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Wear Mechanisms For BioMass

Due to the different options of BioMass fuels, and the various operating parameters of the units, it is important to understand the wear mechanisms of each BioMass Application.

Alkali Attack:

Relative to traditional fossil fuels, most BioMass fuels contain high levels of alkalies (Na, Ca, K). At temperatures as low as 1500˚F, these corrosive compounds can disrupt refractories in two ways:

- **Slag Corrosion:** The alkalies can combine with the silica and calcium in the refractory, forming a viscous slag at high temperatures that will deteriorate the lining.
- **Expansive Alumina Reactions:** The alkalies in the fuel can react with the excess alumina in the refractory, causing a shift from alpha to beta alumina. The beta transformation is very expansive, causing crack propagation in the lining.

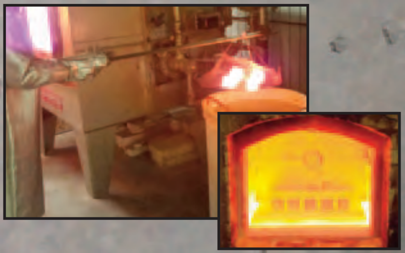
Alkali cup tests serve to approximate the potential reactions. Comparative cup test can help predict a cost-effective solution.

Abrasion & Erosion:

Depending on the type of BioMass fuel, and the hardness of the ash after combustion, various parts of the unit can be subjected to abrasion and erosion. To test and rank the abrasion resistance of different refractories, the ASTM C704 test is commonly used.

Using a prescribed amount and type of SiC grit, the refractory sample (heated to 1500˚F then cooled to room temp.) is eroded at a 90˚angle. The subsequent hole is measured by its size (CCs), with a smaller hole (and lower CC loss) indicating better abrasion resistance.

Thermal Cycling:



Refractory materials are designed to be run at high temperatures with minimal thermal cycling. However, some units…and certainly some sections of many designs, are subjected to thermal cycling.

Some refractories are more resistant to thermal shock and cycling than others. A popular test to determine thermal shock resistance is the prism spall test.

Cubes (2˝ x 2˝ x 2˝) of the refractory in question are heated to 2200˚F and then thermally quenched in water, making 1 cycle. After each cycle, the cube is examined for excess cracking. If the cube is not fractured in half another cycle is run… up to 30 cycles. This data can then be compared to other refractory samples run by the same method.

High Temp. Strength:

Most refractory castables are exceptionally strong at room temperature. However, the true test of a refractory is strength at operating temperature. The most common method to test high temp. strength is the Hot Modulus of Rupture (HMOR) procedure.

The test performs a 3-point modulus of rupture test on a refractory sample at furnace temperatures, often ranging from 1500˚F to 2800˚F. The hot strength (psi) can then be compared to other refractory types.

This test is critical with cement bonded products, as higher amounts of CaO in the refractory can cause a loss of strength at elevated temperatures, causing fluxing and premature wear.

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