Effect of tool design on formability in deep drawing applying compressive force on flange

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ABSTRACT

Cup shaped products are generally formed from sheet metal by bulging or deep drawing. However, it is difficult to fabricate a deep cup in one process, because the material is drawn by the tensional force and then it is easy to break. Authors proposed a new deep drawing process which applies compressive force [1]. The method is composed of "Initial stretching" and "Compressive drawing". A sheet metal is compressed in thickness direction at the flange part in "Compressive drawing", after the center of the sheet slightly stretched into a die in "Initial stretching". The material at the flange part flow into the die by uniaxial compression, and a deep could be fabricated in one process.

In this method, clearance between the punch and the die, and amount of initial stretching is important for suppression of defects. For example, the side wall curves, and the thickness becomes uneven when the clearance is too large. However, load is very high when the clearance is too small. In addition, the material breaks during initial stretching when the amount of initial stretching is too large, but drawing direction cannot be controlled when it is too small.

In this study, the effect of the forming parameters was investigated by finite element analysis in order to optimize the tool design for suppression of defect. At first, the effect of the clearance and the amount of initial stretching was investigated. As a result, deep cups without defects, such as the curvature and the thickness unevenness, was formed under appropriate conditions. However, local thinning occurred near the bottom of the cup. To suppress the local thinning, the effect of corner radius of the punch and the die was investigated. Deep cups without the local thinning was formed successfully by increasing the corner radius of the punch shoulder.

REFERENCES

[1] T. Iizuka, N. Hatanaka, N. Takakura, "Deep Drawing of High Cup of Magnesium Alloy AZ31 by Compressive force", *Steel Research International*, **81**, 1247-1250 (2010).