Smart Clamp

Influence of tool clamping devices on workpiece quality in stamping and deep drawing processes

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Abstract

Vibrations and displacements in forming tools and equipment lead to increased wear of the tools and to a reduction in component quality. Previous work has been aimed towards stiffening the equipment and tools and introducing damping systems. However, these solution approaches always mean additional work and expense, with some independent systems having to be integrated into the production line. The object of the present research project was therefore not to consider the tool or the press, but the interface of both systems to each other - the tool clamping situation.

Project description

The clamping situation has a great influence on the stiffness of the system consisting of the die and the press. This in turn has an influence on the vibrations of the die, which can affect wear. In order to reduce wear as much as possible, the coupling of the die must be as rigid as possible. In this project, therefore, three common ways of fastening tools were used and their influence on wear was compared. Traditional screws and slot nut connections, quick-action clamps and magnetic clamping plates were used. The vibrations of the tool were recorded in-situ with an optical measuring system from the company GOM as well as force sensors and accelerometers (Figure 1).
In order to investigate the influence on industrially used processes, a deep drawing die and a shear cutting die were first designed and manufactured. Subsequently, endurance tests were carried out with the blanking die on a Bruderer high-speed press, while the deep-drawing tests were performed on a servo spindle press.

Results

The die clamping situation as the interface between die and press influences both component quality and wear due to vibrations and misalignments.
The lever arm between process force and clamping force as a decisive parameter is shortened by the use of quick clamps and thus an increase in rigidity is achieved with the same number of clamping devices. Both die acceleration and die vibration are reduced most with magnetic chucks, which create a stiff connection between die and press due to the two-dimensional force application. These results are shown for both the shear cutting die and the deep drawing process. Here, the effect of die vibration is less pronounced for deep drawing than for shear cutting. However, numerical investigations suggest that for large-area formed components, such as those found in the automotive industry, the use of magnetic clamping plates can achieve a significant gain in the stiffness of the connection point.

[1] Tool with refrence points used for optical vibration analysis

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