Effect of sodium phosphate addition on mechanical properties of porous Sigue quartz sand

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ABSTRACT

Porous ceramic separation membranes exhibit many excellent properties, such as a high structural durability, a good thermal stability, a long operational life, and an especially high chemical stability in the corrosive media. In order to prepare low-cost membranes, many researchers have used low-cost starting materials such as clay, dolomite, and kaolin. This work addresses the development of low-cost ceramic microfiltration membrane supports from inexpensive raw materials, such Sigue quartz sand (SQS) and sodium phosphate (SP), using a uniaxially dry compaction method. The prepared samples were sintered at different temperatures ranging between 900 and 1,400°C. The raw materials and the prepared samples were characterized using X-ray diffraction (XRD), optical microscopy, Hg-porosimetry, and tensile strength using a diametral compression test. Subsequently, the effect of sintering temperature and SP amounts on support proprieties, such as the shrinkage, the phase transformation, the porosity, and tensile strength, were also investigated. It was observed that with increasing sintering temperature, dimensions of sintered samples increased; this was due to the phase transformation. XRD confirmed that SQS was transformed into cristobalite phase when both the sintering temperature and the holding time were increased. The porosity and average pore size (APS) increased in all cases (2 and 3 wt% SP) in the range of temperatures between 1,100 and 1,400°C. For example, the porosity increased from 25.4 to 32.9%, and APS increases from 11 to 27 μm in the case of 3 wt% SP. The flexural strength was found to be acceptable. The value varied from 16 to 20 MPa, which corresponds well with the relatively high porosity and APS.

Keywords: Sodium phosphate; Quartz sand; Mechanical properties; Sintering; Porous ceramics

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