

Preface

As the first book on *Liquid Explosives*, this book, covering part of the author's achievements on energetic materials in the past about half a century, presents the results of a wide range of research fields with abundant information and valuable practicality. It also reviews the development of liquid explosives for the first time over the world and focuses on the latest research findings of the explosion mechanism, properties, and preparation process of liquid explosives. Different from the detonation of condensed explosives, liquid explosives show distinct features to easily form under-compressed detonation. The charging and application of liquid explosives are not influenced by geographical conditions, local topographic feature, and land features. Thus, the application range of liquid explosives is considerably wide.

The first word that pops up in the mind would be war, or national-defense, while talking about liquid explosives. The truth is that military use accounts for only a small part. Liquid explosives have been widely used in aerospace, sounding rockets, communications satellites, transportation, mining, construction, seismic prospecting, mineral exploration, channelization, underground blasting, underwater bursting, and channel development. The propellant is the main component of liquid explosives that mainly consist of nitrate ester, perchlorates, hydrazines, or hydrogen peroxide. To understand the basic properties of these materials is important to optimize the performances of liquid energetic materials, including energy levels, combustion behavior, detonation characteristics, stability, processing characteristics, service characteristics, and prolonging storage period. The materials to prepare liquid explosives are well known. Thus, by using the information of technique process, the formulation of liquid explosives can be precisely adjusted to achieve optimized explosion strength and performance. Further improvement of charging conditions and application range would maximize the energy of liquid explosives.

The book is organized into seven chapters. The first chapter, Introduction, contains the concept of liquid explosive and its development direction. In Chap. 2, the detonation mechanism of liquid explosive is reviewed. The liquid explosive exhibits the essential property of explosives. However, its detonation characteristics are different from the common explosives. The general detonation theory cannot

completely explain the detonation behaviors and characteristics of liquid explosives, such as under-compressed detonation. In an infinite free space, the short-distance over-compression of explosion for liquid explosives is not as high as condensed explosives, but the pulse width of its shock wave is much larger than condensed explosives. The positive pressure lasts a long time, thus the total corresponding work is high. Particularly in a semi-closed room, accompanied by the release of large amounts of gas, oxygen surrounding the explosion is involved in the detonation reaction, so-called as oxygen uptake characteristic, which is not observed for common condensed explosives. It is intended to guide researchers to gain primary understanding on the detonation characteristics of liquid explosive, so as to provide supports to applications of liquid explosives. In Chap. 3, the formulating of liquid explosive recipe is presented and the relationship among energy, detonation parameters, and performance of liquid explosives with different structures is systematically discussed. Chapters 4–6 contain the property and preparation technology of typical liquid explosives of nitroalkanes, nitrate esters, and azides. New findings in nitrate ester liquid explosives in our work have been addressed based on previous work. For example, the issue that nitroglycerine is sensitive to be exploded even under a slight shake has been solved using modern technology. We also improved the preparation technology of nitrate esters to implement pollution-free green process of nitrification. Great amounts of azide energetic materials, developed in the past decade, have come to light for the first time in this book. Chapter 7 contains seven types of liquid explosive mixtures and their composition, property, preparation process, and performance.

Besides the author's achievements, the book also contains the scientific views and theoretical knowledge for the research and development of liquid explosives over the world. The main aims of the book are to review the current status of liquid explosive research and development, to provide instruction for studying liquid explosives, and to enlighten researchers of energetic materials. Through reviewing the current application level of liquid explosives, the book, basically, has been designed to address the needs of scientists, researchers, and engineers, who are interested in the composition, preparation, property, application, and performance of energetic materials.

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Any suggestions to the book on both academic and expression grounds are welcome, due to the limitations of the author.

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