

Review Paper on Design Analysis and Optimization of Bending Die by Using Fea Software



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ABSTRACT

One of the most prominent processes in industry is bending. Rotary draw bending method is known to be the most conventional approach for thin wall tube bending. Pressure die is an effective tool which boosts the tube bending process and eventually improves the bending quality. Other effective parameters include mandrel and the amount of clearance between tube and mandrel. In the present study, the process was modeled by finite element method and the precision of the model was validated via comparing practical results. When we want to bend various tube diameter then need to change a die. This changing of die is very time consuming work and very heavy machinery required to do this. Hence we work on reduction of bending die weight by using ANSYS software and practical approach.

Keywords— Bending Die, Optimization.

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1.INTRODUCTION

Tube bending can be performed via various techniques such as rotary draw bending, compression bending, roll bending and Press bending. Among several techniques, rotary draw approach offers the largest range for tube bending; specifically it is the most appropriate method for thin-wall tubes due to accomplishment of mandrel. As shown in Fig. 1, this process consists of the following components: bend die, clamp die, pressure die, wiper die and mandrel; while the mandrel and wiper die are used for thin-wall tubes applications. [4]

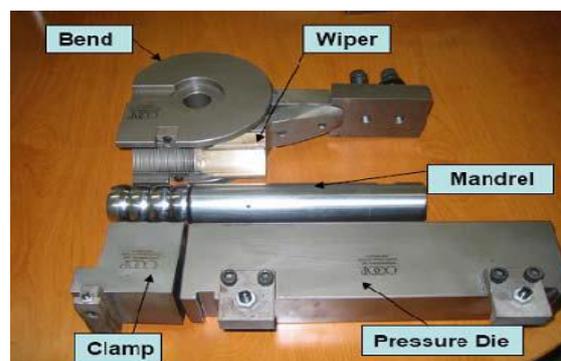


Fig 1: Bending Die with all part

Several studies have been carried out concerning the computer aided simulation of rotary draw bending technique. The mandrel role in thin-wall tube bending is studied using ABAQUS software. Rotary draw bending of a thin-wall tube with square section is simulated. Some other researchers contributed their investigations to wrinkling and flattening phenomena in aluminium thin-wall tubes bending, using ABAQUS software. Discussed the stresses and wrinkling in thin-wall tubes during the bending process through ABAQUS simulations. In addition, they studied the mandrel effects in wrinkling and

flattening parameters during the bending process. Some studies focused on analysing forces and moments in tube bending process, applying stress analyzing equations. Due to discarding the effects of mandrel, as well as work-hardening pushing force effects, in all of these works, the results do not show satisfactory compatibility with practical tests and consequently may not be reliable. [4]

II. LITERATURE REVIEW

Improved design of a three roll tube bending process under geometrical uncertainties

In this paper, the three roll push bending process of tubes has been presented. A strategy for planning the process has been proposed in terms of a bending roll rotation vs. axial booster displacement control curve. The relevant points of this curve can be used as the design variables of a optimization routine. Since the process is not much robust in terms of repeatability and uniformity of the curvature radius $Rc=1/r$, any optimization should be run taking into account process uncertainties (e.g. geometrical properties of tubes). A simple optimization has been implemented according to a designed plan of computer simulations and the results of each simulation runs have been evaluated as the correlation r of the simulated curvature profile vs. a target curvature profile. This approach leads to an optimal control curve with a decreasing value of the angular position of the bending tool.

Cross-sectional distortion behaviours of thin-walled rectangular tube in

Rotary - draw bending process

1. The distribution of circumferential stress is uniform in the initial bending stage of rectangular aluminium alloy 3A21 tube in rotary-draw bending process. However, when the bending angle reaches 30° , the zone of larger circumferential stress appears, and the sagging phenomenon is produced obviously in this zone.

2. The distribution of sagging distance along the width of the cross section of the tube is symmetric. And the cross-sectional distortion locates at the symmetrical line along the width of the cross section.

3. The maximum cross-sectional distortion is obtained in the vicinity with the angle of 50° between the bending reference plane and a certain section in the symmetrical plane of the bent tube. And its position is almost unchanged with the variation of clearances between dies and tube.

Effects of process parameters on numerical control bending process for large diameter thin-walled aluminium alloy tubes

1. It is found that the effects of process parameters on bending processes for large diameter thin-walled aluminium alloy tubes are similar to those for small diameter thin-walled tubes, but the forming quality of large diameter thin-walled aluminium alloy

tubes is much more sensitive to the process parameters and thus it is more difficult to form.

2. In NC bending processes of large diameter thin-walled aluminium alloy tubes, the friction between the pressure die and the out-surface of tube has a significant influence on tube wall thinning, while the push assistant velocity affects tube wall thinning slightly. Larger friction can improve the outside tube wall thinning, while it can also increase the inside tube wall thickening, which is possible to produce wrinkling.

Effect of Mandrel, Its Clearance and Pressure Die on Tube Bending Process via Rotary Draw Bending Method

In the present paper, the rotary draw tube bending process was modeled. In order to validate the simulation results, a comparison was made between the modelling results and the experimental results. Following that, the model was used to investigate the effects of pressure die movement and mandrel clearance, where the following conclusions were obtained:

1. Using mandrel increases the process forces significantly, while the dimensional precision is improved as well.

2. Though using mandrel or reducing its clearance, increases the process forces, the bending quality would be improved remarkably.

3. Pressure die displacement has no considerable effects on process forces and bending quality.

4. When the pressure die moves in a speed equal to tube's speed, the least friction force would be applied on tube's surface.

Role of filling material on defects of thin-walled tube Bending process

This study deals with the making use of a low temperature metal as the filler inside a tube during the thin-walled tube bending process. A 3D FEM model and experiments have been conducted to study the effect of the filler on wrinkling, cross section distortion, wall thinning and thickening. The results of nonlinear FE analysis have been verified by experimental results. According to the results of this research, it can be concluded that:

1. If the rubber core is used inside the tube, the wrinkling phenomenon and cross section distortion could be reduced, but they could not be completely avoided in the steel tube.

2. If a low temperature metal filling material is used inside the tube, the defects such as wrinkling and cross section distortion can be completely avoided.

3. Using a filling material increases the inner-tube energy and, consequently in accordance with the low energy, it can prevent the wrinkling phenomena.

III. OBJECTIVES / NEEDS

(Problem Definition)

Several studies have been carried out concerning the computer aided simulation of rotary draw bending technique. The mandrel role in thin-wall tube

bending is studied using ABAQUS software. In rotary draw bending of a thin-wall tube with circular cross section. We have to work on minimization weight of die by using different geometrical shape in die. In which we design a number of shape in die and analysis it by using ANSYS. With the reference of ANSYS result we final best die shape.

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