ON THE EFFECT OF FOAMING AGENTS ON THE POROUS STRUCTURE AND ZEOLITE CONTENT OF CERAMIC FOAMS PRODUCED BY GEOPOLYMER GEL CONVERSION

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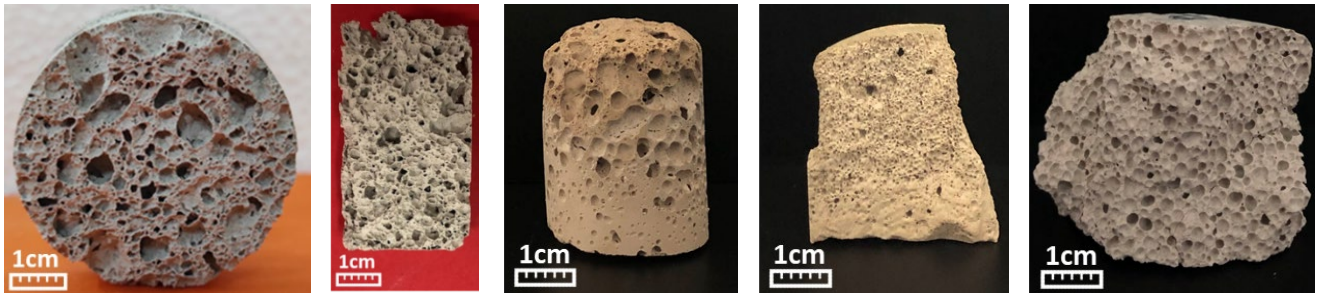
Alkali-activated materials are being widely investigated because of the possibility to be easily produced at low curing temperatures (even using waste as raw materials), and to be efficiently employed for several applications. Among the different classes of such materials, porous geopolymers have been proposed as thermal and acoustic insulators, fire resistant materials, adsorbents, pH regulators, catalysts or supports for catalysts. Recently, a self-supporting zeolitic foam was synthesized by a geopolymer gel conversion process, starting from metakaolin, silicon powder and sodium hydroxide under mild operating conditions (40°C) [1]. Such foam showed the presence of two distinct zeolites (Na-A [LTA] and Na-X [FAU]), and exhibited a multi-modal porous structure, including microporosity (characteristic of zeolites), mesoporosity (typical of the geopolymer matrix), and macroporosity (resulting from the chemical foaming process). This approach can in principle allow to manufacture porous monoliths tuned in terms of zeolite nature and content and pore structure and distribution. The presence of the geopolymer backbone supports and shape the zeolite crystals, widening its technological application field.

In this paper, the effects in terms of crystalline phases and porosity of different foaming agents and stabilizers were investigated (Figure 1). Silicon powder and/or hydrogen peroxide were used as foaming agents, and a vegetal surfactant was optionally used as foam stabilizer. All samples showed a high porous character (total porosity = 70÷75%). Foam stabilizer promoted the formation of smaller macropores (Figure 1b). The presence of zeolites nucleated on the porosity of the geopolymeric framework occurred regardless of the foaming agent nature.



(a) (b) (c) (d) (e)

Figure 1 – Porous geopolymer monoliths with different foaming agents: (a) Silicon powder, (b) Silicon powder with foaming stabilizer, (c) H_2O_2, (d) H_2O_2 with foaming stabilizer, and (e) H_2O_2 and Silicon powder.

[1] B. Liguori, P. Aprea, G. Roviello, C. Ferone, Self-supporting zeolites by Geopolymer Gel Conversion (GGC), Microporous and Mesoporous Materials 2019, Volume 286,https://doi.org/10.1016/j.micromeso.2019.05.045.