

## **Current Innovations in Cement-Based Materials**

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ABSTRACT

At the present time, concrete infrastructures experience deterioration at a much faster rate than expected. This may be due to the fact that structures are subjected to aggressive chemical environments. Such structures include bridge decks, pavements, ocean piers, offshore platforms, pipes, and structures for confinements of solid and liquid wastes containing hazardous materials, etc. Recent investigations in cement-based materials have led to development of a special class of materials called high-performance concrete (HPC). This material is proportioned to have both high-strength and high-durability related properties. This is accomplished through the use of mixture proportioning, high-quality constituent materials, mineral admixtures, and chemical admixtures.

Currently, high strength concrete (HSC) with and without mineral admixtures can be proportioned to attain strength in the range of 40 to 60 MPa at a low water-to-cementitious materials ratio using conventional materials and production technology, with chemical admixtures. HPC above 60 MPa requires the use of special aggregates (small size, closely graded, high-strength aggregates), high-performance low heat of hydration cement, special chemical admixtures, and special care in mixing, handling, and placing.

It is now well established that a very dense homogeneous concrete microstructure, especially in the interface region between hydrated cement paste and aggregate, is required in order to produce HPC. This is accomplished using low water to cementitious materials ratio (0.20 - 0.35) with the help of HRWR that can produce slump in the range of 75 to 125mm.

The use of mineral admixtures for such concretes is a necessity because they are needed for improving densification and homogeneity of the interfacial region. As a result, HPC attains high impermeability to aggressive agents, leading to improved durability under aggressive chemical environments and complex applied loading conditions.

This chapter deals with current advances in manufacture of concrete constituent materials, microstructure of cement-based materials, testing of concrete, and recent advances in various types of cement-based materials, such as high-strength concrete, high-performance concrete, high-durability concrete (HDC), high-quality concrete (HQC), roller compacted concrete, high-volume fly ash concrete, fiber-reinforced concrete, and controlled low strength materials (CLSM).