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Research on the Hardness of Porous Ceramic and Pin on Disc Wear

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ABSTRACT: This paper through the MMW-1A friction wear testing machine of pin on disc friction wear properties, by changing the load of pin on disc wear to observe surface morphology analysis of wear mechanism, study of porous ceramic material hardness of the surface; pin disc wear volume and the load is related to it, the wear mechanism is the abrasive wear and pitting, the hardness of the ceramic porous to use scratch hardness is measured.
Keywords: pin on disc; porous ceramic; scratch hardness

I. INTRODUCTION

Tribology research mainly by means of friction and wear experiments to explore the law of the friction, wear, lubrication between the two contact surfaces and used to guide the design of the friction pair, the production and optimization[1]. Friction is a fundamental phenomenon in human society and life, is also the important foundation of survival and development of human society[2]. Porous ceramic material is refers to by the high temperature burn becomes, with each other mutually or closed pores in the body of ceramic material[3]. SiC porous ceramic material has high strength, good chemical stability, wear resistance, corrosion resistance, etc[4]. Tribology system dependency, time dependence and interdisciplinary[5]. So the varied factors, which affect the friction coefficient. Under different conditions, factors affecting the role of the size is different. The friction caused by friction and wear of materials to human brings great burden on resources, the friction the natural physical phenomena will have help humans to increase the understanding, promote the sustainable survival and development of human society [6]. Friction inevitably accompanied by the emergence of wear, it is an object with another object (solid, liquid and gas) with a surface material dissipation process [7] caused by contact or relative motion occurs, and on test the tribological properties of friction can be broadly divided into test, bench test and practical test three types [8].

II. EXPERIMENT DESIGN

2.1 Experiment Condition

The test is based on the friction pair of the pin on disc, the material is 45 steel. The size isΦ4.5×10mm, inner diameter: Φ32mm, external diameter: Φ56mm. And the SiC porous ceramic. The content of SiC was 98%, the content of Al2O3 was less than 0.02%, and the porosity was 25-32%(as shown figure 1). Experiment using MMW-1A friction and wear testing machine(as shown in figure 2). Under certain contact pressure, the test machine can simulate the sliding motion of the sliding motion under the condition of high temperature, normal temperature and various kinds of fluid. The test shaft to the working range of the test force: 2 ~ 1000N, spindle stepless speed change range: 1~ 2000r / min, mainly used to evaluation of lubricant, friction and wear properties of metal, plastics, coating, rubber, etc. materials.

Figure1 SiC porous ceramic

Figure2 MMW-1A friction and wear testing

2.2 Experiment Program

To the accuracy of the experiment, reducing the external environment and other may affect all the elements of the experimental results, we do experiments on pin "process, measurement, cleaning, the cleaning, to ensure the accuracy of experimental data. Parameter setting in experiment:

a. time is set to: 5min;
b. speed is set to: 100 r/min;
c. pre loading force is 50 ~250 N N;

Experiment, a total of 5 times, every time is 5min, the speed setting for 100 R / min, every time after the completion of the are after ultrasonic cleaning cleaning instrument were measured.

III. EXPERIMENT RESULTS AND ANALYSIS

3.1 Effect of Load on Wear

Measuring the wear of the pin by electronic balance. The data measured in the experiment are as follows (Table 1)

Table 1 Experiment Data

Load(N)	Time(min)	Speed(r/min)	Weight(mg)	Wear(mg)
			1737.47	0
50	5	100	1736.70	0.77
100	5	100	1735.40	1.3
150	5	100	1733.24	2.16
200	5	100	1732.08	1.16
250	5	100	1729.07	3.01

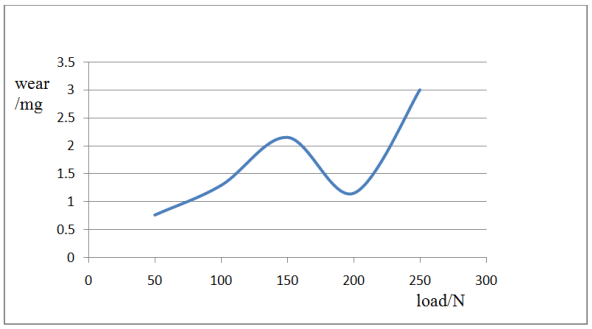
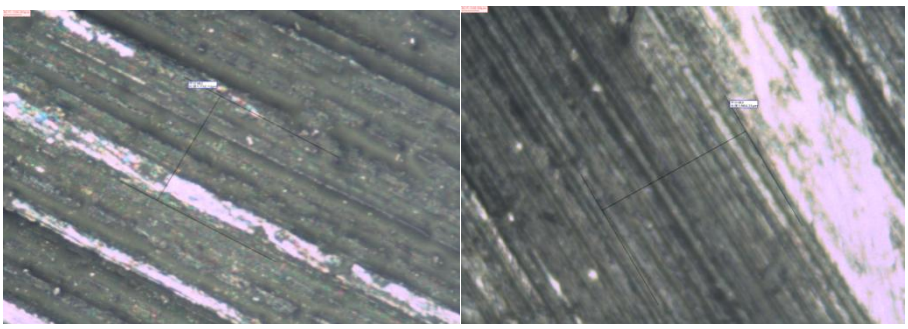


Figure 3 The Relation Wear And Load

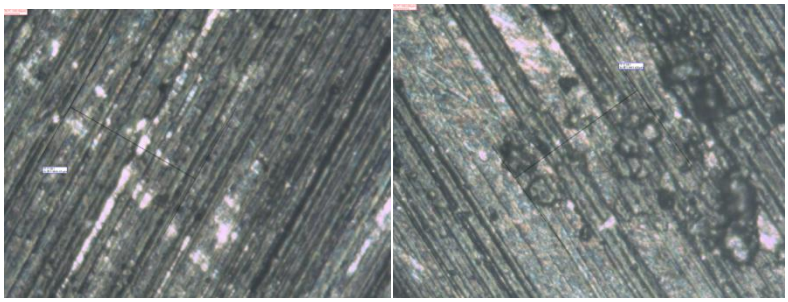
Based on the above data, we put the force loading as abscissa and the amount of wear ordinate curve connecting the points from the data in the figure can be seen, in addition to the four sets of data, the overall wear volume and the loading force is positively related. For MMW--1A friction and wear testing machine for, in setting some parameters to determine the circumstances (such as time and speed), between the wear volume and the loading force will, there is a linear relationship between, loading force between 50N to 150n, with the wear volume is positively correlated, the loading force of between 150 to 200N appear fluctuation, decreases, 200N to 250N recovery proportional, so wear quantity and the loading force of overall size showed a positive correlation relationship.

3.2 Wear Mechanism Analysis

The surface of 45 steel was observed by optical microscope as shown in figure 4.



(a) Load is 50N **(b)**Load is 100N



(c) Load is 150N **(b)** Load is 200N

Figure 4 Pin on disc Surface

Friction two pairs of dual surface in the contact process, because by normal stress and shear stress repeatedly, would inevitably lead to plastic deformation of material surface to surface hardening and finally in surface stress concentrated source of initial crack, the alternating should be repeated action of force, crack development to a certain depth be the shape of cantilever beams, in under the action of hydraulic material from the root fracture and in the surface form fan-shaped fatigue pit, causing the surface pitting

3.3 Scratch Hardness of SIC Porous Ceramic Materials

Hardness is an important index to measure the mechanical properties of materials. It refers to the ability to resist the external forces, that is, the relationship between the external force and the deformation size of the object. As one of the important categories of inorganic nonmetal materials, ceramic materials have made great progress. Structural ceramics with high mechanical strength, high hardness, resistance corrosion resistance and other advantages are widely used in metallurgy, mines and aerospace and other fields. Hardness is an important technical parameter of structural ceramics. It has a close relationship with the strength, wear resistance, toughness and composition of materials, microstructure and so on.

The hardness of SiC porous ceramic material is measured by using the hardness tester. As a result of the special structure of the porous ceramic material, the pressure head of the hardness tester is directly pressed in the gap of the porous ceramic material, and the measurement is not accurate as shown in figure 4.

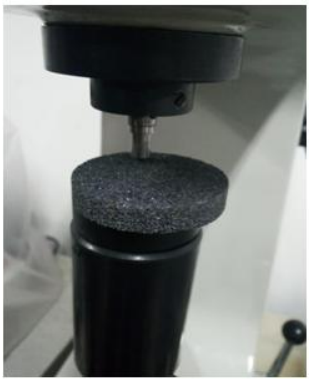


Figure 5 Measurement of SIC Porous Ceramic Hardness

IV. CONCIUSIONS

1. In a certain range, the amount of wear and tear of the pin is positively correlated with the load.
2. The wear mechanism of the pin on disc is abrasive wear and pitting.
3. The hardness of the porous ceramic material cannot be measured by the traditional method, and the hardness is measured by scratch hardness.

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