Vitrification of chromium containing tannery ash

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Vitrification was applied to stabilize Cr-rich ash which was the residue of the incineration of tannery sludge. The aim of the work was to stabilize chromium in silicate based vitreous matrices and their transformation into glass-ceramic added-value products. The initial rich in Cr tannery sludge was retrieved from the industrial area of Thessaloniki in dry form with high organic content. Thermal processing was applied in order to remove as much organic content as possible while trying to retain Cr in the trivalent form. The optimum treatment was incineration for 1,5h at 500°C under anoxic conditions. The resulting ash was rich in trivalent Cr and Ca.

Stabilization of the Cr-ash was achieved through vitrification following two different batch series. In the first series Cr-ash was mixed with reagent grade glass-forming oxides where SiO_2 was used as the main glass-former while Na_2O and $CaCO_3$ where used as modifying agents. Six different batch compositions were prepared in which Cr-ash varied from 10-20 wt% and the variation of the glass forming oxides was so as to achieve a homogenous glass. In the second series Cr-ash was combined with Red Mud and Fly ash, exploiting that they contain high quantities of glass forming and network modifying species, avoiding utilization of raw materials. Three different batch compositions were prepared were 20%wt Cr-ash was mixed with Red Mud, Fly-Ash and in combination with both wastes while low quantities of glass-forming oxides (SiO_2, Na_2O and $CaCO_3$) had been also added. All batch compositions were melt at 1400°C and/or 1500°C depending on the initial composition and then casted rapidly on a refractory steel plate.

Differential Thermal Analysis (DTA) was employed to identify the thermal treatment temperatures where the initial as-vitrified products could be transformed into stabilized glass-ceramic with potential added value. Structural characterization of all series product was conducted using X-Ray Diffraction (XRD) while morphology and composition of the products were studied using Scanning Electron Microscopy (SEM) and Energy Dispersive Spectroscopy (EDS) respectively.

Thermal treatment resulted to the separation of different crystalline phases depending on the treatment temperature and the initial batch composition. The as-vitrified products were either totally amorphous (GL3) or amorphous with dispersed Cr-containing crystalline phases as it is depicted in the X-ray diffractogram of the as-vitrified products of the first batch series. Devitrification of the as-casted products resulted to various crystalline phases dispersed within the vitreous matrix, depending on the initial batch composition as it is revealed from the X-ray diffractogram of the devitrified products. Leaching tests revealed that most of the products were chemically inert [Kavouras *et al*, (2015), Varitis *et al*., (2017)].

Reference

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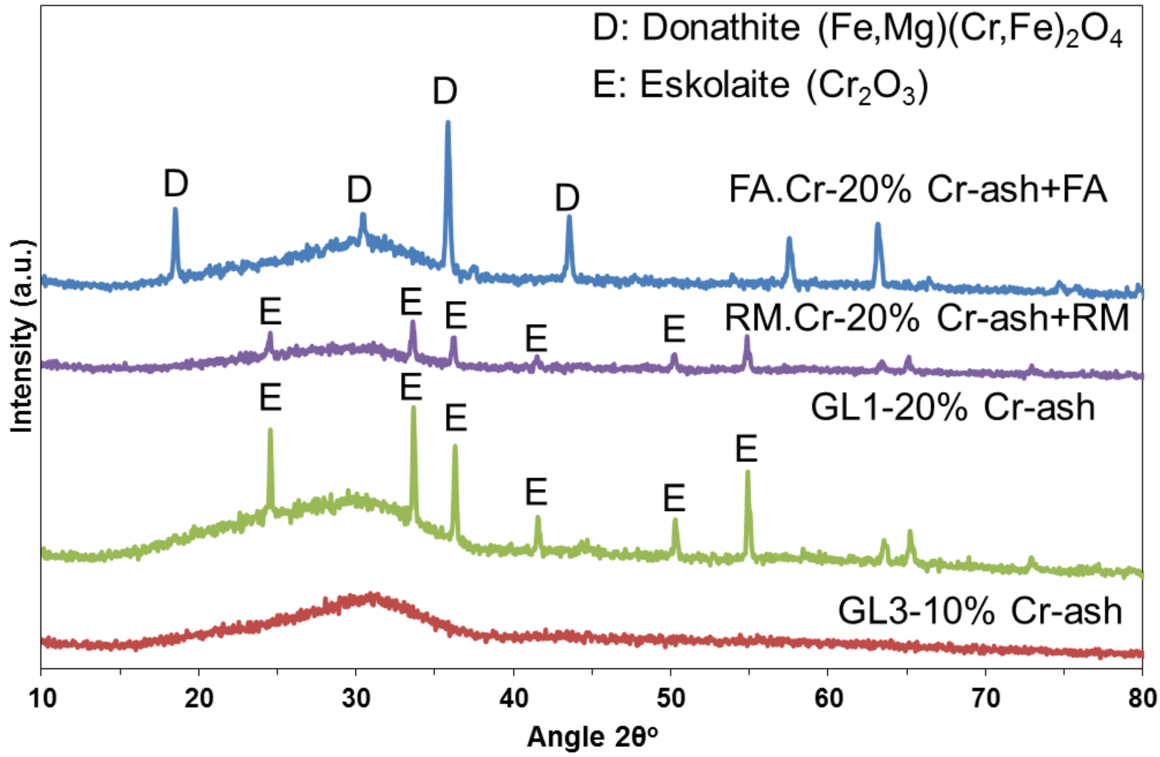

Fig. 1. X-ray diffractogram of the vitrified products

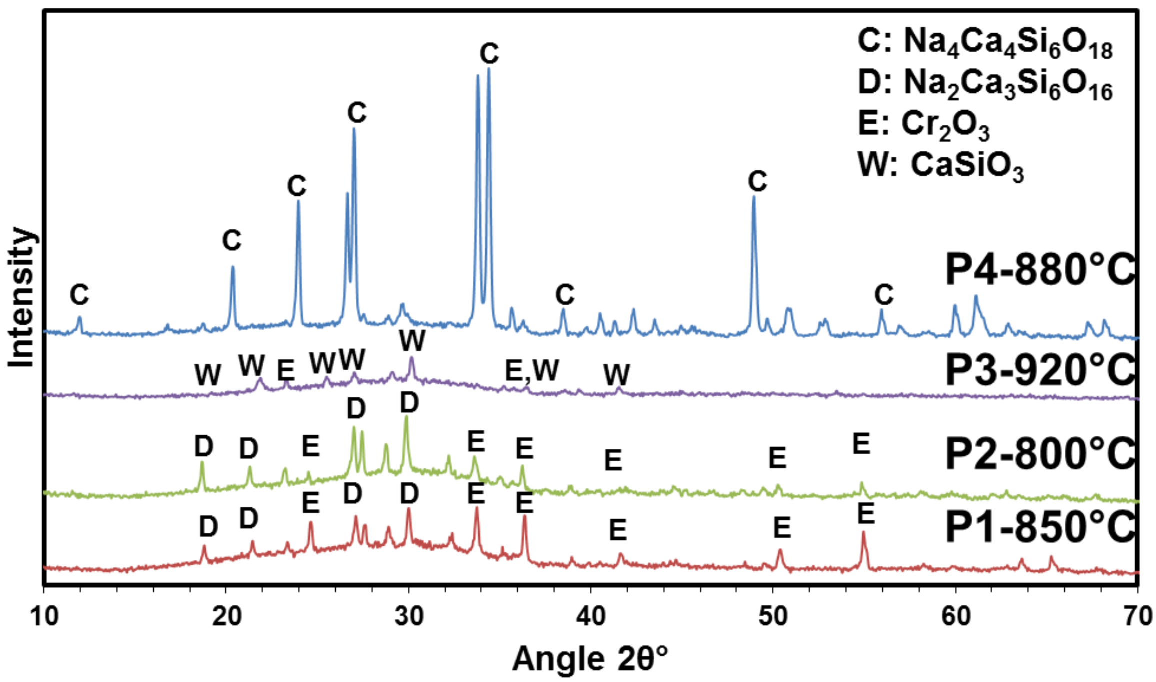

Fig. 2. X-ray diffractogram of the devitrified products