Technology Needs for WTP Simulants

U.S. DEPARTMENT OF ENERGY

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A subsidiary of URS Corporation

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Process Technology - Plant Operations Div
Waste Treatment Plant Project

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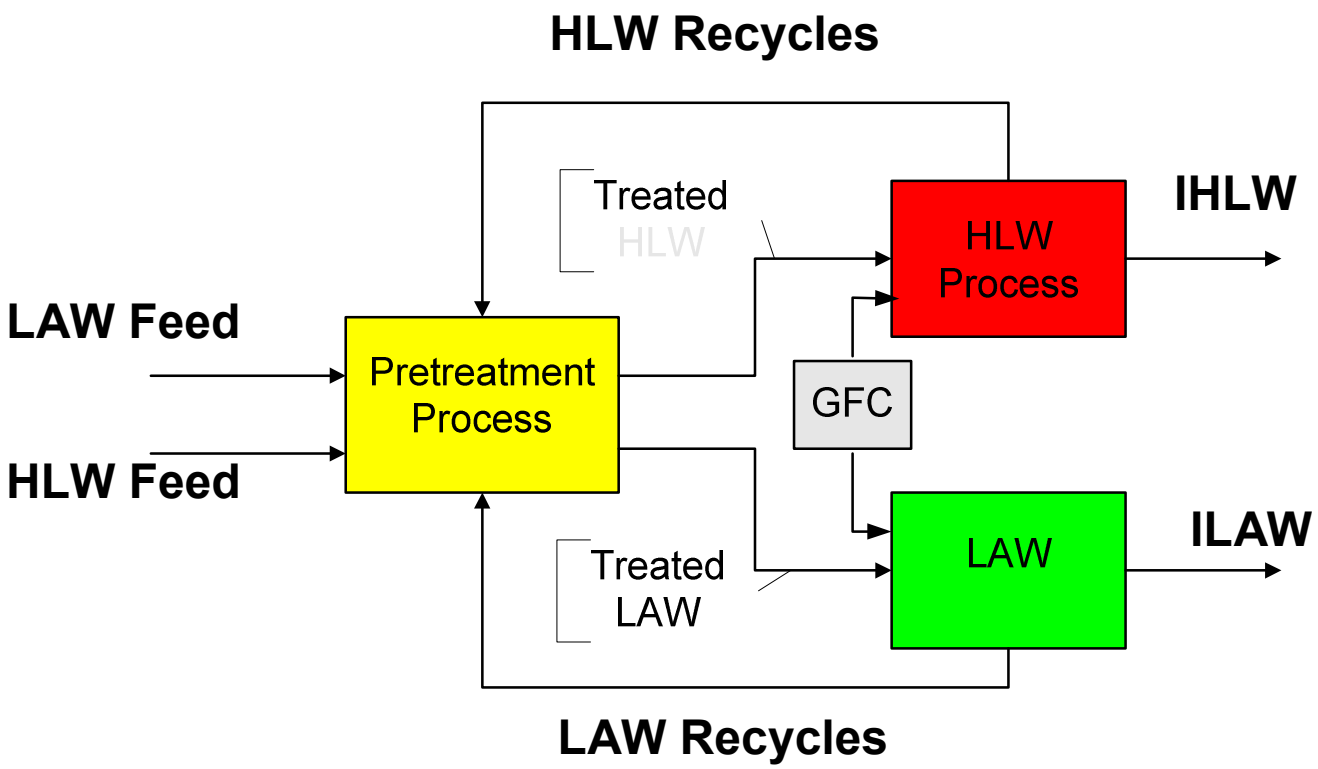
Agenda

- Major simulant requirements of WTP Project and the associated challenges

Simplified Process Flowsheet



Simulant Needs

- Commissioning Simulants
  - As received and pretreated LAW supernatants
  - As received HLW sludge
  - Pretreated HLW sludge
  - Vitrification recycle streams
  - Chromium simulant for oxidative leaching

- Large Scale PJM Mixing Test Simulants
  - Newtonian – complex, precipitated hydroxide simulant
  - Non-Newtonian: Low rheology (6Pa/6cP) leached and washed sludge
  - Non-Newtonian: High rheology (30Pa/30cP) leached and washed sludge

Commissioning Simulant Requirements

Section C, Standard 5 (b):

- Shall demonstrate the normal flow of WTP feed material, individual facility production capability, and the ability to predict product quality and produce acceptable ILAW and IHLW products.

- Support cold commissioning performance testing. The waste feed simulant(s) shall be mutually agreed to by both DOE and the Contractor to represent typical feeds to the WTP. This simulant may be comprised of a baseline composition that with spiking will demonstrate water washing, caustic, and oxidative leaching to solubilize Al and Cr.

Commissioning Simulant Requirements

Section C, Standard 5 (b) contd:

- Pretreatment Facility simulant properties for demonstrating capacity shall:
  - Support caustic and oxidative leaching
  - Be based on average chemical composition, solids loading, operating conditions, and leaching performance based on the design basis G2 Model WTP Contract Run
  - Have average physical properties including particle size, particle density and rheological properties
  - Contain the major chemical constituents required to cost-effectively demonstrate treatment
  - Support LAW and HLW Vitrification facility melter operations.

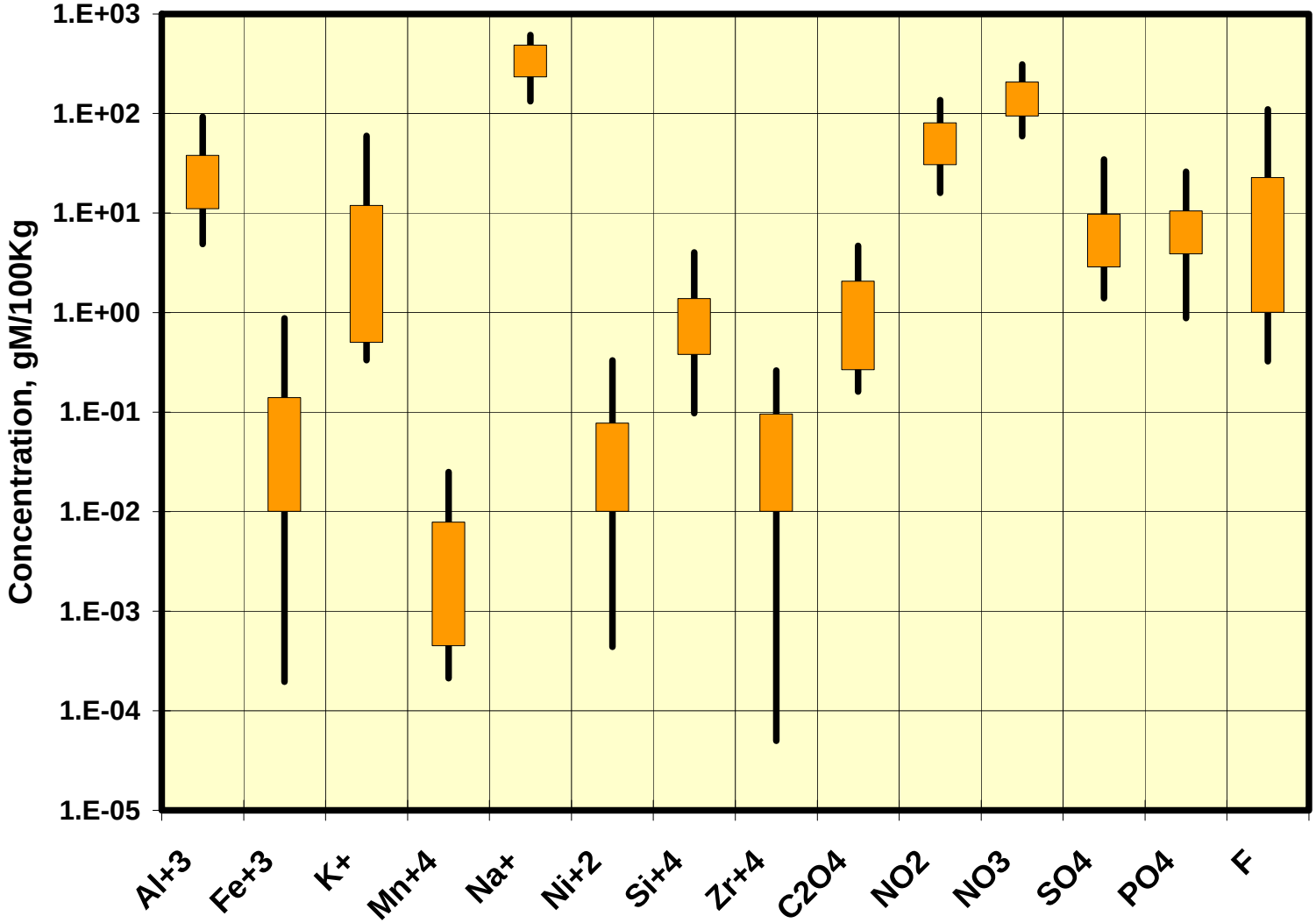
Simulant Development Experience

- Several waste tank specific sludge simulants
- AY-102/C-106 precipitated sludge simulant with AP-101 supernatant simulant for the Semi-Integrated Pilot Plant
- Simulant which chemically bounded ≥ 80% of the Hanford waste feed chemistry. Developed for leaching and filtration process demonstration in the Pretreatment Engineering Platform (PEP).
- Pretreated LAW and HLW simulants for mixing and sampler demonstration for waste form qualification tests.

Simulant Development Challenges

- Definition of average waste properties
- Very large simulant quantities
- Keeping simulant RCRA characteristically hazardous only, except as needed (Cr leaching and environmental controls testing)
- Delivering targeted rheology

Feed Supernatant Concentration Variations



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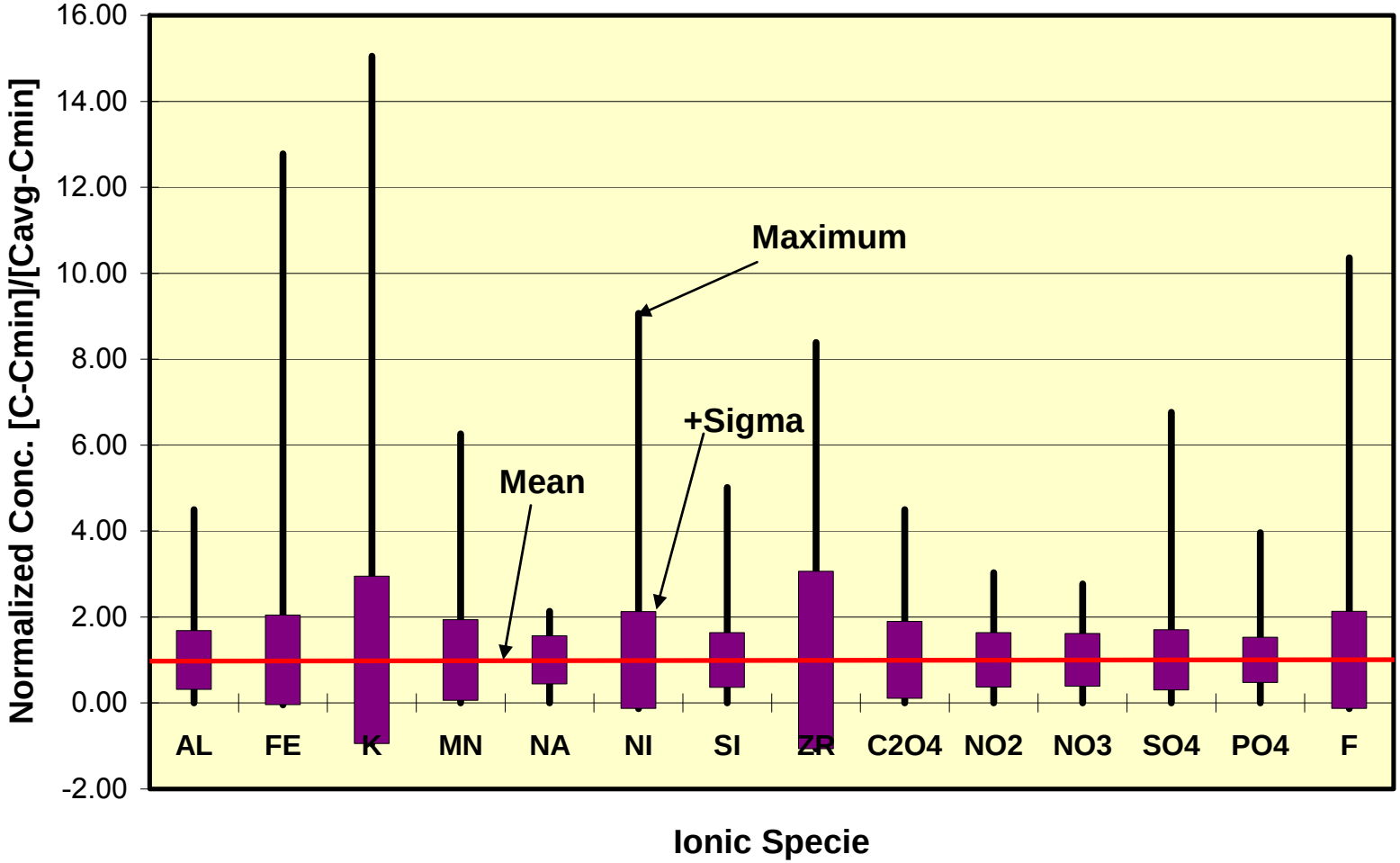
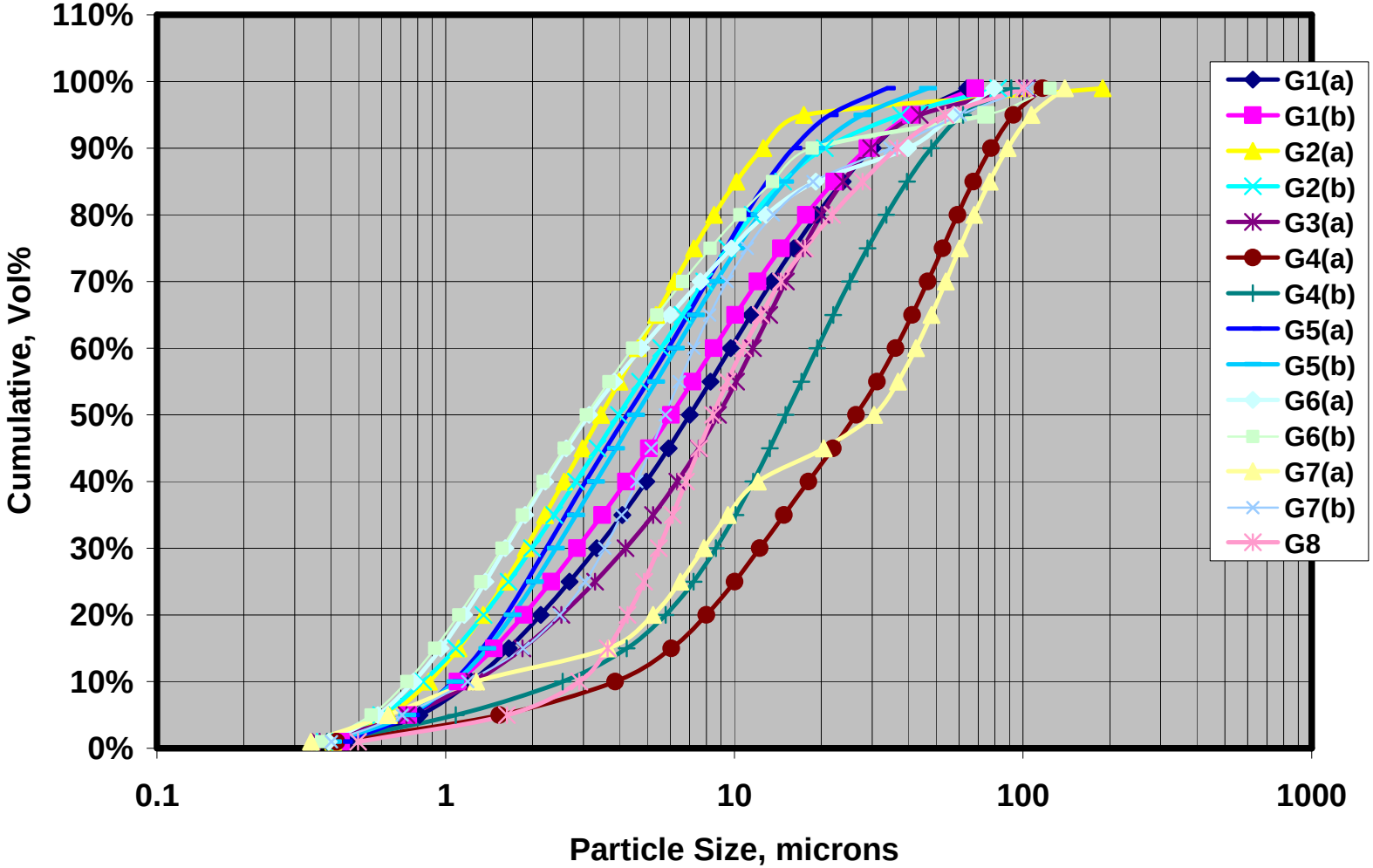


Actual Waste Particle Size Distributions

Unsonicated & 4000 RPM Pump Speed



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- **Effect of acicular particles**

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- **Control of rheology (yield stress and consistency)**

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- Control of rheology (yield stress and consistency)
- **Simulation of actual waste aging**

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- **Scaling up to manufacturing batch size**

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- **Rheology modifiers consistent with PTF & HLW processes**

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- Rheology modifiers consistent with PTF & HLW processes
- **Transport, transfer and storage**

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Q&A