EFFECT OF ORGANIC BINDERS (*corchorus olitorius* and *abelmoschus esculentus*) ON THE FRACTURE BEHAVIOUR OF KAOLIN REFRACTORIES

BY

NJOGU S. MURIUKI

RESEARCH PROJECT FOR PARTIAL FULFILMENT OF THE DEGREE OF MASTER OF SCIENCE IN THE DEPARTMENT OF PHYSICS, UNIVERSITY OF NAIROBI, KENYA.

SUPERVISORS:

DR. F. W. NYONGESA,

Prof B. O. ADUDA

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Abstract

Both the okra and "mrenda" binders were separately prepared from vegetables by boiling in water and sieving to get the filtrate. The chemical compositions of the binders were analyzed to determine both the organic and inorganic components. The test samples for the modulus of rupture measurement were prepared using varying volume concentrations of the okra binder from 0 (plain water) to 1.0 (undiluted binder). Notched samples for the fracture toughness tests were prepared using the optimum volume concentrations for plasticization for both the okra and "mrenda" binders, while the control samples were prepared using plain water. Cylindrical samples were prepared using the okra, "mrenda" and plain water for the fatigue analysis. The bulk density and apparent porosity of the samples were measured. The MOR for green and fired samples was measured using the three-point bending technique. The pre and post thermal shock elastic modulus of the samples was obtained using the ultrasonic non-destructive technique. The fracture toughness of the notched samples was measured using the three-point bend test. For fatigue analysis, samples plasticized with okra, "mrenda" and plain water were repeatedly thermal-shocked from a given temperature to room temperature until failure. The Weibull statistical approach was used to obtain the Weibull modulus and the slow crack growth parameter of the samples.

The density reached a maximum of 1.67 gcm^{-3} and the apparent porosity a minimum of0.248 at 0.3 volume concentration for plasticization of the okra binder The modulus of rupture for the green samples increased from 10.74 MPa (zero binder concentration) to a peak value of 16.2 MPa at a volume concentration for plasticization of 0.3, while that of the fired samples increased from 194 MPa for samples plasticized with plain water, to a peak of 348 MPa for samples plasticized with okra binder of 0.3 volume concentration for plasticization. This represented an increase in strength of 50.84% and 79.4% respectively. Beyond a binder concentration of 0.3 the MOR decreased with further increase in binder concentration. The samples suffer precipitous strength degradation when the quench temperature difference is between 280^{0}C and 380^{0}C. The increase in damage parameter indicates a decrease in residual strength after thermal shock due to

structural degradation sustained by the samples. The fracture toughness improved with the use of the organic binders. There was an improvement of 44.25% when samples are plasticized with okra and a 45.78% improvement with mrenda. From Table 1, it is observed that samples plasticised with the binders have higher values of the Weibull modulus *m* in comparison to those plasticised with plain water (no binder). A high Weibull modulus means that the spread is small while a low value is indicative of a high spread of strength. The slow crack growth propagation parameter *n* for samples plasticised with water is less than that of the samples plasticised with binders. The increase in *n* values signifies slow crack propagation velocities, which implies improved resistance to crack growth on addition of binder to the samples.

It is concluded that the use of organic binders enhances the reliability and service life of kaolin samples used in thermal fluctuating environments. The performance of the two binders in these environments does not exhibit a remarkable difference. This comparative performance means that either of the binders may be used depending on other factors like availability or cost in processing kaolin refractories that would have the high quality performance observed in this study.