Preface

Abstract This book is concentrated mainly with the study of the viscoelastic response of bitumen and asphalt concrete as the functions of time and temperature. It concentrates on the common properties of asphalt concrete, viz., viscoelastic properties of binder, bitumen and air voids content, and stiffness modulus, and does not concern itself with the less common properties. The aim has been to provide the basic parameters of modeling allowing for mix design, pavement design, and analysis. Readers will also note that the relationships outlined are based on materials data commonly available to asphalt concrete producers and users.

Road asphalt is the most important component of the asphalt concrete mixture. Its content in the mixture together with its mechanical properties predetermine the strength, durability, as well as load-bearing and load-distributive capacity of road pavement. Being a composite mixture of hydrocarbons, asphalt typically is a viscous resilient ductile material whose properties depend on temperature and loading conditions. The extent of this dependence differs among different asphalts produced by different methods from different types of crude oil and it varies in the course of aging.

The viscoelastic properties of asphalts and asphalt concretes are ascertained by the way of testing at variable temperature and under load of variable duration or variable rate of application (stress or strain rate), so such testing requires expensive equipment and highly skilled staff. This is required in order to assess, at the designing phase, the asphalt mix design modulus at the given temperature, establish the correct temperature for preparation and compaction of the mixture, verify the pavement resistance to rutting in summer and to thermal cracking in winter, and estimate the asphalt concrete pavement fatigue damage under repeated loading.

In this work, approximate formulas have been developed for prediction of the rheological properties of asphalt based on its standard parameters such as penetration and softening point under different test modes, such as constant stress, constant deformation, or cyclic load.

This monograph consists of four chapters. The first chapter highlights the viscoelastic properties applicable to asphalt and asphalt concretes which are to facilitate further reading. The second chapter determines the dependence of asphalt stiffness modulus on the penetration and softening points. The third chapter analyzes the interrelationship between various performance criteria: stiffness modulus, relaxation modulus, creep compliance, and complex modulus, and then offers the approximate formulas for defining thereof. The fourth chapter gives examples of practical application of the established dependences for determining the viscoelastic properties of asphalt and asphalt concrete as a function of temperature and loading time.

For many years, the authors' academic interests have been focused mainly on pavement design, analysis, construction, and testing methods (Radovskiy 1973, Radovskiy et al. 1989, Radovskiy 2003; Teltayev and Aytaliev 1999, Teltayev 2006, 2007, 2012). However, in their research work, the authors have had to analyze a moving load effect and time-related processes, so they have had to deal with the viscoelastic properties of many types of construction material, of which asphalt concrete is the most *viscoelastic* material. It is true that reliable information about properties of any material may be obtained through testing. Nonetheless, testing is not always possible, so we need some dependences, which would predict, more or less accurately, the time-related deformation or stress development patterns at different temperatures, based on some simple standard parameters. This is to say that in some cases, it is enough to use such dependences instead of testing. Anyway, the authors have had to use these dependences in their research in the field of pavement strength, so the authors believe that such dependences can be useful for other specialists, too.

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