DWPF/WTP Melter Design and Influence of Glass Formulation

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Explain the primary technical differences between the DWPF melter design and the two WTP melter designs
• **Similarities**
  - Monofrax K-3 glass contact refractory
  - Joule heated melt pool, 1150 °C
  - Inconel 690 electrodes
  - Water cooled shell
  - Bubbler driven glass stirring
  - Slurry Feed
  - Similar Borosilicate Glass

• **Differences**
  - Size
  - Shape
  - Design philosophy
  - Plenum heat
  - Glass pouring method
  - Draining method
  - Electrode layout
  - Bubbler gas
  - Offgas treatment system
  - Glass former introduction
  - Canister
DWPF and WTP Melters

• **Size:** melt surface area
  - DWPF: 2.6 m²
  - HLW: 3.75 m²
  - LAW: 10 m²

• **Shape**
  - DWPF: cylindrical heavy wall vessel, complex wedge/curved refractory shapes
  - WTP HLW & LAW: rectangular structure, simple refractory shapes

• **Design philosophy**
  - DWPF: Refractories in compression, locked within water cooled rigid outer vessel. Incorporates compressible materials to accommodate refractory thermal expansion.
  - WTP HLW & LAW: Similar to commercial glass furnace design approach. External cooling panels and adjustable jack screws to retain refractories. “Gas Barrier” shell for offgas control. Incorporate castable backup refractory layers
• **Plenum Heat**
  – DWPF: Lid resistance heaters used during normal operation.
  – HLW & LAW: Lid resistance heaters used for start-up only.

• **Glass Pouring Method**
  – DWPF: Continuous overflow pouring. Pouring initiated and terminated via pressure differential control between melter plenum and canister.
  – WTP HLW & LAW: Batch pouring. Air-lift pumping action within riser channel then gravity flow through pouring trough.

• **Glass draining method**
  – DWPF: Bottom drain valve. Draining initiated via heating of drain valve assembly and raising drain probe into melter.
  – WTP HLW & LAW: Air-lift pumping action via normal path followed by use of evacuated canister.
DWPF and WTP Melters

- **Electrode Layout**
  - DWPF: Two pairs of opposed plate electrodes (upper & lower)
  - WTP HLW: Three electrodes
  - WTP LAW: Six electrodes, Three opposed pairs

- **Bubbler Gas**
  - DWPF: Argon
  - WTP HLW & LAW: Air

- **Offgas Treatment System**
  - DWPF: Redundant systems. Film cooler, quencher, steam atomized scrubber, condenser, mist eliminator, heater, HEPA, exhauster
  - WTP HLW & LAW: Film cooler, submerged bed scrubber, wet electrostatic precipitator, mist eliminator, heater, HEPA, caustic scrubber, thermal catalytic oxidizer. Three LAW melters share common system.
• **Glass Former Introduction**
  - DWPF: Glass frit (powder)
  - WTP HLW & LAW: Glass forming chemicals

• **Canister**
  - DWPF: 2’ diameter, 10’ tall
  - WTP HLW: 2’ diameter, 15’ tall
  - WTP LAW: 4’ diameter, 7’ tall
How have developments and changes in the DWPF glass formulation influenced the design of the WTP melters?
DWPF Glass Formulation Influence?

- DWPF Glass formulation changes have not directly influenced WTP glass melter design
- DWPF glass formulation is governed by DWPF defined performance and processing constraints
  - Durability, Viscosity, Resistivity, Liquidus, Waste loading
  - Constraints defined based on repository requirements, melter design, operational risk, safety basis
  - Proposed glass formulations must meet all constraints
- WTP melters have a similar set of constraints that govern glass formulation