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Comparison of glass fabricated at low temperature with rice husk ashes and commercial sand

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In the last decade, the agro-industrial residue rice husk (RH) has been intensively evaluated to expand its application and marked space, to complete the rice production cycle, and mainly, to be used as an alternative sustainable raw material in the industry. Considering that the ash from the rice husk (RHA) presents a very rich concentration of sílica, RHA recently became a possible substitute for mineral sand in the manufacture of glasses. Therefore, the present study aimed to analyze and to compare glasses made from industrially burned rice husk ash (I-RHA) with the rice husk ash burned in a controlled environment in the lab (C-RHA), in relation to the glass made from mineral sand (MS). All the glasses in this work were produced at low temperatures, precisely at 1200°C. In order to do so, the classical borosilicate glasses recipe was modified, adding a larger amount of boron oxide to lower the melting temperature of the glass matrix. The composition of all glasses was the same: 40% silica (either from I-RHA, C-RHA or MS), 22% sodium oxide (Na2O), calcium oxide (CaO) and 35% boron oxide (B2O3). Na2O, CaO and B2O3 were added to the melt as sodium carbonate, calcium carbonate and borax, taking into account the corresponding stoichiometry of the decomposition reaction. The I-RHA was used as obtained from the rice industry (fluctuating combustion time and temperature), while the C-RHA was burned in a muffle furnace for five hours at a temperature of 800°C. The mixtures were heated, with a heating rate of 10°C/min, for one hour at 1000°C and kept two hours at 1200°C. The melted mixture was poured into a preheated circular mold, and conditioned at 400°C for 1 hour, to reduce possible thermal shocks causing tension and cracks; afterwards, the samples were cooled down to room temperature gradually. The glasses produced from rice husk ash were analyzed and compared by density, X-ray diffraction, X-ray fluorescence, resistance to acid attack, amount of microbubbles, resistance to water absorption, and resistance to thermal shock. The tests performed were obtained from the Brazilian Standards Normative (NBR´s), from the Brazilian Association of Technical Standards (ABNT): NBR 16184 - Horizontal roadmarking - Glass spheres and glass microspheres, NBR 14910 - Glass packages for food products, NBR 11819 - Glass flasks for pharmaceutical products. The glasses produced with I-RHA and C-HA showed conformational characteristics identical to the MS glasses (XRD, microbubbles), but they also showed a better efficiency in the chemical and mechanical resistance tests, as well as they showed higher density overall. This might be due to the presence of a small concentration of alumina oxide in the RHA, which can mechanically strengthen the glass. From the results obtained, we can conclude that rice husk ash, either industrially or lab calcinated, presents itself as a promising, economical and, mainly, sustainable alternative to mineral sand in the production of glass