Preface

The area of protective organic coatings is a field where many scientific disciplines meet. In order to synthesize designed binders and curatives, and apply them so as to get a coating of proper performance, one has to address disciplines like organic chemistry, gelation and network formation theory, rheology, surface science, physical chemistry, solid state physics, especially mechanics of homogeneous and inhomogeneous materials, and degradation and stability science. Because of this complexity, in the past the development of protective coatings was based mostly on empirical experience. One has to admit that on this empirical basis, coatings of excellent performance were developed, and a few "empirical" specialists could often solve a particular problem faster (and sometimes better) than a team of specialists in various disciplines. The methods to characterize coating film formation and properties were mostly empirical without understanding their physics, and several variants of characterization of a given property were available. Yet, gradually the situation has been changing: the coating systems have been becoming more complex, more exact and comparable description of properties has been required, and new methods have been needed to characterize additional properties for new applications. Predictions made on a theoretical basis have been helpful, at least in the form of "what happens, if. . .". Such development inspired us to collect articles on these topics and to publish them in the form of a book.

The book is composed of three parts: The first part "Network Formation and Modeling" is focused on the preparation of contemporary binders of complex composition characterized by the distributions of numbers and types of functional groups and the role of these distributions in network formation and properties development. In this context, modeling of the formation of other defects and the peculiarities of buildup of mechanical properties, when the cross-link density is high and stiff network chains develop, is important. In the second part "Coating Film Formation and Properties," characterization methods of film formation are addressed: rheology, cryogenic scanning electron microscopy methods, infrared spectroscopy, and methods characterizing volume shrinkage and stress development during film formation. This part also deals with diffusion technology as a

method of designing drying of coating films. The third part of the book is "Coating Film Properties and Applications." The chapters of this part deal with methods of characterization of film properties mainly in the final state of a coating. Thermodynamic analysis of swelling, which is a common method for characterizing cross-link density and polymer solvent interactions, points to the dangers of misinterpretation of the results. Chapters on compositional depth profiles are based on slab microtomy and infrared spectroscopy, and confocal Raman microscopy. Several chapters deal with application properties of coatings including coating appearance and scratch and mar resistance. The reader will find information on the present state of the art of the methods. Also, the main factors causing defects and affecting degradation and durability of coatings are discussed. This part is concluded by comprehensive information on automotive paint application. As a whole, the book provides the reader a better understanding of the coating film formation process, coating properties, appearance, defect formation, and durability. The reader also finds information on contemporary trends of development in these areas.

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