INVESTIGATION ON SINTERING BEHAVIOUR OF WASTE ALUMINA ROLLER MATERIAL IN PRESENCE OF MgO AND ZrO_2

By

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I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any university and to the best of my knowledge and belief it does not contain any material previously published, written or orally communicated by another person except where due reference is made in the text.

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Abstract

In the present study the feasibility of utilization of high alumina roller waste from fast firing kiln was studied. These roller wastes, which contain important quantities of SiO_2 and Al_2O_3, can be used as cheaply available raw material in ceramic product.

The sinterability of alumina waste powder at 1400°C, 1500°C 1600°C and 1700°C was studied by density measurement, XRD analysis, microstructural analysis and determination of mechanical properties of those sintered samples. The study was further done by adding ZrO_2 to the waste in different wt% (2-8wt %) and modified with 10wt% alumina powder.

Temperature required for the sintering waste powder to get theoretical density above 95% decreased with the addition of MgO as sintering aid. It showed the addition of MgO in amount above 0.5% promoted densification at 1500°C. At 1600°C, the higher density (~95%) was achieved with addition of MgO in between 0.5% - 1.5%. At higher temperature at 1700°C densification can be achieved with the MgO addition <0.5%. Densification of modified waste with 10% Al_2O_3 was increased with addition of MgO at 1500°C. The maximum density with (99.9%) was obtained at 0.5% MgO.

The XRD patterns of the MgO added waste powder compacts sintered at temperatures up to 1700°C for 3h showed the presence of mullite and corundum as the major phases in all samples. But Mg-Al Spinel was formed when the samples sintered at 1400°C for 3h. Optical microstructure was porous for samples with excess MgO (>1%) sintered above 1600°C for 3h. The SEM observation of the microstructure showed the grain morphology as spherical at 1500°C for 3h, but with increase in sintering temperature to 1600°C for 3h it was observed as elongated rod like grains.

Addition of ZrO_2 acted as sintering aid and above 97% obtained in the sintering temperature range between 1500°C -1600°C. ZrO_2 addition significantly improved the fracture toughness of the waste powder compacts also.

Better mechanical properties such as hardness and strength were obtained for the densified compacts (above 95%). The maximum hardness was given as 5.35GPaq and

6.13GPa for the compositions 100% waste with 1wt% MgO (96.3%) and modified with 10% Al_2O_3 with 0.5% MgO (99.9%) respectively which were sintered at1500°C for 3h. Maximum MOR values for the above composition were 169.3MPa and 213.25MPa respectively.

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