Effect of the chemical composition of iron-based powder materials on the properties of sintered components

Agnieszka Stanula

Abstract

The scientific objective of the doctoral dissertation is examination of the impact of the influence of the chemical composition of iron-based powder materials, as Fe-C, Fe-C-Cu on the properties of sintered components.

Based on the formulated research postulate, the following implementation goals of the dissertation were determined:

1. selection of powder material to determine the strength properties of sintered components
2. reduction of large research amounts under laboratory conditions by the development of an appropriate scientific knowledge base and verification of the implementation of new powder metallurgy products
3. the Digital Twin concept - a comparison of real and literature parameters used for the finite element analysis (FEA)
4. design and construction of a suitable test stand to study the density of sintered components.

The thematic scope of the dissertation, including the definition of the research topic, includes defining the relationship between copper and carbon content and the density parameter for sintered components that are components of vehicle suspension. Using the right chemical composition and a technological process, it is possible to find relationships among the chemical composition, density and mechanical properties of the components (tensile and compression strength, yield strength, elongation and hardness).

Metallographic studies carry information about the effects of a crack in a sintered component on a potential failure in the entire car suspension system. Production costs may be reduced by the calculation and determination of carbon losses in the production process.

The scope of scientific studies requires verification of the following issues:

1. the properties of powder materials
2. the structures of manufactured sintered components
3. the mechanical properties of sintered components

For that purpose, an optical microscope, a scanning and a transmission electron microscope were used. Studies of mechanical properties require hardness, tensile and compressive strength tests and density.

The results of the compression and tensile tests were scattered due to material porosity. In order to determine the relationship of data and results, the tests were separated into the analysis of sintered components from powder material 22 and the analysis of sintered components from the other powder materials, i.e. Fe-C-Cu and Fe-C.

Strength test simulations and a wide range of tests made it possible to establish a material base.

Key words: powder metallurgy, conventional sintering process, hardness, mechanical properties