The work is part of a two-part project funded by the DOE Office of Environmental Management's Hanford Field Office in partnership with glass scientist Albert Kruger. Results from the first part, "Glass design using machine learning property models with prediction uncertainties: Nuclear waste glass formulation," focused on the development of the glass formulation models and was published in the May 2024 edition of the *Journal of Non-Crystalline Solids*.

The second part, "Low activity waste glass optimization with property models from machine learning, part 2: Experimental validation and active learning," published in the April 15 edition of the *Journal of Non-Crystalline Solids*, provides experimental validation of ML-based glass property models developed during the project's first phase.

According to the authors, "The updated models and formulations showed increased waste loading while reducing the failure rate, demonstrating improved predictive accuracy, reduced uncertainties, and the effectiveness of active learning in guiding high-dimensional, nonlinear LAW glass design."

The practical benefits of the models, the authors wrote, include "higher waste loading, shorter mission duration, and lower operational risk."

Kruger told *Nuclear News*, "This effort will allow meaningful economies to expanding the validated glass formulation domain. When the WTP mission kicked off, the contractor adopted an active design to generate line rules to meet the minimum contractual targets for waste loading. That concept was inconsistent with the operational mission but was adequate for starting the plant.

"With the variability of wastes to be treated and lack of maturity for detailed chemical analyses of the inventory, it was evident that a better and more robust process control model would be beneficial. That epiphany opened the door for developing glass formulation activities that accounted for the development of forward process control—understanding the contribution to critical properties from each of the constituents of the waste and the dry materials used for making good glass within the design constraints of the facilities being built.

"The current success in the application of AI should allow for the further expansion of flexibility to address the waste variability, while supplanting the older method of formulating a sufficient quantity of glasses, melting, and testing to add the data to our knowledge base."

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