Report on the Use of Raw or Processed Natural Pozzolans in Concrete

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This report reviews the use of raw or processed natural pozzolans in concrete and provides an overview of the properties of natural pozzolans and their use in the production of hydraulic-cement concrete. Long before the invention of portland cement, natural pozzolans mixed with lime were used to strengthen concrete and mortar. Today, they can be used to enhance the properties of fresh and hardened concrete and may provide economic value in some cases.

Keywords: alkali-silica reaction; diatomaceous earth; lime; pozzolan; pozzolanic activity; strength; sulfate attack.
CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

Pozzolans are made up of siliceous or siliceous and aluminous materials that, in finely divided form, will react with calcium hydroxide to form cementitious materials. The term “pozzolan” evolved from the name given to a deposit of volcanic material located near Pozzuoli, Italy. This deposit, originally referred to as pozzolana, consisted of pumice ash, or tuff, comprised of trachyte found near Naples and Segni, Italy. Trachyte is a volcanic rock comprised primarily of feldspar crystals in a matrix of siliceous glass. Pozzolana was formed from an explosive volcanic eruption in 79 AD at Mount Vesuvius, which engulfed Herculaneum, Pompeii, and other towns along the bay of Naples. Chapter 3 provides historical information about the use of pozzolans.

The term “natural pozzolan” encompasses a broad range of materials. A few of these materials are pozzolanic in their natural state. However, most of the materials considered natural pozzolans require some type of processing to render the material pozzolanic. Some may require only drying and grinding/classifying, while others may require heat treatment and grinding to adequately activate the pozzolanic nature of the material. Chapter 4 provides a brief description of the various materials classified as natural pozzolans, which are the focus of this report.

1.2—Scope

This report contains information and recommendations concerning the selection and use of natural pozzolans generally conforming to the requirements of ASTM C618-08. Topics covered include the effect of natural pozzolans on concrete properties, a discussion of quality control and quality assurance practices, and guidance regarding handling and use of natural pozzolans in specific applications.

CHAPTER 2—DEFINITIONS

ACI provides a comprehensive list of definitions through an online resource, “ACI Concrete Terminology,” http://terminology.concrete.org.

CHAPTER 3—HISTORICAL USE OF NATURAL POZZOLANS

3.1—Ancient history

Many people associate the use of quarried building stones with the construction of structures by the Greeks, Romans, and other similar ancient civilizations. Concretes and mortars using various cementitious binders, however, were likewise used to some extent during these ancient times. These cementitious binders contained pozzolans of a natural origin, such as volcanic ash, pulverized pumice, and diatomaceous earth. When these pozzolans were combined with burned limestone and mixed with water, the combination would form a cementitious material. Therefore, pozzolans have been used in mortar and concrete for several millennia.