事例研究

熱処理，機械加工技術での品質向上の取組み

Improving quality in heat treatment and machining technology

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The transmission systems of automobile powertrains involve many gears. The gear production process involves multiple subsystem processes, including forging for flow shaping, machining for gear cutting, heat treatment to ensure hardness, and hard turning to finish the tooth profile. Here we describe a problem that arose when the heat treatment process for the gears in an actuating device was changed from the conventional gas carburizing method to a new vacuum carburizing method. The problem was that the tool life in the hard turning process was shortened. This problem was dealt with in a parameter design scheme for overall optimization of heat treatment and machining processes at multiple locations. A mixed team of heat treatment and machining engineers used fault tree analysis（FTA）to increase their knowledge and promote their activities. By optimizing the conditions for each process, they were able to find conditions that promised to extend tool life. In a verification trial conducted on a mass production line, these conditions reduced tool costs and reduced labor costs by reducing the number of tool changes.

Key words：robust quality engineering, Taguchi methods, parameter design, S/N ratio, heat treatment, machining technology, gear, overall optimization, fault tree analysis

1. はじめに

歯車は，円柱，円錐の周囲に歯形形状を造り，歯と歯を対にしてかみ合わせることにより，回転運動を伝える機械要素であり，自動車のパワートレイン部品の伝達系で多く使用されている。歯車部品は伝達するトルク，速度，方向により，多種多様な形状となっている。自動車部品での歯車は，大きく平行軸歯車，交差軸歯車，食い違い軸歯車の3種類に分類されるが，今回は，差動装置（ディファレンシャル）で主に使われる，交差軸歯車，食い違い軸歯車を対象としている。**図1**に代表的な歯車の外観図を示す。

歯車は，使用環境の温度，湿度等が変化する中で，焼き付かず，滑らずに，回転力のトルク，回転数，

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