PRIMARY EVALUATION OF THE WEAR BEHAVIOR OF THE COMBUSTION SYNTHESIZED TiC-NiAl COMPOSITE AS MECHANICAL SEAL RINGS

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1. General

In this research, the wear behavior of combustion synthesized TiC-NiAl composite was evaluated in comparison sintered SiC specimens as relevant materials for use in pumps (Hard Face Part of Mechanical Seals), because of low cost and simplicity of combustion synthesis process. Therefore wear behavior of samples was determined by pin on disk test against a 52100 steel pin under dry condition as well as in aqueous environment of a pump.

2. Introduction

SiC belongs to this group of materials and is well known for its high hardness, the relatively high strength, a high melting point and a good corrosion resistance [2, 3]. The most reliable and economic way to control fluid leakage from industrial equipment such as centrifugal pumps, agitators, automotive engines, compressors, turbines and mixers is to isolate the rotating shaft and its housing with a mechanical seal [4, 5]. In compared to the sintering methods for fabrication of seals, combustion synthesis is a simple, low cost and energy conservative process [1]. In seal ring for pumps, lubrication and wear resistance properties are important factors [6, 7]. Also as TiC-NiAl has good properties such as wear resistance and low density [8], therefore combustion synthesized TiC-NiAl was evaluate in comparison sintering SiC in wear test and durability test for use as seal rings in pumps.

3. Experimental procedure

The combustion synthesized TiC-NiAl composite and sintering SiC was prepared. The outer diameter and the inner diameter of the samples were 3.2 and 2.5 mm, respectively. Fig. 1 is shown seal ring sample of sintered SiC and combustion synthesized TiC-NiAl.

Figure 1. Sintering SiC and combustion synthesized TiC-NiAl seal ring samples.

The constituted phases of the samples were characterized employing X-ray diffraction (XRD-Philips X'pert-MPD) and microstructure was observed using by Scanning Electron Microscopy (SEM-XL30). Macro hardness and micro hardness of specimens measured by criterion RA and Vickers respectively.

For evaluated lubricity and wear behavior, wear test was conducted on an oscillating pin on disk tester for combustion synthesized TiC-NiAl and sintering SiC samples, in contrast to AISI 52100 steel pin according to AISI M. Gee 32 [7, 9, 10]. weight loss and friction coefficient of samples were measured under 20, 240, and 280 N loads in pin on disk wear test in 1000 m sliding distance with 0.07 m/s linear velocity. Furthermore weight losses of samples were measured in durability test in pump.

4. Results and discussion

Hardness and density samples are shown in table 1. Result of hardness and density almost were similar to result of other researches [1, 8]. Likewise, in figure 4 has been come friction coefficient of TiC-NiAl in 200 N loads, which has low friction coefficient similar to SiC in wear test. Table 2 shows the coefficient of friction of SiC and TiC-NiAl in various loads in wear test. Coefficient of friction of TiC-NiAl samples change in various loads and are low, especially in low loads similar to working condition that is suitable for use in pump as seal ring.

Figure 5, (a) shows the weight loss curve of both SiC and TiC-NiAl in 240 N loads during sliding distance (every 100 m) in (pin on disk) wear test. Also figure 5, (b) shows friction coefficient curve of samples in 200 N loads during sliding distance. Due to weight loss and friction coefficient in TiC-NiAl sample is low and almost similar to SiC seal ring during sliding distance in wear test, So TiC-NiAl was proper to evaluate in durability test in pump.

Figure 5. a. Weight loss, b. friction coefficient of both TiC-NiAl and SiC samples in wear test.

Table 3 shows the weight loss of samples in wear test via 240 N loads in 1000 m distance and durability test for 30 days continuous work in pump in aqueous conditions at 0.5 MPa pressure.

Seal ring samples	Weight loss after pin on disk test	weight loss after durability test in pump
SiC	1.7×10^{-3} gr	0.0855 gr
TiC-NiAl	2.1×10^{-3} gr	0.0896 gr

Table 3. Weight Loss in samples in wear test and testing for durability in pump.

The result shows that weight loss of TiC-NiAl is low in wear test and durability test in pump similar to SiC. Therefore TiC-NiAl is proper for use in a pump as mechanical seal ring.

5. Conclusions

Experimental results showed that combustion synthesized TiC-NiAl has friction coefficient and weight loss close to sintered SiC in wear test and durability test in pump. Also hardness result showed that TiC-NiAl has high hardness and low density like SiC for use in pump. Therefore primary evaluation showed that TiC-NiAl composite has acceptable primary condition for use in as mechanical seal rings in aqueous environment.

6. References

[1] L. Harmon (2002). Silicon carbide bushings help seal less pump prevent production losses, *Materials and Design*, **3**, 577-581.