Flow Forming Simulation

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ABSTRACT: Flow forming process is a kind of a spinning process. This process is commonly used for production of high precision thin wall. In this study, the material numerical model using finite element codes based on the FORGE® NxT 1.0 software will be applied to estimate the mechanical properties of tube after flow forming such as hardness and thickness by compared with the experimental results. The results used to design process and estimated the occurred deformation between in each pass of process.

1 INTRODUCTION

HIGH Pressure Vessels or HPV are widely used in many applications and industrial. High strength thin wall tube is designed for production of HPV and variety of fabrication method can be used such as forging, machining, extrusion etc. Flow forming Technology is commonly used for manufacturing of pressure vessel, especially in defence application. High performance of HPV can be obtained by flow forming such as high strength, high pressure, light weight and excellent surface finish. Considering in economic, this technique has low tooling and operation cost, chipless and very fast.

Before prototyping, many designers usually use simulation program to analyze the mechanical properties and others. Hence, the simulation have more important to use for analysis the material flow, mechanical properties, deformation etc. after design process. In this paper, investigated the results of FORGE® NxT 1.0 software compared with the experiment results after flow forming.

1.1 *Flow forming technology*

Flow forming is cold metal forming process which means the temperature of workpiece should not be lower than material recrystallization temperature. The process starts from hollow cylindrical workpiece called preform and fitted into rotating mandrel, than apply compression force (axial and radial) to outer surface of preform by rollers to increase the length and reduce the thickness to designed diameter.

Two direction of flow forming can be defined and shown in Fig. 1. Forward flow forming is suitable for the tube no longer than the length of mandrel. The preform should be open and close end frame and deformed material move in the same direction of roller feed rate. Backward flow forming is suitable for the tube longer than the length of the mandrel
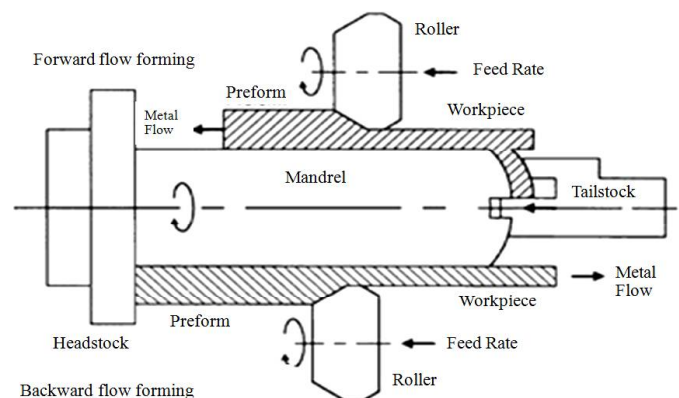

Figure 1. Schematics of forward and backward flow forming

Design of preform tube is based on the principle of constant volume and material flow formability depends on properties and mechanism. The configuration and geometry of roller also effect to accuracy of the product (C.C.Wong et al. 2005, M lakshmana Rao et al. 2008, M.J. Roy et al. 2010, Hamid R. et al. 2011)

1.2 *Finite element model*

Flow forming analysis such as material property, configuration, deformation, load and response factor in each time step are non-linear. The problem analysis in this case is hard to solve by mathematical equation. But it's can solve by finite element analysis. Hench, the finite element has spread widely use for analysis of product design and improve virtual