EXCHANGE OF EXPERIENCE AND INFORMATION

DEVELOPMENT AND INDUSTRIAL APPLICATION
OF A PROCESS FOR THE MANUFACTURE
OF SINTERED TWISTING AND SPINNING RINGS
OF INCREASED WEAR RESISTANCE

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Reliability of operation and useful life of ring-runner friction pairs in twisting and spinning textile machines are factors determining to a large extent quality of production and productivity. In the 1960s the useful life of wool and silk twisting and spinning rings was increased from 3 to 7 months by the adoption of rings made of a porous sintered material based on iron powder. Subsequently, ring life was once again markedly shortened by the introduction of new textile machines with high-speed operating mechanisms.

Analyzing the results of researches carried out with the aim of increasing the wear resistance of sintered porous materials, the authors came to the conclusion that with iron-base materials an effective way of achieving this end is to add phosphorus and sulfur to the starting charge. Phosphorus was added by two methods: 1) phosphatizing of porous sintered materials in aqueous solutions of phosphorus-containing salts [1]; 2) addition of phosphorus-containing salts to the starting iron-base powder charge [2]. The most effective proved to be the addition of Mazhef salt* to the charge [2]. Mazhef salt contains acid manganese phosphate and up to 15% free phosphoric acid. The latter reacts with an iron powder, resulting in the formation of iron phosphate. During the preparation of such a charge some of the iron powder particles are phosphatized by the wet acid manganese phosphate in the presence of the phosphoric acid, and manganese and iron phosphates are deposited on their surfaces.

In the course of development work on this process metallographic examinations were made of the structures of materials in the sintered condition. In addition, electron probe microanalyses were carried out, using an MC-46 Cameca apparatus. Figure 1 shows micrographs of structures and the topographic distribution of the elements Fe, P, S, and Mn in specimens. Photographs were taken in electron radiation. It was found that sintered specimens produced from a charge without Mazhef salt had a ferritic-pearlitic structure containing up to 20% of pearlite and some cementite inclusions (occupying up to 1% of the whole micrograph area). The addition of 1% of Mazhef salt raised the hardness of the ferrite grains to H₉₀ =109-188 kgf/mm²; in the ferrite grains could be seen some fine, light-colored inclusions of manganese and iron phosphides. After the addition of Mazhef salt to the charge the amount of pearlite decreased to 10% and cementite disappeared altogether. Phosphorus was evenly distributed throughout the material after sintering (Fig. 1f).

Machined surfaces of specimens produced from a charge containing sulfur (up to 0.4%) and Mazhef salt (1%) had a finish one to two classes higher compared with specimens produced from a charge containing no additions. Tool life in the former case was twice that in the latter. A continuous chip formed during machining. In Fig. 2 are shown photographs of swarf obtained in the machining of: a) sintered porous iron (100% of fine reduced PZh4M2 iron powder), short (l =3-5 mm), sheared chips with surfaces varying from blue to dark blue in color; b) the same material with a 0.5% S addition, long (l =7-10 mm), sheared chips with surfaces varying from yellow to brown in color; c) a sintered iron-base material from a charge with a 1% Mazhef salt addition, continuous chip (l =50-60 mm) having a yellow surface color. Machining conditions were identical: t=1.5 mm, s =0.32 mm/revolution, V =178 m/min, turning tool with a brazed-on T15K6 (WC−15% TiC−6% Co) alloy tip.

To the process of manufacture of parts has been added a chemo-thermal treatment (diffusion impregnation) operation — carbonitriding with triethanolamine in shaft furnaces followed directly by oil-quenching from

* A commercial mixture of monometallic manganese and iron phosphates used in the preparation of phosphatizing baths - Translator.

the furnace temperature. The process is accompanied by the formation of complex carbonitrides alloyed with phosphorus and manganese, the hardness of the martensite forming during quenching and of the complex carbonitrides being appreciably higher (by 30-50%) than that of the material not subjected to carbonitriding.

The wear of rings produced by the new process is 60% less than that of rings manufactured by the former technique. The improvement in the wear resistance of parts may be attributed to the fact that the complex eutectic grains in the structure of the material are enriched with phosphorus, sulfur, and manganese, the presence of which improves the running-in of working surfaces and consequently decreases local load concentrations on the rubbing surfaces of parts. This in turn increases the probability of protective boundary films, which form from oil emerging from the pores of the material during rubbing and contain iron and manganese phosphides, being retained on the rubbing surfaces.

In a mass program of industrial tests on PK-57 sintered rings of optimum composition carried out at the Moninsk Worsted Concern it was found that rings produced by the new technique from a charge containing Mazhef salt: 1) Had a minimum useful life one and a half times longer than that of standard rings made accord-