事例研究

かしめハブ軸受の金型形状の最適化と新たな制御因子の探索

Optimization of Die Shape for a Swaging Hub Bearing and Search for New Control Factors

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The design of forged metal dies involves complex interrelationships between a large number of dimensions, which are generally determined through trial and error on the basis of professional experience and intuition. Once determined in this way, however, the dimensions are hard to improve. We attacked this issue by performing a computer-aided engineering（CAE）analysis of the 23 dimensions of a die for a swaging hub. The dimensions were assigned to an L_{24} orthogonal array with reduced separation between their levels to minimize interactions. Four effective control factors were thereby discovered. Next a CAE analysis was performed by varying the levels of the control factors without using an orthogonal array, the range of candidate designs was narrowed down to nine, and these nine candidates were evaluated by applying a noise factor（the hardness of the metal）. Optimal conditions were thereby found, under which expansion of the inner ring was reduced by 33 % without changing the axial force. Next, to explore seeds for further development, the causality search Taguchi（CS-T）method was applied: seventy intermediate characteristics were selected from the results of the CAE analysis of the L_{24} orthogonal array experiment and the effective ones were determined. On the basis of these intermediate characteristics it was possible to devise a mechanism and file a patent application for a new swaging method.

Key words：swaging, hub bearing, die shape, CS-T method, forge, development, improvement, quality engineering, Taguchi methods

1. はじめに

自動車のホイール用ハブユニット軸受（以下，ハブ軸受）は，**Fig.1** に示すように，タイヤの中心で使用し，車体を支え，タイヤをスムーズに回転する役割を担う。

ハブ軸受は，重要保安部品であり，**Fig.2** に示すように，信頼の高い塑性変形によるかしめ加工で，内輪，外輪，シャフト，転動体を一体にするものが多い。ここで，かしめ加工によるハブ軸受の金型設

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