

Guide for the Use of Silica Fume in Concrete

Reported by ACI Committee 234

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This report describes the physical and chemical properties of silica fume; how silica fume interacts with portland cement; the effects of silica fume on the properties of fresh and hardened concrete; recent typical applications of silica-fume concrete; how silica-fume concrete is proportioned, specified, and handled in the field; and areas where additional research is needed.

Keywords: curing; durability; high-range water-reducing admixture; high-strength concrete; placing; plastic-shrinkage cracking; silica fume; time of setting; water-reducing admixture; workability.

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CHAPTER 1—INTRODUCTION

1.1—General

Silica fume, a by-product of the ferrosilicon industry, is a highly pozzolanic material that is used to enhance mechanical and durability properties of concrete. It may be added directly to concrete as an individual ingredient or in a blend of portland cement and silica fume. ACI Committee 234 estimates that at least 120,000 metric tons (130,000 tons) of silica fume are used in concrete worldwide annually. Using this figure, more than 6 million cubic meters (nearly 8 million cubic yards) of silica-fume concrete are placed globally each year.

Interest in the use of silica fume resulted from the strict enforcement of air-pollution measures designed to stop release of the material into the atmosphere. Initial use of silica fume in concrete was mostly for cement replacement, along with water-reducing admixtures (WRAs). Eventually, the availability of high-range water-reducing admixtures (HRWRAs, often referred to as superplasticizers) allowed new possibilities for the use of silica fume to produce high levels of performance.

This document provides basic information on using silica fume in concrete. The document is organized as follows:

- Chapter 1 provides general information on silica fume;
- Chapter 2 describes the physical properties and chemical composition of silica fume;
- Chapter 3 describes the mechanisms by which silica fume modifies cement paste, mortar, and concrete;
- Chapter 4 describes the effects of silica fume on fresh concrete;
- Chapter 5 describes the effects of silica fume on hardened concrete;
- Chapter 6 shows how silica fume has been used on actual projects. This chapter covers only a very small number of applications because ACI Committee 234 is currently developing an additional document that will provide detailed case histories of many more projects;
- Chapter 7 discusses specifications for silica fume and silica-fume concrete;
- Chapter 8 presents a step-by-step methodology for proportioning silica-fume concrete for specific applications;
- Chapter 9 presents recommendations for working with silica fume in field concrete;
- Chapter 10 summarizes research needs for using silica fume in concrete; and
- Chapter 11 presents all of the references from the other chapters.

Note that the coverage in Chapters 7, 8, and 9 is somewhat brief. More details on working with silica-fume concrete in