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An Investigation into the Forging of Bi-metal Gears

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Abstract

This paper introduces a method for the production of bi-metal gears using the forging technique. To study the process, model materials of copper (tooth ring material) and lead (core material), were used for both experimentation and simulation. Firstly, experimental setup and test procedures are introduced and the bi-metal gears are forged with different thicknesses of the outer ring material. A simplified FE model is established based on the symmetry of a gear forging process, which enables the 3D FE analysis to be carried out in an efficient manner. The material flow and thickness distribution of the experimentally forged bi-metal gears are analysed and compared with FE predictions. The effect of friction on the axial lock caused by the material flow of the forged gears is also studied. Finally, simulations of different combinations of the inner core and outer ring materials, specifically steel (ring material), copper (ring and core material) and lead (core material) are performed. The numerical and experimental data showed that: thin rings can deform excessively, affecting the structure of the gear; and that both tooling friction and flow stress can significantly affect the relative material flow between the core and the ring.

Key Words: Forging; Gear forging; Bi-metal gears; FE simulation; Experimentation