Vitrification of incinerated tannery sludge

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Stabilization of tannery waste is of great importance due to its high organic and chromium content. This issue can be dealt with by applying vitrification, which is a promising method for the fabrication of glass and glass ceramic products with potential use for structural and decorative applications.

The chromium containing tannery sludge was first incinerated for 1.5 h at 500°C in anoxic conditions and the resulting ash was vitrified using SiO_2, CaO and Na_2O powders in various relative proportions. This work aimed to the synthesis of (a) vitrified products using the chromium containing ash and (b) glass ceramics products for various applications.

Three different batch compositions were examined containing from 10wt% to 20wt% chromium containing ash and the vitrifying agents mentioned above. All batch mixtures were heated at 1400°C for 2h in order to achieve a homogeneous melt and subsequently rapidly cooled down. The resulting vitrified products were studied by X-Ray Diffraction (XRD), Differential Thermal Analysis (DTA), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and microindentation.

Thermal treatment of the vitrified products was conducted for 30 min for each sample, with temperature decided from the DTA results. Devitrification occurred by surface crystallization of Devitrite ($Na_2Ca_3Si_6O_{16}$) or by surface and bulk crystallization of Combeite ($Na_4Ca_4Si_6O_{18}$) (Figure 1b). Crystallization mechanisms in the case of Combeite depended on the thermal treatment temperature.

Microindentation was conducted in order to study microhardness and crack propagation in vitrified and glass ceramic products, as a function of batch composition and microstructure. Microhardness was increased after crystallization, while crack propagation depended on the morphology of the separated crystallites.

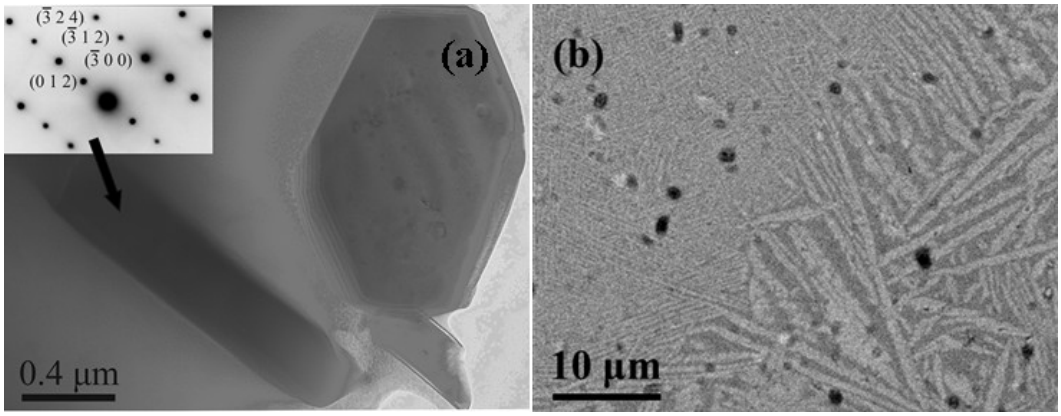

Figure 1: (a) TEM image obtained from GL1-850 devitrified product. A Cr_2O_3 crystal is denoted by the arrow and the corresponding diffraction pattern along [06-3] zone axis. (b) SEM micrograph from GL3-880°C glass ceramic product.

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