MATERIALS AND TECHNOLOGIES USED IN THE PRODUCTION OF HIGHLY LOADED GEAR WHEELS

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The gear wheels are included the most important machine elements used in stationary drive systems and mobile technology devices as well as all kinds of motor vehicles. Hence the need to use appropriate materials and appropriate technology of mechanical processing as well as heat treatment or thermo-chemical treatment in order to obtain high strength properties leading to maximization of service life.

The presented abstract concerns research work on a wide range of materials, technological issues, fatigue contact strength σ_{Hlim}, the fatigue strength of the tooth σ_{Flim} and X-ray method of measuring residual stresses and retained austenite content in the surface layer. The tests were carried out on modelled gear wheels made of five steel grades: steel 8620, 4817 according to AISI and steel according to PN 18 HGM, 18 H2N4MA, 20 HG.

Two methods were used in the finishing treatment of the teeth: grinding after carburizing and hardening, and turning with final carburizing and hardening. In both technological variants, the carburized layer was characterized by a hardness of 60 - 62 HRC. Grained wheels with final carburizing and hardening obtained a higher value of compressive residual stresses, and a lower content of retained austenite compared to wheels ground after carburizing and hardening. Fatigue tests were carried out on the test bench in the circulating power system. In the case of fatigue testing of contact strength $\sigma_{H\,lim}$ the parameters of the gears were as follows: $z_1 = 17$, $z_2 = 23$, $m = 6$ mm, $\alpha_0 = 20°$, $x_1 = 0.4888$, $x_2 = 0.46$. However, in fatigue tests for the strength of the tooth root $\sigma_{F\,lim}$, gears with the following parameters were used: $z_1 = 27$, $z_2 = 35$, $m = 4$ mm, $\alpha_o = 20°$, $x_1 = 0$, $x_2 = 0.2574$. The fatigue contact strength $\sigma_{H\,lim}$ was determined at the base number of load cycles $N_G = 50 \times 10^6$, and the fatigue strength of the tooth root $\sigma_{F\,lim}$ at $N_G = 10 \times 10^6$. In each case, from the five steel grades used, the technology of final carburization and hardening ensures higher fatigue contact strength $\sigma_{H\,lim}$, as well as higher fatigue strength of the tooth root $\sigma_{F\,lim}$ compared to the technology of grinding after carburizing and hardening.

On the example of AISI 8620 steel, the determined numerical values of fatigue contact strength $\sigma_{H\,lim}$ and fatigue strength of the tooth root $\sigma_{F\,lim}$ depend on: $\sigma_{H\,lim} = 1459$ MPa, $\sigma_{F\,lim} = 455$ MPa in grinding technology. However, by using the shaving technology, the values of these parameters are: $\sigma_{H\,lim} = 1492$ MPa, $\sigma_{F\,lim} = 488$ MPa.