



EDITOR-IN-CHIEF'S WORD

Dear Readers,

It is my pleasure to introduce a new edition of *Engineering Power*, which addresses the complex and technically demanding field of explosives — an area that lies at the intersection of fundamental science, engineering practice, safety considerations, and environmental responsibility.

The contributions in this issue exemplify how modern computational methods and meticulous experimental work complement one another: numerical modelling helps narrow down viable formulations and scenarios, while targeted experiments validate these models and uncover practical limitations. This synergy is essential for developing solutions that meet stringent safety standards while delivering the performance demanded by industry and large-scale infrastructure projects. The work presented here clearly demonstrates the Academy's growing role in tackling challenges that are both technically complex and socially significant.

Editor-in-Chief

Vedran Mornar, President of the Croatian Academy of Engineering



EDITOR'S WORD

Dear Readers,

The first issue of *Engineering Power* in 2025 was edited by Prof. Mario Dobrilović, PhD, from the University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering. The articles in this issue are dedicated to the topic of explosives and cover the prediction of explosives performance, new secondary explosives and oxidising agents, and modelling of soil density zones in the vicinity of an explosive charge. There is also an overview of the 55th Ordinary Annual Assembly of the Croatian Academy of Engineering and the 3rd Mini Scientific and Professional Conference which was held as part of the Assembly. I hope you enjoy reading this issue.

Editor

Bruno Zelić, Vice- President of the Croatian Academy of Engineering



FOREWORD

Dear Readers,

Explosives are energetic materials that undergo extremely rapid chemical decomposition, releasing large amounts of energy. Their properties range from highly brisant military explosives to insensitive military explosives and safe civil emulsion explosives. Beyond military uses, probably more significant application is civilian: explosives enable the mining of large quantities of coal and metallic and non-metallic ores and make possible the fragmentation and movement of vast volumes of material required by major infrastructure, energy and transportation projects.

The foundations of detonation theory were established relatively recently — principally during the 1940s and throughout World War II. The so-called “ideal” military explosives are chemically pure, often monomolecular compounds discovered near the end of the nineteenth century and deployed extensively during the two world wars. In contrast, commercial (civil) explosives were developed primarily after World War II to meet growing demands for raw materials and economic development. Today's civil explosives are predominantly heterogeneous mixtures whose individual components are not explosive in themselves; their detonation behaviour does not fully conform to classical ideal detonation theory, which makes their modelling a still challenging task.

Explosives remain energetic materials with modest heat content per unit mass but extraordinarily fast detonation processes that concentrate energy over microsecond timescales, producing pronounced destructive effects. Advances in computational power now permit thermochemical and hydrodynamic (hydrocode) modelling of new formulations — both monomolecular and mixtures — to assess their likely performance and practical usefulness prior extensive experimental testing. For example, Professor Klapotke's successful synthetic approaches have been documented along with the detonative property modelling carried out using a domestic thermochemical code developed by Professor Sućeska.

Although the primary use of civil explosives is rock fragmentation, their application in soils is also important. Modelling studies that compare numerical predictions with experimental measurements in clayey soils — using non-ideal commercial explosives — help to validate models and improve predictive capability for ground-coupled blasting scenarios.

Where is explosive technology heading? Military research continues to seek compounds that detonate faster and generate higher pressures and temperatures to maximize destructive effect while improving safety and insensitivity to accidental initiation. Civil formulations, meanwhile, are being driven toward safer, more environmentally acceptable compositions that still deliver required performance at acceptable cost. Explosives will remain indispensable in the future; the hope is that their future role will shift from military to more civilian applications, including advanced sectors such as space technology.

Guest Editor

Mario Dobrilović, University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering