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Chapter 1 : High-performance Construction Materials: Science and Applications - Caijun Shi - Google Book

This book describes a number of high-performance construction materials, including concrete, steel, fiber-reinforced cement, fiber-reinforced plastics, polymeric materials, geosynthetics, masonry materials and coatings.

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Chapter 2 : Triple: L Warbird â€“ Motocycles

Introduction Caijun Shi and Y.L. Mo -- High performance concrete Caijun Shi, Y.L. Mo and H.B. Dhonde -- High performance fiber reinforced cement composites Antoinie E. Naaman -- High performance steel material and structures for earthquake resistant buildings Keh-Chyuan Tsai [und weitere] -- Advanced fiber reinforced polymer composites L.C.

At that time HPC was in the research stages and was not yet ready to enter the market. The engineers prevailed upon scientists to allow its use. Eventually, the tunnel was built using this material. The reason for the use of HPC lies in its ability to reach an adequate maturity in 24 hours rather than 7 days for regular concrete. Many organizations in the world started research programs on high performance concrete. The first meeting of the Lead States was held in September , in St. During the past two decades, significant progresses have been made on the design, testing and use of HPC. Zia et al [4] summarized some of the early research activities and applications of HPC. Many structural design codes, specifications and guidelines have also been developed correspondingly. Many books and conference proceedings have been published even by American Concrete Institute see www. This chapter discusses the selection of raw materials, mix design, performance and applications of some HPCs. Russell summarized many of them in a paper published in [5]. Users of this definition can indicate the level of performance that they require for each performance characteristic, based on their own field and weather conditions, in order to determine the HPC mixture best suited to their specific need. HPC mixes are composed of essentially the same materials as conventional concrete mixes. But the proportions are designed, or engineered, to provide the strength and durability needed for the structural and environmental requirements of the project. According to the American Association of State Highway and Transportation Officials AASHTO Technology Implementation Group, HPC, which is concrete that has been designed to be more durable, and, if necessary, stronger than conventional concrete, can help highway agencies to build bridges that are better able to hold up to traffic and environmental demands. These bridges must also be economical to build and maintain. In , ACI published the following definition: ACI has published committee documents on all these types of concrete [9]. As the performance requirements are different for different applications, the following sections mainly discusses high performance concrete as specified by FHWA. SCC is also discussed in detail due to its fast and wide adoption by the industry. It is still the most used binder for HPC. However, supplementary cementing materials such as silica fume, ground granulated blast furnace slag, coal fly ash have predominantly used for HPC. The use of superplasticizer is essential to achieve high strength, good workability and good durability. The selection of proper gradation and quality aggregates is the other requirement to produce high HPC. The ingredients of HPC are to be chosen to result in the desired performance and yet ensure economy [10]. In this process, the materials are stretched to their limits of performance [11]. Variation in the chemical composition and physical properties of the cement affect the concrete compressive strength more than variations in any other single material. In US and some countries or regions, Portland cement is the commercial cement. It is much easier to select cement for HPC. Compressive strength differences among the mixtures were most pronounced at one day, but High Performance Concrete 23 diminished over time through 56 days. Type III cement is often selected for high early strength. In some other countries and regions, cements are produced and marketed based on strength grades and their ingredients. In that case, it is more difficult to select the right grade and type of cement to be used. Previous experience and trial batches will be very important during the selection process. There is an optimum cement content beyond which little or no additional increase in strength is achieved by increasing the cement content [13]. However, if cement content is increased there will be a remarkable influence on the consistency of concrete for the same watercement ratio [14]. They can be divided into two categories based on the type of reaction they undergo: Hydraulic materials react directly with water to form cementitious compounds, while pozzolanic materials chemically react with calcium hydroxide, a soluble hydration product, in the presence of moisture to form compounds possessing cementitious properties. The production and characteristics of these materials can be found in several publications [15,16]. The use of silica fume usually requires the use of a high range water reducer. The products resulting from the reactions between lime and SCMs refine the pore structure of hardened pastes and reduce the permeability of hardened pastes. In many cases, it is necessary to use SCMs to achieve low permeability. Dhonde High Performance Concrete 25 granite and river gravel. The mineralogical differences in the aggregate types are considered to be responsible for this behavior. For a given mortar, the modulus of the concrete increases as the modulus of coarse aggregate increases [19]. The packing of aggregate also affects the properties of HPC. Tasi et al [20] found that the denser the aggregate packing the better the workability and engineering properties are under sufficient paste content. The application of the densified mixture design algorithm DMDA on designing HPC for every aggregate packing type can obtain high flowability and suitable strength growth. The compatibility between cement and chemical admixtures and the optimum dosage of an admixture or combination of admixtures should be determined by laboratory experiments [21,23]. Water-reducing admixtures and high-range, water-reducing admixtures in HPC minimize the quantity of water necessary to produce a concrete with the required workability. They are often used in HPC specified for durability and are almost always used in high-strength concrete. Retarding admixtures and accelerating admixtures are used to delay or accelerate the setting of concrete. Shrinkage reducing admixtures are designed to decrease the effects of drying shrinkage. They function by reducing capillary tension in pore water that develops within concrete as it dries. This reduction in capillary tension reduces drying shrinkage, attendant cracking, microcracking and compressive creep [24]. Corrosion inhibitors are used in concrete to raise the chloride threshold level at which corrosion starts and to reduce the rate of corrosion after it begins. They are used primarily in producing structures that are exposed to chloride salts, such as bridge decks, parking garages, and marine facilities. For casting under water, antiwashout admixtures may be used to increase the cohesiveness of 26 C. Dhonde concrete, thereby reducing the loss of cement and increasing resistance to segregation. Alkali-aggregate reaction inhibitors are mainly these lithium compounds used as either an admixture in new concrete or as a treatment of existing structures. The quality of hardened concrete is greatly influenced by the amount of water used in relation to the amount of cement, or water to cementitious materials ratio. Higher water to cement ratio is detrimental to the mechanical properties, deformation and durability of concrete. Mix proportions for HPC are influenced by many factors, including specified performance properties, locally available materials, local experience, personal preferences, and cost. HPC is usually designed based on the requirements for specific applications and environments, which decide the constitute materials and mixture proportions for the HPC to be produced. For example, for precast, prestressed concrete bridge components such as beams and piles, engineers generally specify both a minimum strength at release of the prestressing strands and a design strength. For conventional strength concretes, mix proportions are then selected to achieve the release strength while the specified design strength at 28 days is easily exceeded. With high strength concrete, the design strength is higher and the release strength is correspondingly higher. To achieve the higher strength, it is necessary to increase the cementitious material content. For cast-in-place high performance concrete, as used in bridge decks or substructures, durability criteria rather than strength often control the selection of concrete mix proportions. In many cases, multiple engineering performance requirements in addition to strength need to be met High Performance Concrete 27 simultaneously. The production of HPC is more of an art than a science, although the basic principle is simple [27]. There are various methods for proportioning conventional concrete [28]. Generally, these methods are based on fundamental functions: However, most high-strength concretes contain SCMs other than cement. Consequently, the water-cementitious materials ratio must be considered instead of the water-cement ratio where the cementitious materials include cement, fly ash, silica fume, and GGBFS as appropriate. The effect of chemical admixtures, such as plasticizers or superplasticizers, can also be incorporated into these existing methods. However, with the new generation of HPC the problem of designing the concrete mixture becomes more sophisticated. Several procedures for proportioning HPC have been proposed or developed []. Most of them are semi-analytical. Sobolev [34] investigated strength properties and the rheological behavior of a cementâ€"silica fumeâ€"superplasticizer system and proposed a method for proportioning HPC based on how the constituents affect the properties of the concrete. Recently, Zain et al. The system was developed using hybrid knowledge representation technique. It is capable of selecting proportions of mixing water, cement, SCMs, aggregates and superplasticizer, considering the effects of air content as well as water contributed by superplasticizer and moisture conditions of aggregates. Magee and Olek [36] collected and analyzed approximately HPC mixtures from more than publications. The statistic analyses on these mostly commonly used water, binder, air content, fine and coarse aggregates are plotted in Fig. High Performance Concrete 29 Table 2. The most commonly used admixtures include water reducers, air entrainers and retarders. As for the binders in HPC, six different combinations have been used, as summarized in Table 2. Silica fume is also often used in ternary combinations with portland cement with fl ash or slag. Many terms such as consistency, flowability, mobility, pumpability, compactibility, finishability, and harshness, have been used to describe the properties of fresh concrete. Workability is often used to represent all those properties of fresh concrete. It is defined as the amount of mechanical work, or energy required to produce fully compacted concrete without segregation. A large number of tests have been proposed for the measurement of workability. The common ones include: Slump test is the most widely specified workability testing. The literature information 30 C. Many factors affect the strength of concrete. A simplified view of the factors affecting the strength of concrete is shown in Fig.

Chapter 3 : High-performance construction materials: science and applications - PDF Free Download

HIGH-PERFORMANCE CONSTRUCTION MATERIALS: Science and Applications (Engineering Materials for Technological Needs) by Caijun Shi (Editor), Y. L. Mo (Editor), Yi-Lung Mo Hardcover, Pages, Published

In this study, we tried to explore the hepatic Nrf2 pathway upon arsenic treatment comprehensively, since liver is one of the major target organs of arsenical toxicity. Our results showed that inorganic arsenic could quickly and significantly induce the nuclear transcription factor Nrf2 protein expression in Chang human hepatocytes. In addition, our results also found a dose-dependent increase of Nrf2 transcriptional activity indicated by the enhancement of ARE-luciferase activity , as well as both the mRNA and protein levels of NQO1 and HO-1, two downstream targets of Nrf2, were upregulated dramatically after arsenic invasion. Induction of hepatic Nrf2 pathway in our results, unanimously with many in vitro studies using other cell types altogether [32 , 33], indicates that the Nrf2 pathway activation by arsenic is a kind of cellular ubiquitous phenomenon, and the hepatic Nrf2 pathway might play indispensable roles for the cellular defense against arsenic hepatotoxicity. Studies have clarified that Nrf2 is sequestered in the cytoplasm by Keap1-mediated ubiquitination and the proteasomal degradation system, and that oxidative stress activates Nrf2 by permitting its translocation into the nucleus, suggesting that the regulation of Nrf2 transcriptional activity is mainly mediated by posttranscriptional mechanisms [31], In our results, we also observed the remarkable nuclear accumulation of Nrf2 protein and the enhancement of Nrf2 transcriptional activity with sodium arsenite treatment. However, as demonstrated by some other studies that Nrf2 mRNA levels could be affected by arsenic [15], our results also found a moderate improvement of Nrf2 mRNA levels by arsenic exposure. It is therefore suggested that multiple mechanisms might be involved in Nrf2 activation, including both the transcriptional and the posttranscriptional events as far as inorganic arsenic is concerned. On the other hand, a kind of transcriptional repressor, Bach1, has gained close attentions in recent years. In general, Bach1 serves as a repressor of the oxidative stress responses. Some researches indicate that activation of Nrf2 requires the inactivation of the transcriptional repressor Bach1 [34], and it is therefore argued that even when Nrf2 enters and accumulates in the nucleus, Nrf2 could not bind to the ARE site to initiate the Nrf2-mediated antioxidant responses unless Bach1 inactivates and probably exits out of the nucleus. What is more, it is also found that some of the Nrf2-regulated gene transcriptions are related to Bach1. Similarly, it has been demonstrated that knockdown of Bach1 in human keratinocytes specifically upregulated the gene expression of HO-1 [35]. In addition, Sakamoto et al. As to inorganic arsenic exposure, Reichard et al. They also proved that the inactivation of Bach1 was necessary and sufficient for Nrf2 activation and the subsequent transcriptional induction of HO-1 in human keratinocytes. Consistent with their studies, our results here also found that sodium arsenite could regulate the intracellular localization of Bach1. Bach1 protein levels gradually decreased in the nucleus, while increased correspondingly in the cytoplasm after arsenic treatment. In addition, Bach1 fluorescence was transferred from the nucleus to the cytoplasm. Our results therefore confirmed that the nuclear import and accumulation of Nrf2 by arsenic were associated with Bach1 export from nucleus in hepatocytes. As a result, Nrf2 could be able to bind to the ARE-binding sites to initiate the downstream gene transcription. About the mechanism of Bach1 inactivation and translocation, Kaspar and Jaiswal demonstrated that antioxidant-induced phosphorylation of tyrosine was essential for the nuclear export of Bach1 [38]. Another study reported that arsenite regulated the Bach1 cysteine residues C and C to regulate the Bach1 function in human microvascular endothelial cells [28]. The relations between Bach1 and Nrf2 and the details of Bach1 translocation by arsenic still need to be confirmed and investigated. In our results, we also found that both the mRNA and the protein levels of NQO1 and HO-1 were all increased when exposed to different concentrations of sodium arsenite. As the downstream target genes of Nrf2 pathway, NQO1 and HO-1 are all believed to have imperative cytoprotective functions. NQO1 is one of the phase II enzymes, capable of converting reactive electrophiles to less toxic and more readily excretable products, thus protecting cells against various chemical stresses and carcinogenesis [39]. HO-1 possesses cytoprotective properties such as antioxidative, immunomodulatory, anti-inflammatory, and antiapoptotic functions [40 , 41]. What is more, a recent study that used a high-throughput chromatin immunoprecipitation with parallel sequencing methodology identified more than Nrf2 target genes, further confirming the essential role of Nrf2 as the central regulator of cell protective and survival responses against numerous oxidative and electrophilic chemicals [42]. Induction of other Nrf2 downstream molecules by arsenicals and clarifying their potential roles in maintaining the cellular redox homeostasis and limiting arsenic-caused oxidative damage are still under investigation in our laboratory. In summary, our results showed that arsenic accelerated the Nrf2 mRNA and protein expression in hepatocytes, promoted Nrf2 protein entry, accumulated in the nucleus, and enhanced the Nrf2 transcriptional activity. On the other hand, we found in this study that transcriptional repressor Bach1 exported from the nucleus to the cytoplasm. In addition, the mRNA and protein levels of NQO1 and HO-1, two Nrf2 downstream genes, increased correspondingly, which may exert their antioxidant and detoxification roles to against damages of arsenic treatment. The results of our study confirmed the arsenic-induced Nrf2 pathway activation in hepatocytes and attempted to uncover tentatively the interplay of Bach1 and Nrf2, which may be helpful to further understand the cellular self-defensive responses as well as the diverse biological effects of arsenicals.

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Chapter 6 : HIGH-PERFORMANCE CONSTRUCTION MATERIALS Science and Applications - é•“å®¢å·´å

High Performance Concrete Caijun Shi College of Civil Engineering, Hunan University Changsha, China CJS Technology USA Ltd, USA Y. L. Mo and H. B. Dhonde Department of Civil and Environmental Engineering University of Houston Introduction Historical development Use of High Performance Concrete (HPC) truly began in when engineers.