

# Primary Explosives

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# Preface

Primary explosives, or initiators, represent a small subset of those chemical compounds called explosives and are used for the purpose of initiating explosions. Simply said, they can be found in various initiation devices where it is necessary to use a mechanical, thermal, or electrical stimulus to prime the combustion or detonation of the main explosive.

We are currently confronted with an overwhelming volume of negative news about the use and abuse of explosives for criminal activities or terrorist bomb attacks, such that the word *explosive* itself has acquired a rather pejorative connotation and is often replaced with the more neutral, but rather meaningless, term *energetic material*. Leaving aside the Orwellian Newspeak, it is fair to say—without any exaggeration—that, although not generally known, explosives are part and parcel of everyday life, much more so now than in the past. If one just considers a small group of explosives used for initiation—primary explosives—we find that most of us are in contact with them on a daily basis, in the form of initiators or pyrotechnic devices in air bag systems, for example. Given this, it seems rather surprising that there has been nothing published in English summarizing the vast knowledge of their properties, preparation, or usage.

Of course, claiming that no information is available on primary explosives would not be entirely true. However, it is common for primary explosives to be discussed in a chapter or a paragraph in publications dealing with explosives in general or in a wider picture (e.g., in T. Urbański's "Chemistry and Technology of Explosives" or David's "The Chemistry of Powder and Explosives"). Another significant source of information are the hundreds or thousands of specialized articles in technical periodicals and papers published in conference publications, which are far too focused on a particular substance or phenomenon and do not allow an easy grasp of the function of primary explosives in the wider context. A fair amount of information is also included in encyclopedias on explosives (of which the most famous and comprehensive are Fedoroff, Sheffield and Kaye's "Encyclopaedia of Explosives and Related Items" or Meyer's "Explosives"). However, information included in these publications is usually rather brief and generally omits many essential details. Very comprehensive and valuable sources of

information on primary explosives are the many publications written in non-English languages, which, despite today's translation capabilities, often remain inaccessible for the majority of potential readers due to the language barrier. This is really regrettable as there are numerous comprehensive and high-quality sources produced in Russian or the Czech language. Here, one should note Bagal's 500-page publication "Khimiya i tekhnologiya initsiiiruyushchikh vzryvshchatykh veshchestv" (Chemistry and Technology of Primary Explosives) written in Russian or Hanus's Czech publication "Méně známé třaskaviny" (Lesser Known Primary Explosives).

Given all the above, the authors of this publication decided to summarize the information on primary explosives included in the sources mentioned above. The information given is not restricted to the traditional primary explosives used in numerous applications, but there is also information on the latest trends and substances which are currently the subject of research and development projects, which are regarded as being potentially useful in the future. The publication also contains some information on primary explosives which are frequently produced illegally by nonprofessionals. Their inclusion represents the authors' intention to provide accurate information on this group of substances, for which the general public, and even the experts, find rather fanciful, distorted, and false information in the mass media and on the Internet. Being chemical engineers, we could not resist the temptation to include also a few substances which are unlikely to be used practically in the future but whose properties are so interesting that omitting them would be unforgiveable.

The publication has been written for the general public interested in the field of explosive chemical compounds, but especially for chemistry students and teachers, researchers working in the field of explosives, police officers, criminologists, forensic analysts, soldiers, engineers working in the production of initiators, rock blasters, and others who are likely to come across primary explosives in their various forms in their professional lives. A basic knowledge of chemistry at a secondary school level may be of great benefit to the reader; however, even a complete layman may learn a lot about the properties, methods of preparation, or use of individual substances. Ideally, the publication should assist in achieving a deeper understanding of the role of primary explosives, helping to demystify their extreme sensitivity and dangerousness, and providing precise definitions, enhancing understanding of the historical context of their development and outlining the potential future use of this group of substances.

With the exception of the first two chapters dealing with general performance and sensitivity properties of primary explosives, the structure of the publication is rather simple, each chapter covering a group of substances. The chapters which follow are consistently subdivided and include information on the discovery of the substance, sometimes including a few anecdotal or historical pieces of information, followed by a summary of physical, chemical, and explosive properties, a brief description of methods of preparation and a final part giving information on its usage. We have not sought to discuss special properties in great detail. We aimed to summarize what we consider to be most important and we paid special attention to

thorough referencing to enable the reader easily to find detailed information in the available literature sources. Detailed instructions are not provided for individual syntheses; methods resulting in individual substances are highlighted. In places, where necessary, the topic has been discussed in more detail; in others, it has been simplified. However, it is always rather easy to find the original source, including all details, using the references. To make the rather technical text more user-friendly, we decided to accompany it with photographs of a number of the substances discussed. In most cases, these are the authors' unpublished photographs of products made or supplied by the authors and which cannot therefore be found in the available literature.

In conclusion, let us express our gratitude and thanks to all who supported the development of this project. Without their help, its creation would not have been possible. We would like to thank especially Prof. How-Ghee Ang, director of the Energetics Research Institute, Nanyang Technological University in Singapore, who had the original idea to create such a work and who generously supported the writing of the book throughout the first year of its preparation. We would also like to thank Prof. Svatopluk Zeman, director of the Institute of Energetic Materials, University of Pardubice, Czech Republic for his support in the second stage of its development, especially for creating an inspiring environment for completing the publication. Further, thanks to Mr. Jiří Strnad, in memoriam, for providing valuable and unpublished information, which significantly enhanced the chapter on Explosive Properties of Primary Explosives.

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