Refractory Insulating Castables with Permanent Linear Change Anomaly—Case Study

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Refractory Insulating Castables with Permanent Linear Change Anomaly—Case Study

1 Scope

This technical report documents an observed anomaly with the permanent linear change (PLC) of insulating castables with a density less than 1280 kg/m^3 (80 pcf). The curing time is shown to impact the permanent linear change when samples are subsequently fired to 816 °C (1500 °F). The sample preparation and testing were performed by an independent laboratory on behalf of the API Refractory Projects Group.

Disclaimer: This report only reviews the data from one castable material, which was only tested by one laboratory. Therefore, it may not be conclusive that this anomaly is applicable to all castables with a density less than 80 pcf. While originally adapted from fired refractory brick testing, it should be noted that PLC has been a long-standing physical property measurement for castables to monitor and control the permanent linear shrinkage. Over this extended period of commercial practice, the test has proven to be an effective tool to monitor excessive shrinkage cracking during initial heating of newly installed castable linings without time-factoring for the anomaly before firing. Further study is required to determine if this anomaly is unique to the refractory formulation or more widely relevant to the overall population of lightweight, castable refractories being manufactured from a wide range of raw materials and additives to make products that otherwise appear similar.

2 Normative References

No other document is identified as indispensable or required for the application of this report. A list of documents associated with API 983 are included in the bibliography.

3 Terms, Definitions, Abbreviations, and Acronyms

3.1 Terms and Definitions

3.1.1
castable (refractory)
A combination of refractory grain (aggregate) and suitable bonding agent that, after the addition of a proper liquid, is installed into place to form a monolithic shape or structure that becomes rigid because of thermal or chemical action.

3.1.2
cement (refractory)
A powdery substance that is mixed with water and will harden by itself hydraulically and generally bind larger aggregates into a refractory system. Refractory cements are higher-temperature materials and generally are based on calcium aluminates, but can include other materials, such as hydrated alumina.

3.1.3
curing
The process of bond formation in a newly installed monolithic refractory.

NOTE For hydraulic bonded castables, curing occurs at room temperature and is facilitated by an excess of water being present to react with the cement component. For phosphate-bonded plastic refractories, heating to 500 °F to 700 °F (260 °C to 370 °C) is required to form the bond.

3.1.4
density
The mass of a unit volume of a substance, usually expressed in kilograms per cubic meter (kg/m^3), grams per cubic centimeter (g/cm^3), or pounds per cubic foot (lb/ft^3).