Study on the Springback of FDSC MPF for Cylindrical Surfaces

JIA Bin-bin, WANG Wei-wei, DI He

(School of Material Science and Engineering, Harbin Institute of Technology, Weihai, Shandong 264209,China)

Abstract: In this paper, Force-Displacement Separated Control Multi-Point Forming technology (FDSC MPF), a new technology of multi-point forming was proposed. Through controlling displacement by upper die and controlling force by lower die, the technology realized the separated controlling of displacement and forming force through the forming process. In this technology, the sheet deformation mode is changed from local normal constraint and overall deformation to overall normal constraint and local forming in order. The stress state of the forming sheet is improved effectively, and had many advantages such as a simple and stable control, no need of blank holder, restrain wrinkles, small amount of rebound, etc..

A Force-displacement-separated-control MPF simulation model was established and built in ABAQUS, and an experimental device was designed and manufactured. Trough numerical simulation and forming experiment, the springback regular was studied as the cylindrical radius changed by r250mm, r225mm, r200mm and as the forming force changed by 500N, 700N, 900N, 1100N. The results show that, numerical simulation has the same tendency with the experiment. The springback decreases with the increase of forming force and the decrease of cylindrical radius.

The traditional cylindrical MPF springback regular was studied through numerical simulation. The springback regular was studied as the cylindrical radius changed by r175mm, r200mm, r225mm, r250mm.The simulation results show that the springback increases with the increase of the radius. Based on the geometric compensation method, different cylindrical radius was calculated, the simulation results show that, a qualified surface will be acquired when the forming is based on three times calculated compensation.

The springback of traditional cylindrical MPF was studied through experiment and the experimental parameters are the same as simulation. The results show that, the springback increases with the increase of the radius, and experimental result has the same changing trend with the simulation result. A qualified surface will be acquired when the forming is based on three times iteration calculated compensation. By comparing the results of simulation and that of experiment, it indicates that the simulation has a high accuracy, and can calculate optimized parameters, which can provide an effective guide to the experiment.

Through the contrast of two forming methods by numerical simulation and experiment, it is confirmed that the springback can be restrained effectively in FDSC MPF. During the forming of force-displacement separated control MPF, compressive stress is applied on the sheet normal direction by punches and additional tensile stress at tangential direction is produced. Thus the tangential compressive stress at the sheet neutral plane is decreased, the wrinkling instability is restrained and the springback is decreased.

Keyword： force-displacement separated control, multi-point forming, springback, cylinder