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Plug and Die Design and Development to Optimize Springback Effect in Seamless Tubes

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ABSTRACT

Different diameter and sectional tubes form an important segment of Indian Seamless tube market. The paper emphasizes on the problem of Spring-back effect on sectional seamless steel tubes faced in production. This study was performed for the analysis & modification to be done on land width of Die in controlling the spring back of sectional seamless steel tubes. The work also includes the quality assurance measures taken during the production of sectional seamless steel tubes. Seamless tubes manufactured by hollowing out solid heated billets in a Piercing mill and then cold drawing process continued. Cold drawing is the process of reducing the dimensions of sectional tubes as per required size. Both the tension & compression acts on the tubes. So required thicknessof tube is achieved. In case of sectional seamless steel tubes, corresponding cross sectional plugs of suitable cross sectional dies were used. The cold drawing process is the process of reducing the cross sectional area of wire, bar or tube by drawing the material through a die without any preheating. Cold drawing process is used for the production of bright steel bar in round, square, rectangular, hexagonal, and flat section.

In the present study, the effect of any one or two sizes with land widths of 5, 10, 15, and 20mm, similarly the range of die and plug angles is also analyzed. The remaining sizes are studied theoretically using analysis software to analyze the effect of design changes in the die and plug angles, land width etc. To arrive at the best possible combination to achieve dimensional stability and least spring back, this will be well within the permitted dimensional specifications. Hence achieving the target as reduction in scrap rate of tube due to spring back.

Keywords : Springback, Seamless Tube, Elastic Recovery, Analysis

I. INTRODUCTION

The tubes are mostly seen as joining together the flat strip by welding. Seamless tubes are without weld. The pipe and tubes can be seamless or with seam. Tubes with seam are manufactured with various welding techniques. Seamless tubes are made by Extrusion and hot rolling processes. Seamless tube find application in

high pressure hydraulic cylinders, drilling deep bores etc. several automotive components like truck axels, bearings, steering columns, pneumatic cylinders etc. are made out of seamless tubes. Seamless tubes are manufactured by the hot extrusion process. In the manufacturing of seamless tubes, direct extrusion is often used in combination with other processes like forging, piercing and rolling. Another most popular method for seamless tube manufacturing is cold drawing. Cold Drawing is an operation in which the cross sectional area of a tube is reduced by pulling it through a tapered or curved converging die and with various types of plug. The various type of plug include fixed, floating, and movable. The process may be used to decrease the diameter, to produce shapes other than round, to produce a smoother surface. This manufacturing process is widely used in industry due to its versality and good mechanical properties of the part. Successful drawing operation requires careful selection of process parameters and consideration of many factors. The principal variables are semi die angle α, cross section reduction, and the friction between the die and the plug.

With the above manufacturing processes it is not guaranteed that the quality of the seamless tube is always at the higher side. The major problems faced in cold drawing of tubes are dimensional variation, bending of tubes, chattering and scores on tubes. Out of which most serious problem of the dimensional variation is due to springback. Springback is one of the major problems faced in tube drawing. Springback is due to the elastic energy stored in the tubes during forming process. When the forming forces are removed the elastic energy is released in the form of springback, as the tube tries to regain its original shape, and this causes a change in the dimension of the tube. Generally the springback causes the dimensions within the tolerable limit to exceed and hence causes the tube to be rejected for improper dimension.

This paper gives idea about the problems involved in cold drawing process and appropriate approach to solve these problems. To keep up with the ever demanding customer needs the industries have to keep on improving in terms of product quality, minimum product development cycle time, optimized usage of resources and incorporation of modern methods, technologies to achieve the aforementioned goals. This paper is a review on literature published in the context of cold drawing process; which is used for manufacturing high quality products that have wide variety of applications in different sectors of engineering. It helped in understanding the developments and research carried out over a period of time for different problems associated with cold drawing and different approaches involved in problem solving.

II. LITERATURE REVIEW

Many researchers studied the spring back effect on sheet metal and very small study is available on the springback. Kumar and Agnihotri [1] proposed that the literature published on the cold drawing process. Louahdia and. Khirania [2] gives analysis on Evaluation of springback under the effect of holding force and die radius in a stretch bending test. Various important results obtained regarding the springback and results are also used in validation of finite element simulation of stretch bending test. A.L.R. de Castro, H.B. Campos, P.R. Cetlin [3] investigates that in drawing process the die semi angle is one of important parameter influences the drawing forces, lubrication parameter and mechanical properties of bar. Results shown by this paper are

(1)For single pass drawing, die semi-angle affects the yield strength, tensile strength and tensile elongation of Copper bars. Both yield and tensile strength increase with higher semi-angle, whereas elongation decreases. All effects were more pronounced for a semi-angle of 24,5".

(2)The geometrical parameter A was not suitable to encompass the simultaneous effect of area reduction

and die semi-angle on the final mechanical properties of drawn Copper bars.

(3)For the case of drawing in two passes, die semi-angle in the second pass had a limited influence on final mechanical properties of copper bars.

(4)For two successive drawing passes covering a total reduction of area of 30%, a final heavier pass led to higher strengths and ductilities.

A. Benhrouzi, B.M. Dariani and M. Shakeri. [4] gives literature about springback. They told that springback is most important parameter in sheet metal forming. And they give analytical approach for the springback compensation. This approach results in optimum die shape design. Springback is a very important factor to influence the quality of sheet metal forming. Accurate prediction and controlling of springback is essential for the design of tools for sheet metal forming. Several approaches have been proposed for springback compensation by modification of the tooling shape. These approaches are iterative finite element methods. In this paper an analytical approach is presented for one step modification of the tooling shape in channel forming process to compensate the springback error. Rahul K. Verma, A. Haldar [5] gives effect on normal anisotropy on springback, paper gives literature regarding improvement of anisotropy. Share of high and advanced high strength steels in automobile is increasing, however, such steels generally have poor formability and high amount of springback. One of the focus areas of research in high strength automotive steel is to increase the normal anisotropy to get better formability. Effect of strength and process parameters on springback has been studied by many researchers but that of anisotropy has not been studied by many. IhabRagai, DuraidLazim, James A. Nemes [6] This paper has provided a summary of an experimental and computational study of springback during draw-bending of stainless steel, type 410. This paper discusses the effect of sheet anisotropy on the springback of stainless steel 410 draw-bend specimens. The role that the anisotropy plays in the springback is assessed experimentally as well as through finite element simulations.

From the above literature review we can concludes that the spring back is the serious problem in the cold drawing and efforts must be put forward to minimize it.

III. PROBLEM DEFINATION

The cold drawing process is generally a precision tube making process in which the accuracy of the product manufactured is maintained[1]. The problems faced in the cold drawing process are discussed above. One of the major problem faced in cold drawing process is springback in the drawn tubes. In this report the major emphasis is given on the springback studies of circular tubes and dimensional stability[1]. A general study will be done on evaluation of the springback, causes of springback and techniques to reduce it. A contact non-linear analysis in ANSYS will be done in order to simulate the cold drawing process in which the springback and the dimensional study will be carried out [2]. So the problem title defined as “Design and Development of die and plug to minimize Springback effect in seamless tubes”.

IV. METHODOLOGY

For to minimize the springback effect following methodology is proposed [3]

1. Detail formulation of cold drawing processes with used general paper.

2. Analysis steps and analysis result.

3. Old model and new model comparison due to analysis.

4. So corrected model is so and so and we recommended this to industry.

5. Experimental result by quality control dept. after changes in die land and angels as like this for clearing the concepts (if possible)

In Metal forming process large forces are applied to the work material to deform it plastically to get the desired product. The most important item in the analysis of a metal forming processes is the determination of the magnitude of the applied force, since it is an item necessary for the design of processing equipment [4]. Another important factor is to know the extent of deformation to which a work piece can be subjected before it fails. So, we ought to know the relationship between a force and the deformation that it produces[6].

The most common method of determining the relation between force (load) and deformation is the tension test. In this test, a suitable work specimen is subjected to an increasing axial load until it fractures. The measurements of force and deformation (elongation) are taken at frequent intervals during the test.

V. POSSIBLE OUTCOMES

A detail simulation of cold drawing process for circular tubes will be carried out to study the springback effect. The actual drawing angles and die land length is used while modeling the process. In order to reduce the computer time and utilities the die, plug and the tube was modeled quarterly.

The possible outcomes of the research are:-

1. The springback measured will found in an agreement with the experimental studies.
2. The end effect found in the simulation will also found in experiment.
3. The FEM analysis can also be used for predicting the dimension of the actual process. Hence results in minimizing failures[6].
4. The simulations techniques can also be used for validation of die and plug design when used for sectional tube formation such as rectangle, square, hexagonal, elliptical etc.

Are selected and manufactured from the design of dies and plugs. The dies and plugs are designed to ensure the minimum spring-back in tubes. Various measurements were taken for spring-back and wall thicknesses are tabulated.

From the modeling and simulation analysis of hexagonal cross sectional tube, we can conclude that

- 3D modeling of the tube drawing process helped in visualization and conceptualization. The modeling saves the research time and the minimize the risk of design failure.
- Simulation of the process helps to check the design of dies and plug as well helps to visualize the formation of shaped tube. The maximum stress induced in the hexagonal tube was found to be 698.879 MPa. Which is well below the ultimate stress of 705 MPa. Hence tube will not break or crack in the process of manufacturing[3].
- Simulation helps to predict the metal formation as well gives the idea of region of high stress formation. This helps us to check or correct the design of die and plug.
- The simulation helps to predict the dimension and the spring back of the tube.

A detail simulation of cold drawing process for circular tubes has been done to study the springback effect. The actual drawing angles and die land length is used while modeling the process. In order to reduce the computer time and utilities the die, plug and the tube was modeled quarterly or halfly.

- The spring back measured was found in an agreement with the experimental studies.
- The end effect found in the simulation was also found in experiment
- The FEM analysis can also be used for predicting the dimension of the actual process. Hence results in minimizing failures.
- The simulation techniques can also be used for validation of die and plug design when used for

sectional tube formation such as rectangle, square, ovule, elliptical, octagonal etc.

VI. REFERENCES

[1]. A. Benhrouzi, B.M. Dariani and M. Shakeri. A one step analytical approach for springback compensation in Channel Forming Process.

[2]. A.L.R. de Castro, H.B. Campos and P.R. Cetlin. Department of Metallurgical Engineering, UFMG, Belo Horizonte, MG, Brazil. Influence of die semi-angle on mechanical properties of single and multiple pass drawn copper. Journal of Materials Processing Technology 60 (1996) 179-182.

[3]. IhabRagai, DuraidLazim, James A. Nemes. Department of Mechanical Engineering, McGill University, 817 Sherbrooke Street, West Montreal, Que., Canada, H3A 2KG, Anisotropy and springback in draw-bending of stainless steel 410: experimental and numerical study.

[4]. E.H.Ouakdi, R.Louahdi, D. Khirani, L. Tabourot / Evaluation of springback. under the effect of holding force and die radius in stretch bending test. pp. 106- 112.

[5]. Praveen Kumar, Dr.GeetaAgnihotri/ International Journal of Engineering, Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 3,Issue 3, May-Jun 2013, Cold Drawing Process –A Review. pp.988-994.

[6]. Rahul K. Verma, A. Haldar, R and D division, Tata Steel Ltd. Jamshedpur, India. Effect of normal anisotropy on springback. Journal of material processing technology 190 (2007) pp 300-304.

[7]. http://freepatentsonline.com, United States Patent, Patent Number 4,569,256.

[8]. http://freepatentsonline.com, United States Patent, Patent Number 4,785,591.

[9]. http://www.asme.org

[10]. http://freepatentsonline.com, United States Patent, Patent Number 6,030172

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