

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: alkali-silica reaction, compressive strength, concrete durability, corrosion resistance, curing concrete, drying shrinkage, filler effects, finishing concrete, fresh concrete properties, hardened concrete properties, high-strength concrete, microstructure, permeability, placing concrete, plastic-shrinkage cracking, porosity, pozzolanic reactions, proportioning concrete, shotcrete, silica fume, silica-fume concrete, silica-fume products, specifications.

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CHAPTER 1—INTRODUCTION

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In recent years significant attention has been given to the use of the pozzolan silica fume as a concrete property-enhancing material, as a partial replacement for portland cement, or both. Silica fume has also been referred to as silica dust, condensed silica fume, microsilica, and fumed silica (this last term is particularly incorrect - see Section 1.3). The most appropriate term is silica fume (ACI 116R).

The initial interest in the use of silica fume was mainly caused by the strict enforcement of air-pollution control measures in various countries to stop release of the material into the atmosphere. More recently, the availability of high-range water-reducing admixtures (HRWRA) has opened up new possibilities for the use of silica fume as part of the cementing material in concrete to produce very high strengths or very high levels of durability or both.

Investigations of the performance of silica fume in concrete began in the Scandinavian countries, particularly in Iceland, Norway, and Sweden, with the first paper being published by Bernhardt in 1952. Other early Scandinavian papers included those by Fiskaa, Hansen, and Moum (1971), Traetteberg (1977), Jahr (1981), Asgeirsson and Gudmundsson (1979), Løland (1981), and Gjørsv and Løland (1982). In 1976 a Norwegian standard permitted the use of silica fume