

Durable Refractory Coating

Developed for difficult biomass and waste-to-energy boilers

TNO-validated coating extends lifespan of refractory materials in waste-to-energy applications.

A new mineral-based coating, developed in collaboration with industry partners and tested in the lab by TNO and long term applied in several Dutch EfW plants is now available.



Enhanced
protection

Up to
1400°C

Cost-
effective

Conventional refractories in waste-to-energy systems are often exposed to aggressive conditions, including alkali-rich fuels and corrosive slag formation. These factors contribute to rapid degradation, frequent shutdowns, and high maintenance costs.

The newly developed coating offers a cost-effective solution by significantly improving the performance and lifespan of standard refractories.

Originally developed for thermal protection in **phase change material (PCM) encapsulation**, the coating has been adapted for use in industrial thermal protection systems. It combines high-temperature resilience with material compatibility, making it ideal for waste-to-energy and other demanding applications.



Application in waste-to-energy boiler

Field Tested

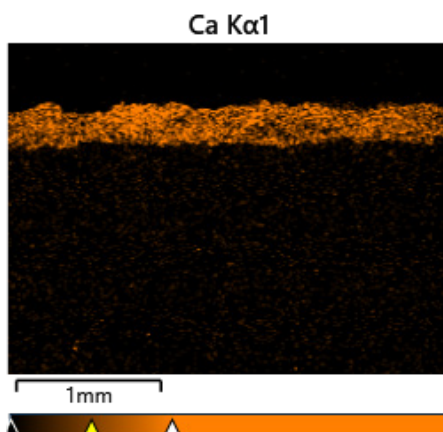
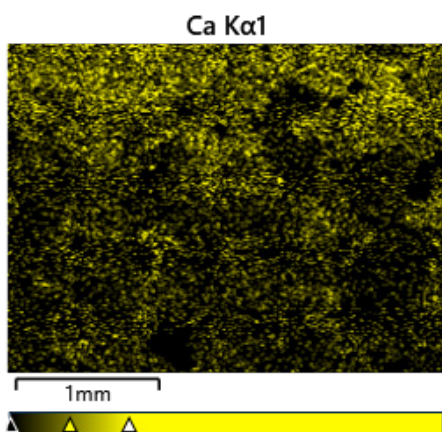
Tested under realistic combustion conditions at **TNO-Energy Transition's GROB facility**, the coated refractory segments were subjected to temperatures up to 1400°C, simulating the harsh environment of industrial residue and bio-waste combustion. Analysis using **Scanning Electron Microscopy (SEM)** confirmed the coating's effectiveness in acting as both a **barrier and sacrificial layer**, preventing the penetration of (alkali) elements such as **Ca, Na, Fe, and K**, and **reducing slag deposition**.

Proven in Practice

In addition to extensive laboratory testing, the coating has also been applied in practice at various WtE plants in the Netherlands and the experiences with this confirm the results of TNO. Field results confirm the coating's ability to reduce wear, extend refractory life, and minimize unplanned maintenance, further validating its readiness for full-scale commercial deployment.

Key Objectives and Benefits

- Protect standard refractory materials with a proprietary, binder-reinforced coating
- Improve resistance to chemical attack, oxidation, and mechanical wear
- Reduce slag formation and maintenance frequency
- Enable partial diffusion of the coating into the refractory surface for enhanced adhesion
- Maintain structural integrity under operating conditions **up to 1400°C**
- Lower total cost by extending refractory service life
- Easy and quick to apply



SEM/EDX image calcium distribution in refractory tiles. Both after one year of exposure in a EfW plant.
Left picture: without coating; heavy calcium penetration in the refractory tile.
Right picture: with coating; calcium only present in the top layer. The coating prevents calcium to penetrate in the refractory tile.

Conclusion

Lab tests and application in EfW plants have shown its capabilities:

- Effective **preventing penetration of alkali metals**
- Significantly **reducing slag deposition**

Resulting in a innovative market-ready solution.

