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ECO-TRIBOLOGICAL PROPERTIES OF NODULAR CAST IRON OF FERRITIC STRUCTURAL BASIS

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Abstract. Ecological design of triboelements implies the selection and application of materials with the highest possible strength and wear resistance. In the design process, it is very important to take into account all eco-tribological aspects, while their neglect in the short and long term can lead to consequences that can be catastrophic and their remediation requires significant financial resources. The paper presents the research results of the influence of normal force, sliding speed and type of isothermal improvement on the friction coefficient for two types of triboelement materials. Based on the obtained results, a proposal for the selection of triboelement materials from the ecological aspect was given.

Keywords: eco-tribological properties, nodular cast iron, friction coefficient.

AIMS AND BACKGROUND

Humanity largely depends on the environment in which people live and work. Modern society has developed numerous tribo-mechanical systems in which there are certain triboelements that nature can not recycle in an acceptable period of time without leading to disturbances in the natural biological cycle. Effective legal instruments significantly contribute to the avoidance of environmental disasters. The design of tribo-ecological systems has a significant role in the application of the rules imposed by the law on the environment and the protection of the health of the individual. Wear of triboelements leads to malfunctions of tribo-ecological systems. With the appearance of wear, in addition to increasing the friction force,

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there is also pollution that is not dangerous at first glance. However, having in mind the cumulative effect, these triboelements can very quickly lead to endangering human health, and even to disturbing the ecological balance.

Increasing strength and wear resistance, as well as increasing durability, multiple lead to global reductions in triboelement consumption, reduced financial recycling efforts, and reduced storage space in anticipation of new non-polluting recycling technologies. Tribological properties of materials can be determined by measuring the friction force (friction or energy aspect) and by measuring the magnitude of any wear parameter of the critical element of tribo-mechanical system[1–3].

The value of the friction force in the contact zone as well as the value of wear parameter of the critical element of tribo-mechanical system after the certain time of contact duration, depends upon numerous factors that are defining the conductions under which contact is realised (loading, sliding velocity, type of lubricant, surface integrity, etc.)[3-5]. Comparing of tribological properties of two different materials during contact with, for instance, any steel has to be realised under the constant conditions[6,7].

The aim of the research is to determine the influence of normal force, sliding speed and type of isothermal improvement on the coefficient of friction for two types of triboelement materials, and based on the obtained research results a proposal for the selection of triboelement materials from the ecological aspect is given.

Generally speaking, materials can be viewed from several aspects: the composition and internal structure of materials, properties and possibilities of application, aesthetic appearance, price, possibility of procurement, etc. can be studied. The importance of certain materials in the development of human progress can not be objectively assessed.

In modern mechanical engineering, different materials are used for the production of triboelements. It is very important to determine the tribological and other significant characteristics of the existing materials from which the elements of tribomechanical systems will be made[8–10]. Eco-tribological characteristics of the existing materials can be improved thanks to the development of materials science and surface engineering[9,11]. Appropriate quantitative indicators play a significant role in the selection of materials for the production of triboelements. It is very important to choose those sizes with which it would be possible to compare materials and make the final selection of materials in the most precise and reliable way possible. The most complete and adequate set of data on the properties of materials is obtained by normalised and standardised laboratory tests of samples from semi-finished or finished parts. The influence of the composition and microstructure of materials, as well as the technological process of production on the properties and behaviour of materials and their interaction are given in Fig. 1 (Refs 12 and 13). One of the indicators of material properties and characteristics is the coefficient of friction[8,14].

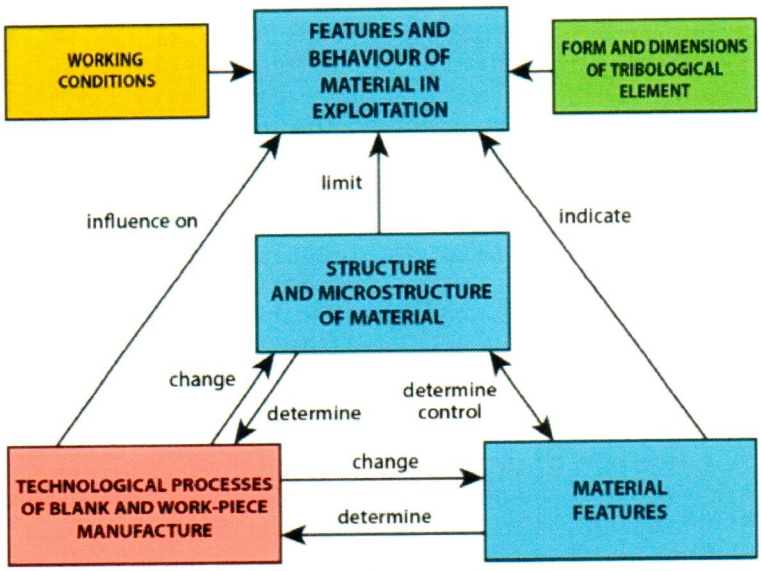

Fig. 1. Influential factors on features and behaviour of material

Modern materials, which are becoming more and more common in the application of various products, must have good mechanical properties, which certainly implies good resistance to abrasion and wear[1,2,8,10,14]. Good wear properties, as tribological characteristics of the material, certainly depend on the conditions under which contact is achieved between the elements in the tribomechanical system that are in contact[5,8,10]. This tribological pair of two materials can be performed on tribometers where three different contact geometries are possible (touch at a point on a line or on a surface)[5,6,13,14]. Evidence that heat treatment affects mechanical properties such as resistance to wear and friction is also visible through the literature review, which primarily refers to the importance of heat treatment[7,15,16]. The use of nodular iron in scientific research is very common where the influences of the microstructural basis as well as the tribological behavior of different pairs are studied[3,17–21]. In particular, the study of the characteristics of nodular cast iron from the aspect of wear has been investigated in the following literature sources[22–24]. Certainly, the wear resistance can be improved by carrying out appropriate heat treatment, however, not every thermal treatment improves the properties of the material, thus, we also find that there are some shortcomings after its implementation[25,26].

Isothermal improvement enables a double increase in strength than with the standard quality of ductile iron, while the values of toughness and ductility remain unchanged. If we keep in mind a very important aspect of environmental protection, which is increasingly demanding today, the production process can reduce