MECHANISM OF ANISOTROPIC DIMENSIONAL CHANGES
DURING SINTERING OF METAL POWDER COMPACT

Hidenori Kuroki and Masahiro Hiraishi
Department of Mechanical Engineering
Hiroshima University, Higashi-hiroshima City
724 Japan

INTRODUCTION

The dimensional change of a metal powder compact during sintering has been considered as one of the major parameters with which the mechanism of sintering can be described quantitatively. The changes, however, are anisotropic in a cold pressed compact. The value depends on the direction in which it is measured, i.e., the compacting one or the lateral one.

E. H. Exner has counted anisotropy as one of the fundamental problems which has not yet been solved. Various types of mechanisms have been proposed and discussed for the occurrence of anisotropy since the days of H. H. Hausner and F. V. Lenel. One of the present authors has proposed two mechanisms. One mechanism is the expansion of flat pores in the direction of thickness or the pressing direction of the compact by the internal gas pressure. This has been well known for the hydrogen disease of copper compacts. The other mechanism is the larger recovery in the pressing direction of the smallest size which has been attained during pressing and ejecting from larger sizes before sintering of the ejected or dewaxed compact. This mechanism has been proposed for iron powder compacts.

The dimensional changes of a compact in the latter mechanism can be attributed to the changes of distances between particles. Thus, a quantitative explanation of the larger dimensional changes in the pressing direction would be possible by counting the number of the particle boundaries in that direction, and then multiplying the number by the mean change of the distances between particles. In the present work, some experiments are made on wire-wound model compacts and on powder compacts to evaluate the changes of distances between particles during sintering.

EXPERIMENTAL PROCEDURE

Preparation of Wire-wound Model Compacts

Structure: A wire, 0.16mm in diameter, of austenitic steel 304(18Cr-8Ni), is wound in 5 layers and 17 or 18 turns in a layer on a shaft, and pressed in the axial direction of the shaft (Fig. 1). A movable flange is fixed with a small bolt on the shaft. Fastening the bolt maintains the tight contact condition attained by pressing.
Pressing: Flat contacts having a width of about one third of the diameter are developed between the neighboring wires by the pressing operation under 3330N (Fig. 2).

Sintering: The model compacts are sintered in a furnace held at 1263-1463K for 5 minutes-17 hours in a hydrogen atmosphere.

Evaluation of Sintered Model Compacts

A section of a pressed model compact shows narrow gaps of about 0.5