# WEAR BEHAVIOUR OF COST EFFECTIVE SİALONS UNDER SAND BLAST TEST

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## 1 ABSTRACT

Although SiAlON ceramics are potential materials for wear applications due to good mechanical and chemical properties their use has been limited until now because of high powder and processing costs. In order to solve this problem low cost refractory grade β-Si3N4 powder was tested to produce SiAlON ceramics with sufficient hardness and fracture toughness to be used in wear applications. Sand blast wear tests were carried out on the developed SiAlONs to simulate wear caused by severe particle impacts. The effect of SiC-addition to the SiAlON compositions on the wear behaviour was investigated, as well. In addition the developed cost effective SiAlONs were compared with commercial ceramic materials which are commonly used in wear applications.

## 2 INTRODUCTION

Little work has been published in the literature on the erosive wear behaviour of SiAlON ceramics. Waga [1] and Lui and co-workers [2] showed that the erosion rate of the SiAlON ceramics decreases with increasing hardness and fracture toughness. Besides they reported erosive behavior are much more affected from fracture toughness than hardness. On the other hand, Cheng and co-workers [3] investigated how microstructural parameters (grain size, grain shape and intergranular phase chemistry) govern the erosive behavior. They were found that the dominant material removal mechanism for the fine equiaxed-grained SiAlON was grain dislodgment, while that for the elongate-grained material was transgranular fracture; optimum amount of grain boundary glass had a beneficial effect on erosion resistance; heat-treated samples exhibited a higher erosion rate than their as-sintered counterparts. In all the above available cited research papers, SiAlON monolithics were used to evaluate their erosive behaviour. Here, we report the erosive wear behaviour of SiAlON monolithic and SiAlON composite with SiC, under identical testing conditions to compare the relative wear properties. The wear mechanisms are investigated and qualitative information on the wear behaviour is provided.

## 3 EXPERIMENTAL PROCEDURES

Low cost refractory grade β-$Si_3N_4$ powder (0.8 μm average particle size) was attempted to be used to produce 30α:70β SiAlON composition. The addition of 18 wt% SiC was done in order to improve the hardness of SiAlON phase and the sample coded as B0.8+18SiC (*composite*). The

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sand blast wear tests have been performed at Röchling Leripa GmbH (Austria). The test conditions were given in Table 1.

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|---|---|
| Pressure | 6 bar |
| Particle composition | Alumina |
| Particle size of alumina | 0.5 – 1 mm |
| Alumina content | 2 kg |
| Sample dimensions | 24.5 mm ×7 mm |
| Test duration | 10 min. |
| Distance to nozzle | 10 mm |
| Impact angle | 50$^{o}$ |

*Table 1. Sand blast test conditions*

The erosion rates of the nozzles are defined as the nozzle mass loss divided by the nozzle density times the mass of the erodent abrasive particles. The fracture surfaces of the SiAlON samples were examined using scanning electron microscopy.

## 4 RESULTS AND DISCUSSIONS

It has been found that microstructural development is one important parameter for the wear resistance under the test conditions. The effect of SiC-addition to the SiAlON compositions on the wear behaviour was investigated, as well. The results showed that SiAlON-SiC composites exhibited lower wear rate than monolithic SiAlONs. In addition the developed cost effective SiAlONs were compared with commercial ceramic materials which are commonly used in wear applications. The sand blast test results showed that the novel developed SiAlON ceramics are much more durable than typical alumina ceramics used in tribological applications. Furthermore, these cost effective SiAlONs showed similar performance to silicon nitride ceramics although the former were prepared from cost effective heterogeneous powders, whereas the latter are made from high quality raw materials.

## 5 CONCLUSION

This study attributes to scientific understanding in respect of production of high performance SiAlON ceramics from low cost heterogeneous powders. It is expected that such cost effective SiAlONs could replace alumina ceramics in wear applications due to their superior properties.

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