

# Finite Element Simulation of Hot Press Forming Process in high strength steel in automobile part

Kyunghoon Lee

Solution Lab.  
Daejeon, Korea  
(klee@deform.co.kr.)

## ABSTRACT

In response to the growing demand of high strength steel to reduce the weight of automobiles, the hot press forming process has been developed and applied for high strength steel. Numerical simulation of HPF involves elasto-plastic deformation, heat transfer and also phase transformation phenomenon to predict correct residual stress and hardness of product.

## I. INTRODUCTION

The race among metals to achieve lighter weight and higher strength is getting fierce. The amount magnesium and aluminum used in automobiles replacing steel parts is increased every year. However, the formability of high strength steel such as TP and TRIP steel at room temperature limits its usage.

In hot press forming process steel sheets are heat up to the austenising temperature and formed into part with good formability. Quenching process right after the forming transforms the part into harder and stronger Martensite.

The HPF process is simulated by Finite element simulation software. Numerical simulation could provide important process parameters to achieve required hardness and strength of part

## II. Theory

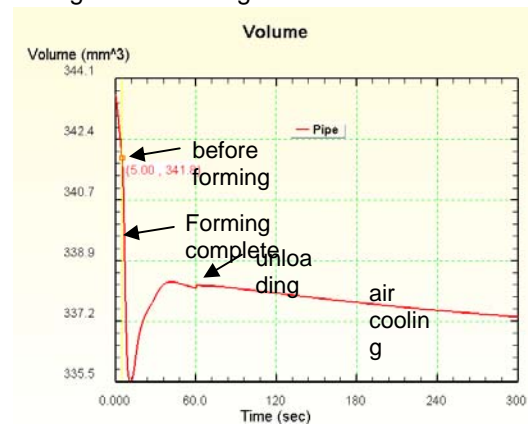
Hot press forming process simulation needs to consider many phenomenun including heat transfer inside and between dies and sheet, phase transformation of sheet during the quenching and elasto-plastic deformation during the forming and unloading after air cooling.

$$\dot{\epsilon} = \dot{\epsilon}^e + \dot{\epsilon}^p + \dot{\epsilon}^{\theta} + \dot{\epsilon}^{tr} + \dot{\epsilon}^{tp} \quad (1)$$

The additive definition of strain represents each phenomenon. The strain terms in equation (1) are elastic strain, plastic strain, volumetric strain due to temperature change, volumetric strain due to phase change and plastic strain due to phase change in order.,

## III. Numerical Simulation

Commercial FEM software DEFORM v10.1 has been used to simulate HPF automotive part. The figure shows part volume change during the HPF process. The part volume decreases during the forming by die cooling but increases by phase change after forming



## REFERENCES

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