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Influence of Die Wall lubrication Compaction on Densification, Microstructure and Mechanical Properties of Low Alloyed Mo and Cr Steels

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Abstract - The influence of die wall lubrication (DWL) during cold compaction on the sintering shrinkage and the properties of three low alloy sintered steels, 1.5%Mo, 1.8%Cr, 3%Cr and 0.5%Mo, were investigated. Carbon content was 0.3%. The lubricant content was adjusted to the compaction strategy. Compaction was carried out at 1000 MPa, with either bulk (BL) or die wall lubrication, warm die compaction at 90°C. Three points bending specimens were produced, and sintering was carried out at 1250°C in a vacuum furnace, with nitrogen backfilling.
Die wall lubrication allows a much higher green and sintered density to be achieved respect to bulk lubrication; in addition, sintering shrinkage is less than in bulk lubricated specimens. The pore characteristics are slightly improved by die wall lubrication, while the microstructure of the matrix is almost unaffected, while both strength and ductility are greatly improved by die wall lubrication.

Keywords: die wall lubrication; high sintering temperature

Conclusions - Three steels obtained by adding 0.3wt% graphite to three pralloyed powders: 1.5%wtMo, 1.8%wtCr and 3%wtCr-0.5wt%Mo, have been investigated in this paper. They were warm die (90°C) compacted with bulk and die wall lubrication conditions at 1000MPa pressure and sintered at 1250°C.
The effect of die wall lubrication is the same for the three materials. It allows to obtain higher green density than bulk lubrication that results in a lower and less anisotropic sintering shrinkage.
DWL compaction also promotes a slight improvement in pores characteristics: a smaller number of the largest pores (D_{circle} > 20µm) and an increase until 60% of the shape factor f_{circle}.. The microstructure and microhardness of the metallic matrix is not affected by the lubrication. Die wall lubrication promotes a great increase in TRS and E_f due to the increased density. The increased density combined with the decreased sintering shrinkage and the enhancement of mechanical properties represents a great technological advantage that might be exploited in the production of high performance structural parts.

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