Applications of Refractory Lining Materials

API TECHNICAL REPORT 979
FIRST EDITION, OCTOBER 2018

AMERICAN PETROLEUM INSTITUTE

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Foreword

This report is the second in a series of three American Petroleum Institute (API) reports covering the use of refractory concrete (castables), plastics, and ramming mixes for applications for the hydrocarbon processing industry (HPI). Its content is complimented by the two other reports in this series:

— API TR 978, Monolithic Refractories: Manufacture, Properties and Selection

— API TR 980, Monolithic Refractories: Installation and Dryout

These API technical reports update and add to the original reports written by Committee 547 of the American Concrete Institute (ACI) in 1979 and 1989. The ACI reports are ACI 547.R-79, *State-of-the Art Report: Refractory Concrete*, and ACI 547.1R-89, *State-of-the Art Report: Refractory Plastics and Ramming Mixes*.

ACI Committee 547 was organized in 1969 to provide a reliable and comprehensive source of information on monolithic refractory technology. In subsequent years, participation in the ACI refractory technical community waned. At the same time, participation increased on the API committee that was drafting refractory content. The API committee currently runs a certification program for refractory practitioners based on API Standard 936, *Refractory Installation Quality Control—Inspection and Testing Monolithic Refractory Linings and Materials*. To facilitate use of the updated content in the API certification program, ACI allowed API to use the material from the two above-mentioned ACI publications, no longer maintained by ACI. This enabled API to create new technical reports by updating and adding to the material from the ACI reports.

API formed the Vessel Refractory Task Group in the late 1980s with the objective of providing a standard for the inspection and application of quality controls for monolithic refractories used in refining applications. In response to demands for greater reliability and cycle life objectives, refiners had already developed their own company specifications for refractory installations for the highest-value applications where unit availability is critical. A cottage industry of supporting quality control experts and inspectors evolved has have helped owners reduce this gap in the last few decades. Up until that time, however, manufacturers and installers largely had little say in this development, and uniform industry standards were never developed or adopted.

To address this issue, a broad representation of all the stakeholders gathered as part of the API's spring and fall Refining Equipment Standards Meetings. Addressing the standards gap and noting the many similarities in owner- and equipment manufacturer–developed specifications, the API task force undertook the task of identifying useful industry practices and/or negotiating to agreement best fits for standards application. API's *Refractory Installation Quality Control Guidelines—Inspection and Testing Monolithic Linings and Material* was first issued in 1996 as a recommended practice. After a number of subsequent revisions, it was approved as API Standard 936 in 2006, with a certification program that began in 2004.

In addition to maintaining API 936 and overseeing the certification program, the task force reorganized in 2014 under the API Committee on Refinery Equipment (CRE) and became the Refractory Project Group. As a project group, work expanded to writing ceramic fiber and brick quality control standards and unit-specific applications, such as sulfur recovery units and hydrogen furnaces, as well as drafting technical reports (such as this report). In response to this broadening recognition of the need to advance this technology for HPI applications, the API CRE reclassified the group as a full subcommittee in 2016, and it now works under the title of Subcommittee on Refractory Materials (SCRM).

Contents

Contents

Application of Refractory Lining Materials

1 Scope

This technical report focuses specifically on the information on the applications of refractories contained in two American Concrete Institute (ACI) refractories documents:

— ACI 547.R-79, *State-of-the-Art Report: Refractory Concrete;*

— ACI 547.1R-89, *State-of-the-Art Report: Refractory Plastics and Ramming Mixes*.

The original content of these ACI reports was focused primarily on steel- and glass-making applications, which represent the largest refractory markets. API, in tailoring the revision of this content to the hydrocarbon processing industry (HPI), has greatly expanded the text pertaining to the specialized oil refining and petrochemical processing applications. At the same time, API has retained and updated the information covering applications outside of the HPI (see Section 5) because of the similarities and applicability that this information has for refractory professionals in these other industries.

2 Referenced Documents

API Standard 560, *Fired Heaters for General Refinery Service*

API Standard 936, *Refractory Installation Quality Control—Inspection and Testing Monolithic Refractory Linings and Materials*

API Technical Report 978, *Monolithic Refractories: Manufacture, Properties, and Selection* [1]

API Technical Report 980, *Monolithic Refractories: Installation and Dryout* [1]

ACI SP-34, *Handbook on Concrete Reinforcement and Detailing*

ASTM C71, *Standard Terminology Relating to Refractories*

ASTM C638, *Standard Descriptive Nomenclature of Constituents of Aggregates for Radiation-Shielding Concrete*

ASTM C704, *Standard Test Method for Abrasion Resistance of Refractory Materials at Room Temperature*

3 Terms and Definitions

NOTE See ASTM C71 and API 936 for additional information on definitions.

3.1
abrasion resistance
The ability to withstand the effects of eroding particles for an extended period without significant loss of material or other damage.

NOTE 1 Often referred to as “erosion in fluid solids units,” such as FCC units, which is technically incorrect, but commonly understood in refining jargon.

NOTE 2 For refractory materials, abrasion resistance is measured in the form of eroded volume loss in accordance with ASTM C704/C704M.

EXAMPLE A vapor stream containing solid particles.