Influence of waste addition on the porosity of clay-based ceramic membranes

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ABSTRACT

Incorporation of waste into ceramics can be an eco-friendly alternative for modification of their microstructure and related properties such as porosity, pore size and, therefore, permeability and mechanical properties. In this work, two wastes are added to a common clay mixture traditionally used for porous ceramics manufacturing: Screen Glass, G, from monitors and TV panels, and Diatomaceous Earth, D, from oil-filtering processes. Processing of the reference clay-based material (R) and two waste-containing formulations (10 wt.% of Screen Glass, R10G, and 10 wt.% of Diatomaceous Earth, R10D) was carried out through vacuum extrusion shaping and firing of test specimens at three maximum temperatures: 850, 950, and 1,050°C. Final sintered specimens were characterized to determine density, bending strength, and water absorption. Microstructure was observed by SEM while pore size distribution was determined by mercury intrusion porosimetry. Permeability coefficient was calculated from these experimental parameters. Materials containing Glass waste have lower porosity and larger pore size due to partial melting of glass. As a consequence, mechanical strength of R10G increases around 10% due to the lower porosity while, contrary to expectations, permeability also increases due to the larger pore size. In the case of R10D materials, extra porosity created by oil combustion during sintering also leads to larger permeability values although a significant decrease of mechanical strength and reliability is observed.

Keywords: Ceramics; Waste valorization; Porosity; Mechanical properties; Permeability