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Technical Faculty in Bor and
Mining and Metallurgy Institute Bor

48th International October Conference on Mining and Metallurgy

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Nada Štrbac
Dragana Živković

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on Mining and Metallurgy

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CAVITATION DAMAGE OF MULLITE CERAMIC: IMPLEMENTATION OF IMAGE ANALYSIS

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Abstract

The paper presents the results of testing the mullite ceramics in terms of cavitation e samples were sintered at 1200°C. To determine the cavitation resistance the ultrasonic vi with stationary specimen was used. Mass loss and level of degradation of surface s monitored using the image analysis. Test results showed a high cavitation resistance of m and its possible application to various areas- metallurgy, mining, construction, chemical i it is expected the presence of cavitation erosion.

Keywords: *mullite ceramic, cavitation erosion, image analysis.*

1. INTRODUCTION

Mullite ceramics ($3Al_2O_3 \cdot 2SiO_2$) is stable at high temperatures, it has high properties, chemical resistance and resistance to thermal shock. Mullite thanks to density of 3.16 to 3.22 g/cm^3, hardness 7.5 by Mosh scale, relatively low coeffici expansion ($6 \cdot 10^{-6}$ °C^{-1}), the coefficient of thermal conductivity (1.3 W/m· resistance, is widely used in the industry to obtain different products of dense ceramics [1-3]. Advanced mullite ceramics is used for creating different filters for d and other parts. This is a porous mullite ceramics sintered at low temperatures (be bulk density below 60%. Filters based on porous mullite ceramics are characterized at high temperatures, excellent chemical inertness, a very good resistance to mecha even at porosities above 60 %. High performances of filters are achieved b conditions of formation of structures with a certain grain size, a particular pore size high fineness of surface texture. These performances contributes to improving of process, achieving a vacuum, more efficient catalytic properties of interacting wi Mullite is a key ingredient in many refractory and ceramics applications. As a mullite is used to obtain mullite refractory bricks, as one of the components porcelain masses, for special purposes. Mullite is a good lower cost alternati alumina. Typical applications include, but are not limited to, thermocouple applicati muffle tubes, kiln rollers, sight tubes, rods and kiln furniture [8-11].

2. EXPERIMENTAL

2.1 Materials

In this paper synthesized mullite is used from a mixture of alumina and quartz using 1% NaF. Synthesis of mullite was performed in a laboratory furnace with oxidation type Netzsch the sintering temperature with 1200 °C, 1h. For obtaining dense cerami and shape of mullite grains are very important. For this study mullite powder with rounded grains, with average grain size was used, 12,48 μm (100 % -12 x 10-6 m) and the shape factor 1.6. For characterization of the mullite samples, X-ray diffraction analysis was applied in the X-ray diffractometer PHILIPS, model PW-1710. The microstructure of the samples was characterized by scanning electron microscopy method (SEM) using a JOEL JSM-6390Lv microscope. Fig.1. shows XRD of the sintered mullite sample with dominant presence of mullite and α-corunde. Fig.2. shows SEM microphotograph of sintered mullite sample, at homogenous structure, high density and very little porosity (dark part of the surface).

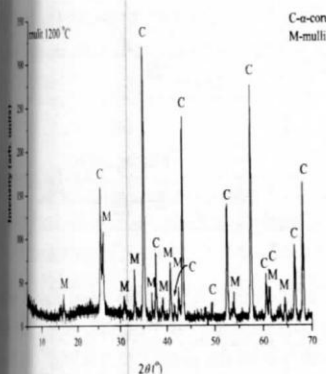


Figure 1 - XRD of mullite sample sintered at 1200°C.

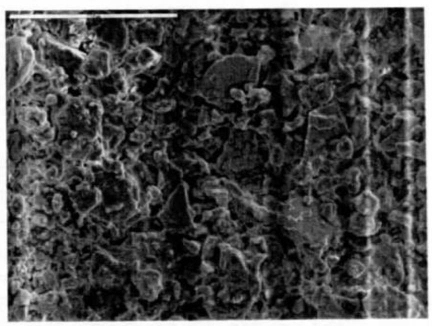


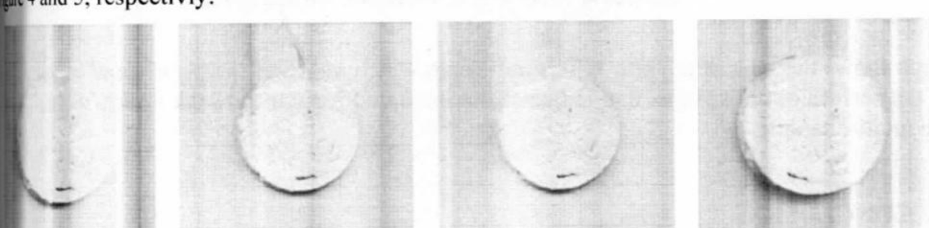
Figure 2 - SEM microphotograph of mullite samples sintered at 1200 °C

2.2 Methods

Cavitation erosion testing was performed using ultrasonic vibration method (with stationary specimen) according to standard ASTM G32 [8]. The usual characteristics for the frequency and peak-to-peak displacement amplitude of the horn were used, as well as characteristics of liquid [6,7]. During cavitation erosion test surfaces of samples were photographed with stereomicroscope. Macroscopic photos and footages were subjected to image analysis in order to determine the loss of mass destruction and monitoring of surface samples under the influence of cavitation erosion. For data processing and analysis a software program Image Pro Plus (IPP) was used [9].

3. RESULTS AND DISCUSSION

Sintered mullite samples were photographed before end during the cavitation erosion test, Fig.3. Mass loss and level of surface damage of mullite samples during the cavitation test are shown in Figure 4 and 5, respectivly.



20 min 40 min 60 min 80 min

Figure 3 - Photographs of sintered mullite samples before and during cavitation erosion testing

Fig.3. shows the appearance of small pits on the surface of the samples in the form of wal which, during the testing time increases slowly. This corresponds to the results of the gra loss of weight of the sample during the test, Fig. 4, and appears smaller incremental damage the surface of the sample, Fig. 5.

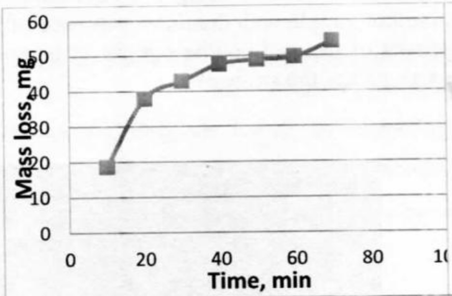


Figure 4 - Mass loss of the sample during testing

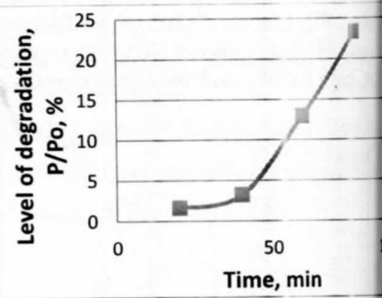


Figure 5 - Level of degradation of the sample during testing

Very good resistance of mullite samples on the cavitation effect can be interpreted based on structure of the sintered samples, Fig.2, and based on the properties of mullite, primarily hardness of the sample. This indicates that such a dense ceramic body may have a high resis to the effects of cavitation. This is confirmed by examining the microstructure of specime the end of cavitation test, Fig.6.

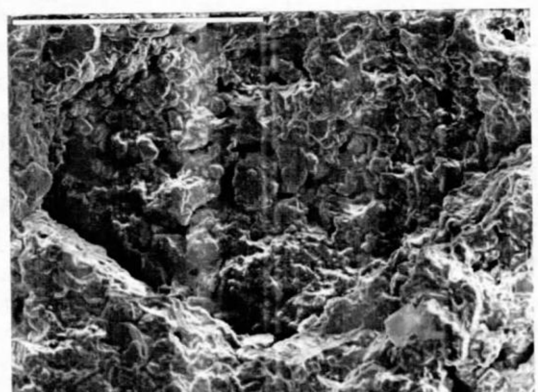


Figure 6 - SEM microphotographs of mullite samples sintered at 1200 °C after cavitation erosion testing

Fig.6 shows the look of the pits with small depth which indicates the presence of minor da to the surface of the sample, and indicates the increased resistance to the effects of cavita the mullite sample.

4. CONCLUSION

The test results showed high cavitation resistance of mullite ceramics. This can be interpre obtaining a fine, homogenous structure of the samples of sintered mullite high hardnes compactness. Mass loss, as well as level of degradation are increasing during testing, b

...of increasing is small. This points to the possibility of applying a dense mullite ceramics in ...ditions of cavitation. This is primarily related to the use in the chemical industry, metallurgy ...making foundry furnace parts, making protective coatings, for making shellfish when casting ...cial castings of high-temperature alloys. Menagement implementation methods of image ...lysis (IPP analysis) is fully contributed to the characterization of the sample mullite in terms ...cavitation erosion and can be used for fast and reliable choice of materials for use in these ...ditions.

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