Conversion of waste feed into glass – cold cap formation

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Abstract

The cost and schedule of nuclear waste treatment and immobilization is greatly dependent upon the rate of glass production during vitrification. To address this issue, we have developed in recent years a 1D mathematical model of the cold cap, which solves the heat and mass transfer and estimates the rate of melting. However, the one-dimensionality of the model ignores the complex geometry of the cold cap with a central slurry pool from which the slurry periodically overflows to form other boiling pools across the cold cap surface. Thus, this contribution focuses on the understanding of water evaporation on the cold cap top and the interaction of the overflowing slurry with the dry cold cap crust. To simulate the conditions in the cold cap, fast-dried slurry solids were prepared by rapidly evaporating water from feed slurry poured onto a 300∘C surface. After water evaporated from the sample, a fresh slurry with 5 wt.% 3Na2WO4 . 9WO3 (tracer) was poured onto the dry sample. During the whole experiment, an array of thermocouples recorded the temperatures at various depths in the sample and the water content in the slurry was measured. After the experiment, an X-Ray mCT and XRF were used to investigate the degree of mixing between the incoming slurry and the original sample. We will discuss the implications of the results for the cold cap formation in the melter and for the development of the cold cap mathematical model.

Keywords: Waste vitrification, batch melting, cold cap, rheology

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