CROSS WEDGE ROLLING TO PREFORM LIGHT METAL FORGINGS

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Preforming by cross wedge rolling (CWR) results in increased efficiency and saved resources.

The forging of a component with oblong shape and complex geometry can not be realized in a single forming operation. Preforming operations are applied to ensure complete cavity filling with smallest amount of material loss, to avoid forging defects and to keep loads and wear of the dies low. In preforming the distribution of the material along the main axis can be realized either by displacement or by accumulation.

In accumulation processes the cross section of a forging is increased while the length is reduced. The process limit is characterized by the failure mechanisms of outward bending and buckling.

In the displacement operation of CWR a billet with circular cross section is formed by two wedge-shaped tool halves which are moved in opposite direction to each other and which represent the negative shape of the rolled workpiece contour. The diameter is reduced and the material is redistributed in axial direction by the radial plunging of the roller wedges into the billet. CWR is an incremental forming process with open groove and partial force exposure. Due to the varying degrees of freedom, the layout of the cross rolled shape and the design of the tools have special significance.

Research and Technology development in the field of bulk metal forming at the Fraunhofer Institute IWU Chemnitz has resulted in a number of successful applications of CWR in preforming.

Forged guide vanes made from the standard alloy Ti-6Al-4V are applied in jet engines. Closed die forging is used to form the basic shape on which the entire manufacturing chain of the vanes is based. An aero engine vane is divided into the shroud, airfoil and foot section, which have a mass difference of up to 6 times, thus necessitating preforming operations. A CWR preforming design as double workpiece and a corresponding roll-tooling was designed to reduce manufacturing steps, improve material utilisation and reduce energy consumption.

Another application of CWR resulted in enhanced preforming for a subsequent flash-poor forging of aluminium power train components. The challenges of controlling the material structure and tight temperature requirements were met by a flow-optimized workpiece design in combination with a heated rolling tool.

For further information please contact the Department Bulk Metal Forming at Fraunhofer Institute for Machine Tools and Forming Technology in Chemnitz, Germany: http://www.iwu.fraunhofer.de/english/index.htm

Logo of Fraunhofer Institute for Machine Tools and Forming Technology

Fig. 1: Round tool rolling machine RBQ 1000 in the workshop of Fraunhofer Institute

Fig. 2: Process chain of forging aero engine vanes

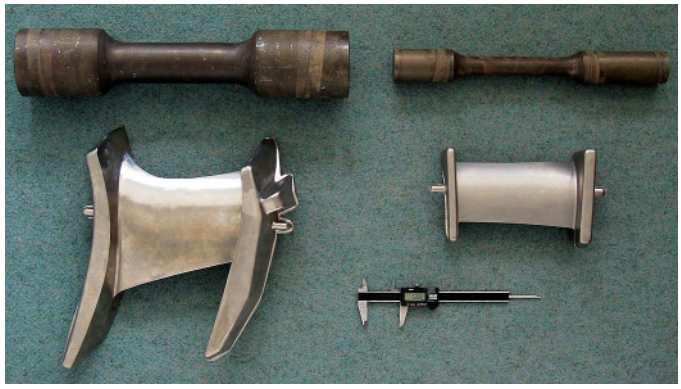

Fig. 3: Additional examples of cross rolled preforms of aero engine vanes

Fig. 4: Aluminium control arm for motor vehicle