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Glass ceramic obtained by tailings and tin mine waste reprocessing from Llallagua, Bolivia

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In Bolivia Sn mining activity produces large tailings of SiO_2-rich residues. These tailings contain potentially toxic elements that can be removed into the surface water and produce a high environmental pollution. This study determines the thermal behaviour and the viability of the manufacture of glass-ceramics from glass. The glass has been obtained from raw materials representative of the Sn mining activities from Llallagua (Bolivia). Temperatures of maximum nucleation rate (Tn) and crystallization (Tcr) were calculated from the differential thermal analyses. The final mineral phases were determined by X-ray diffraction and textures were observed by scanning electron microscopy.

Crystalline phases are nefeline occurring with wollastonite or plagioclase. Tn for nepheline is between 680 ºC and 700 ºC, for wollastonite, 730 ºC and for plagioclase, 740 ºC. Tcr for nefeline is between 837 and 965 ºC; for wollastonite, 807 ºC and for plagioclase, 977 ºC.

In order to establish the mechanical characteristics and efficiency of the vitrification process in the fixation of potentially toxic elements the resistance to leaching and micro-hardness were determined. The obtained contents of the elements leached from the glass ceramic are well below the limits established by the European legislation. So, these analyses confirm that potentially toxic elements remain fixed in the structure of mineral phases formed in the glass-ceramic process. Regarding the values of micro-hardness results show that they are above those of a commercial glass.

The manufacture of glass-ceramics from mining waste reduces the volume of tailings produced for the mining industry and, in turn enhances the waste, transforming it into a product with industrial application.

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