cause the conditions of preliminary sintering to influence the properties of the re-compact and re-sintered bodies.

CONCLUSIONS

1. The optimum concentration of hydrogen chloride in the process of sintering cermet iron amounts to 5-10%. An intensive blowing with hydrogen at the end of the sintering cycle averts the harmful effect of HCl on the rust-resistant properties of sintered compacts.

2. The effect produced by HCl additions becomes manifest only if the holding periods were longer than 10-15 min. The degree to which the properties may be improved is estimated at 25-40%.

3. The conditions of preliminary sintering produce a decisive effect on the properties of re-pressed and repeatedly sintered bodies. In utilizing the atmosphere of H2+10% HCl for preliminary sintering (1100-1200°C, 15-90 min) it becomes possible to obtain the properties of cast electric steel, after re-pressing of the compacts to a density of 7.7-7.8 g/cm³ and sintering at 1200°C (4 hours).

REFERENCES


THE EFFECT OF DIFFUSION POROSITY APPEARING IN NICHROME ALLOY ON THE SINTERING OF NICKEL AND CHROME POWDERS

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In studying the process of sintering nickel and chrome powders we have been able to observe a rather unusual variation of the lattice spacing and the shape of lines in X-ray photographs of Nichrome Ni80Cr20.

Samples with varying porosity were prepared for investigation by cold-pressing of nickel and chrome powders. The porosity of samples ranged from 10 to 15, 25 to 30, and 40 to 40%. The samples were sintered in hydrogen current at 1150°C for a period of 8 hours. The X-ray patterns were produced in a KROS chamber with a molybdenum standard and copper radiation.

The lattice spacing was calculated on the basis of line (420). It was revealed that the character of lattice-spacing variation during sintering is not monotonic, but staggered, Figure 1.

A similar variation pattern is to be observed in the blow-up of the lines on X-ray pictures: the lines now become diffuse, then sharp again to the point of doublet Kα separation. Furthermore, the sharp lines in the X-ray pattern correspond to the large lattice spacings. A similar phenomenon appearing during the anneal of Cunico alloy is described in paper [1]. The enumerated phenomena attest to the fact that the homogeneity of the solid solution does not vary monotonically in the process of powder nickel and chrome sintering. This may be explained on the basis of the completed investigation of the formation and growth of submicroscopic porosity in Nichrome alloy.
Porosity appeared in an alloy with closely approaching composition (21% Cr) as chrome was driven off in vacuo at different temperatures. The size of the submicroscopic pores was determined by studying the low-angle X-radiation scattering [2]. The analysis of X-ray patterns was conducted in the same manner as in work [4]. The layout of the apparatus is shown in Figure 2.

It was disclosed that sub-microscopic pores measuring a few hundred Å arise and grow in Nichrome in the process of chrome elimination. The kinetics of the pore-size variation during isothermal sublimation at different temperatures are represented by the curves in Figure 3. The sizes of the submicroscopic pores also do not vary monotonically. Moreover, the lower is the sublimation temperature, the greater is the number of the extreme points on curve \( \frac{R_0}{R_0} = f(\sigma) \). The disclosed phenomenon, apparently, may be explained only by the healing of the formed sub-microscopic pores, since the maximum size was considerably lower than 1000 Å.

The healing must occur as a result of chrome diffusion, since the partial coefficient of its diffusion in Nichrome is considerably higher than the diffusion coefficient of nickel [4].

Healing is possible in the case when the inflow of chrome atoms is greater than the inflow of vacancies. After the

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**Fig. 1.** Lattice spacing of ceramic Nichrome versus sintering time at 1150°C; initial porosity:
1 - 15-20%; 2 - 30%; 3 - 40-45%.

**Fig. 2.** Schematic diagram of the apparatus for investigation of low-angle X-ray scattering:
1 - X-ray tube; 2 - monochromator; 3 - sample; 4 - collimator; 5 - G.-M. counter; 6 - scaler.

**Fig. 3.** Variation with time of the pore sizes and total porosity in Nichrome subjected to vacuum sublimation at different temperatures:
a) at 1200°C; b) at 1350°C.