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Introduction

Concrete is manufactured at the plant or on site from various components: cement, water and different granular materials such as sand, gravel and various mineral additions. It may also contain admixtures intended to modify its properties from its fresh state (for example retarding or accelerating admixtures, superplasticizer) or its properties in its hardened state (for example air entraining agents). Properties introduced in this material are varied. They concern both its fresh state through its ability to be transported and poured in forms that are more or less fluid, as well as in its hardened state. Properties include its performances, for example mechanical resistance, resistance to aggressive environments, and acoustic or heat insulation. The formulation of concrete consists of finding components and their proportions to meet specific requirements, which may be very different. All of this should be done keeping in mind that concrete is a widely used material, its cost should be limited, and it is prepared and implemented on site in variable environmental conditions.

Understanding the rheological properties of fresh concrete, the hydration phenomenon of cement responsible for structuration, the relationship between the characteristics of the porous solid obtained and its mechanical performances or resistance to the aggressive penetration requires a complex knowledge of the physicochemistry of reactive porous materials. The development of simple formulation rules therefore requires the assimilation of this knowledge and a good command of the properties of these materials.

The purpose of this book is to provide the “mix designer” with useful knowledge on granular and porous materials, which will enable the innovative design of concrete. Topics covered include the characterization of

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granular materials, the concepts of porosity and specific surface area, and the transport properties (diffusion and permeation) of concrete. Some of these topics are already covered in other general books dedicated to granular or porous materials. The objective here is to bring them together in one book by adapting them for use by concrete specialists.

Simulations in the form of exercises are offered at the end of each chapter to enable readers to assimilate theoretical knowledge and to apply such knowledge to specific problems encountered in civil engineering.

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