Analysis of causes of cracking of piston rings mad of graphite cast iron

Silvia Hudecová, Milan Uhríčik, Peter Palček, Veronika Chvalníková, Martin Slezák, Zuzana Šurdová, Edita Illichmanová, and Lukáš Šikyňa

University of Žilina, Faculty of Mechanical Engineering, Department of Materials Engineering, Univerzitná 8125/1, 010 26 Žilina, Slovakia

Piston rings are key components of internal combustion engines, which provide a seal between the piston and the cylinder, thereby significantly affecting the performance, reliability and service life of the engine. Rings made of graphite cast iron are often used in practice, mainly due to their favorable tribological properties, wear resistance and good self-lubricating capabilities. Despite these advantages, cases of premature failure of these components in the form of cracks and subsequent fracture may occur in operation [1, 2].

The aim is to identify and analyze the main causes of cracking of piston rings made of graphite cast iron, by combining experimental and analytical approaches. The work presents macroscopic and microscopic analysis of fracture surfaces, metallographic and fractographic observation, as well as results from chemical analysis of the material. Special attention is paid to the nature of the graphite shape.

The findings contribute to a deeper understanding of degradation mechanisms in piston rings and offer recommendations for optimizing the manufacturing process, choosing the appropriate microstructure and operating conditions in order to increase their service life and reliability.

The research was supported by the Scientific Grant Agency of the Ministry of Education of Slovak Republic and Slovak Academy of Sciences, No. 1/0461/24, No. 004ŽU-4/2023, No. 016ŽU-4/2023, APVV-20-0427 and project to support young researchers at UNIZA, the ID of project 20422.

[1] A. Diószegi, V. Fourlakidis, and I.L. Svensson, Mater. Scien. For. 649 (2010) 517.

[2] H. Yamagata, The Scie. And Tech. of Mat. In Aut. Eng. (2005) 87.