

Role of Potassium in Degradation of Nineteenth Century Glass Flutes

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This work endeavours to bring to light the remarkable story behind Claude Laurent's "*flûte en cristal*" of the early 19th century, as well as to understand current condition issues that plague many of these valuable musical instruments. The investigation was spawned in 2014 by the curator's concern over the condition of the glass flutes, some of which appeared to have become "foggy". Elemental analysis by XRF of 27 Laurent flutes of various worldwide collections has revealed that most of the flutes examined are not leaded glass, as is commonly assumed, but an unstable type of potash glass. Micro-sampling of two damaged joints from different flutes afforded the opportunity for in-depth analyses and fabrication of glasses replicating the composition of these two potash-glass flutes. The two glasses contain 16.5 and 20.5 wt% K₂O, 78 and 74 wt% SiO₂ respectively, and 3.5 wt% CaO. Low levels of Na₂O, Al₂O₃, Cl, P₂O₅, and SO₃, with only trace amounts of Li₂O, B₂O₃, and a few transition metals, are also present.

Five glasses fabricated with K₂O contents varying from 16.5 to 20.5 wt%, as well as one glass replicating a 30% leaded glass flute, have been subjected to various alteration tests: (1) 90°C and 90% RH in an environmental chamber; and (2) vapour hydration testing at 200 °C and 50% RH, for 1, 2, 3, 5, 7 or 9 days. The resulting test matrix shows the formation of hydration layers on the model glasses similar to the observed hydration layer in cross-section on an actual flute after ~200 years, although generally much greater in depth.