Experimental and Numerical Development of GEN3 Durability Life Models (08370)

Material degradation at high temperatures can be significant even at low velocities.

1. Impact

Particle attrition and containment erosion is largely unknown in particle based CSP systems. Understanding long term durability in relevant operating conditions is needed. Degradation of materials could potentially impact plant performance, plant lifetime, and overall operational cost.

2. Project Goal

- Understand thermal cycling on the optical properties of particles.
- Evaluate particle attrition, containment abrasion, and impact erosion
- Develop particle and containment material durability models to predict wear rates

3. Method(s)

Custom setups are capable of measuring erosion at room to high temperature at low velocities for multiple particle types and containment materials.

4. Outcome(s)

Erosion from stainless steel is 100-400x larger at 800°C relative to room temperature while only a 2-30X increase was observed for high nickel alloys and refractory type materials. Optical degradation of particles from isothermal aging is less than 6% for most particles.

5. Conclusion/Risks

Combined oxidation-erosion mechanism is critical to wear rates of materials at high temperatures. While velocity is significant, erosion at low velocities can still be substantial.

6. Team

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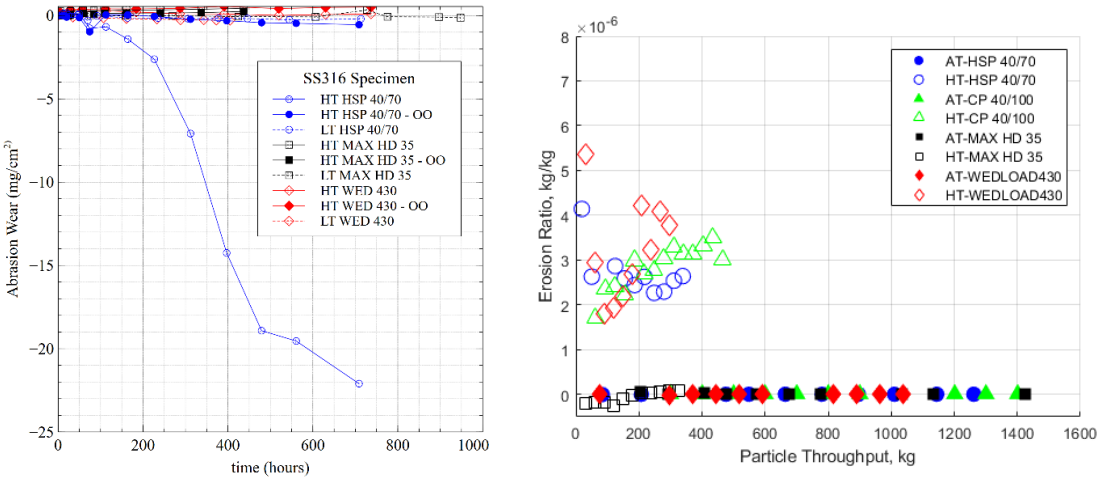

Figure 1. Low and High Temperature Erosion. (left, abrasion wear for different particles and SS316; right, impact erosion wear for SS316 and various particles)