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MICROSTRUCTURAL CHANGES INITIATED BY SINTERING OF REFRACTORY CONCRETE BASED ON RECYCLED BAUXITE AGGREGATE

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Concretes whose structure and final properties are shaped during thermal pre-treatment or during life-service at elevated temperatures can be applied as construction material for thermal insulation and/or refractory linings in high-temperature-operating plants. Refractory concretes designed with waste raw materials show satisfying performances in comparison with standard concretes. Sintering initiates microstructural changes within concrete. Concrete microstructure further develops with increasing temperature. Change progression can be monitored by means of destructive and non-destructive tests: either by investigating change of compressive strength or apparent porosity of concrete samples. Destructive tests, in this study, were applied in compressive strength investigation, while non-destructive tests were performed for results comparison. Experiment has been conducted on corundum (standard) concrete and recycled bauxite (experimental) concrete. Samples underwent thermal treatment from 110 to 1500 °C. Macro-performance of the final refractory concrete was correlated to the microstructural change detected by means of XRD and SEM analysis. Creep testing was conducted to prove sintering process. Results showed that recycled concrete has equal if not better properties in comparison with standard refractory concrete and can be used as thermo-insulation or refractory material.

The results presented in this paper contribute to the idea of including other testing methods (i.e. nondestructive methods) in investigation of microstructural changes and sintering process of refractory concrete. At the same time results of this investigation highlight advantages of application of secondary raw materials in design of refractory materials.

Although recycled aggregate concrete showed lower compressive strength and higher porosity than commercial concrete it should be noted that both porosity and compressive strength are within satisfying value range for high-temperature application, i.e. these concretes will not be used as structural materials but as thermal insulation linings. In such application refractoriness is the property which is more important than strength. Considering the fact that compressive strength is above 50 MPa (and above 20 MPa at 1500 °C) these concretes should be able to withstand load induced by other constructive parts of furnace and slag.

Refractoriness test showed that bauxite-based recycled concrete is highly resistible on increasing temperatures and creep test showed initiation of sintering process. Corundum concrete can be used for temperature above 1500 °C.

Due to the satisfying performances it is concluded that recycled concrete can be equally used as standard concrete. Even though it has slightly lower properties, accent should be on the financial and ecological benefit found in using of recycled material and savings of energy and natural resources.