Experimentation using HMDD setup and validated by finite element simulation
2	S. Bagherzadeha et al. (2015)	Fluid pressure	Drawing ratio, thickness distribution	Elsevier	Numerical and Experimental investigation by HMDD setup for laminated aluminium/steel sheets
3	Masoomeh Salahshoor et al. (2015)	pressure path, geometrical parameters of the punch	Thickness distribution, drawing ratio	Springer	Experimental investigation of hydro dynamic deep drawing for concave cylindrical part and validated by finite element simulation
4	H. Sato et al. (2015)	Counter pressure	wrinkle formation and reduce friction drawing force	Elsevier	Development of hydro dynamic deep drawing setup
5	Bao Meng et al. (2014)	Blank holding force and cavity pressure	Control the wrinkle and tear formation	Elsevier	Development of sheet metal active-pressurized hydro dynamic deep Drawing system and its applications
6	William J. Embloma et al. (2014)	Micro scale grid	To measure strain	Elsevier	The development of a micro scale strain measurement system applied to sheet bulge hydro forming
7	Bharatkumar Modi and D. Ravi Kumar (2013)	Blank holding force and varying hydraulic pressure	Formability and thinning	Springer	Development of hydro forming setup
8	Farhang Pourboghrat et al. (2013)	Hydraulic pressure	Limit drawing ratio	Elsevier	Compare to stamping process limit drawing ratio was better than in hydro forming validated by simulation results
9	Jyhwen Wang and Cheng-Kang Yang (2013)	Fluid pressure	Failure of part	Elsevier	Experiments have been performed on sandwich panels to analyse the failure mode by finite element simulation results
10	S. Bagherzadeha et al. (2012)	Fluid pressure	Drawing ratio, thickness of layer	Elsevier	Experimentation using HMDD setup and validated by analytical model
11	Abdolhamid Gorji et al. (2011)	pressure path	Thickness distribution, drawing ratio	Springer	Experimental investigation of hydro dynamic deep drawing for conical-cylindrical part and validated by finite element simulation
12	Huiting Wanga et al. (2011)	Radial pressure	Thickness distribution, punch force and flange were studied	Elsevier	Numerical simulation and experimental investigation of hydro dynamic deep drawing process.

13	F. Djavanroodi and A. Derogar (2010)	Effect of floating disc	Thickness, the yield and tensile strength, strain-hardening and strain-rate sensitivity	Elsevier	Experimental investigation of hydro forming deep drawing validated by finite element model
14	Anup K. Sharma and Dinesh K. Rout (2009)	Fluid pressure	Strain hardening, anisotropy ratio, interfacial friction between blank and tools surfaces.	Elsevier	Experimentation, Taguchi design, finite element model develop and validated by simulation.
15	XU Yong-chao et al. (2009)	Fluid pressure	Height to diameter ratio, thinning, thickness distribution	Springer	Numerical and experimental investigation
16	Swadesh Kumar Singha and D. Ravi Kumar (2008)	Pre bulging pressure(initial pressure), cut-off pressure	Thickness distribution and surface finish	Elsevier	Design and fabricated HMDD process.
17	Takayuki Hama et al. (2007)	Hydraulic pressure	Thinning	Elsevier	Experimentation and finite element simulation was performed
18	C. Bruni et al. (2007)	Pressure, die insert geometry and friction at the blank holder	spring back effect, residual stress	Springer	experimental work on double sheet hydro forming setup and analysed by finite element analysis
19	Ch. Hartl (2005)	heat energy	design steps, semi finished products, process and tool	Elsevier	information about the research and development of hydro forming technology
20	Nader Abedrabbo et al. (2005)	Fluid pressure	Wrinkle and tear	Elsevier	Numerical and Experimentally investigate wrinkle control in aluminium sheet hydro forming
21	S.H. Zhang and J. Danckert (1998)	process parameters in theory and in numerical simulation	related development	Elsevier	represented hydro mechanical deep drawing features

III. CONCLUSION

The review of contemporary literature suggests that a good amount of work has been performed in the area of experimental studies and parametric analysis in the area of sheet metal hydro-forming. The work need to be extended to study the spring back effect on variety of sheet material which can help the industries to select the right material for the necessary application to eliminate any chances of defects.

ACKNOWLEDGMENT

I am humbly expressing thanks to my respected guide Mr. Shashank J. Thanki for their valuable time, constant help, encouragement and useful suggestions, which helped us in completing the research in time.

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