STUDY OF FRICTION COEFFICIENT BETWEEN PARTS OF ALUMINUM AND IRON CONTAINING ALLOYS

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Summary: The high coefficient of friction increases wear, temperature, roughness of the sliding surfaces of parts. These side effects due to the increased friction coefficient are usually enabled in the break-in. In this work the possibilities for reducing the coefficient of friction in brake-in of the sliding surfaces are considered. To reduce the coefficient of friction various coatings on the surface of parts made of aluminum alloy are used.

INTRODUCTION

The Al–Si alloy/iron containing alloy pair is widely used in automotive industries and agricultural machinery. Iron containing alloy used in engine shaft (crank shaft, camshaft, pump shaft). Al–Si alloys, with lighter weight and better heat conductivity than iron, have been increasingly used in engine rod for small agricultural machine.

Al–Si alloy/iron containing alloy pair scuffing is one of the major failure mechanisms in engines. Scuffing is a complicated phenomenon. It involves mechanical, thermal, physical and chemical interactions among the contacting bodies, the environment, the lubricant, and other species at a sliding interface. Nautiyal and Schey [3] found that the transfer of aluminum to a steel surface might occur even in the presence of a substantial amount of lubricant. Cocks [1] studied the interaction of sliding metallic surfaces and found that scuffing happened when wear particles deposited on the rubbing surface, and created a high tendency of adhesion. Reddy et al. [4] reported that scuffing loads increased with the increase of silicon content and decreased with the increase of sliding speed. He proposed a scuffing criterion for this type of contact, stating that scuffing would occur if the traction force is larger than the allowable shear stress of the surface materials. Guo [2] reported that micro scuffing could self - heal in further running, otherwise macro scuffing might occur. In unlubricated Al–Si alloy/iron containing alloy contact, the transition from severe wear to scuffing was related to the surface temperature. The coefficient of friction increased with the increase of load in severe wear regions [4,5].

One of major phenomenon of tribological behavior is friction coefficient. The purpose of this research is to study friction coefficient between Al–Si alloy/iron containing alloy pair.

MATERIAL AND METHODS

In this research, tester of tribologicul performance was used to simulate the contact and lubrication conditions between the shaft and bearing. The tester consists of three major parts: driving system, loading system and lubrication system, as shown in Fig. 1. The tester provides a rotating motion of shaft sample. A horizontal adjustable load (normal load) is applied through a mechanical actuator to push a bearing sample against the shaft sample.

Three parameters are measured during the test: the normal load, the frictional force between the Al–Si alloy bearing sample and the iron containing alloy shaft sample shown on Fig. 2, and the temperature of the contact surfaces. The normal load is measured using an analog gauge. When the shaft sample rotates against the bearing sample, the frictional torque between them is measured by torque sensor on the driving shaft. In order to simulate the real working condition lubricant is used.

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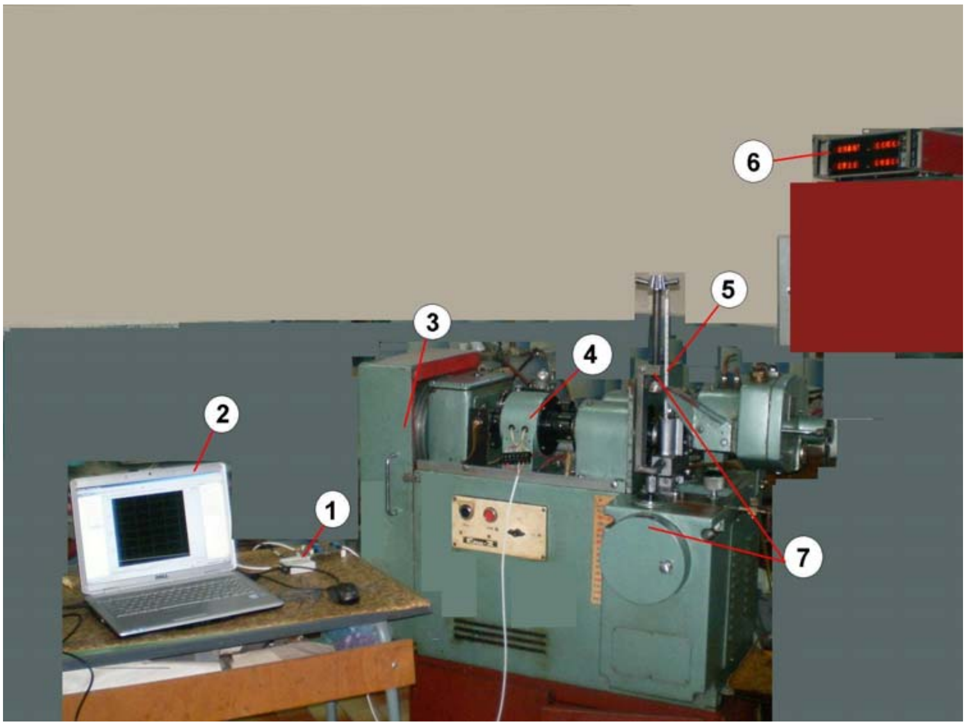

Fig. 1. Tester of tribologicul performance: 1 - NI DAQ USB-6009; 2 – mobile computer; 3 – driving system; 4 – torque sensor; 5 – thermometer; 6 – impulse counter; 7 – normal loading system.

A K-type thermocouple is set inside the bearing sample just behind the rubbing surface to measure the temperature in the area of interest. These measured analog signals from torque sensor input into a computer through a NI DAQ USB-6009 data acquisition unit. By using VI Logger software, signals are collected. After finishing of the experiment the data was transferred in program MS EXCEL. Some simple calculations were done and final graphic is shown on Fig.3.

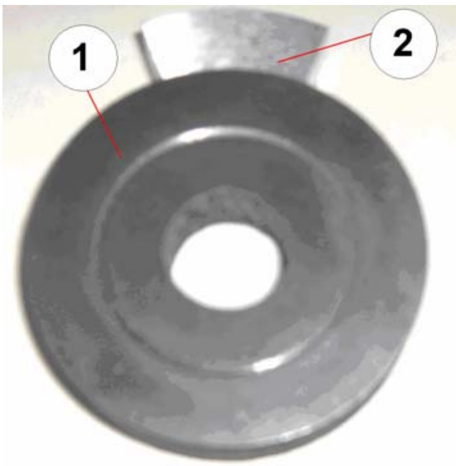

Fig. 2. Al–Si alloy/iron containing alloy pair: 1 - iron containing alloy shaft sample; 2 - Al–Si alloy bearing sample.

All bearing samples specimens are made from the same eutectic Al–Si alloy with or without surface coatings. Coated bearing samples surface include those with Al_2O_3 plating or chemical treatment surface plating (CTUP), or with an Al_2O_3 plating and chemical treatment