

# **Explosion Hazards in the Process Industries**

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*To my dear wife Astrid for her everlasting love and support,  
to our five grandchildren Gunhild, Sigurd, Johanne, Elias  
and Maren, to the precious memory of the two, Åshild and  
Nora, who we so sadly lost, to the one that is on its way, and  
finally to those who we hope are still to come! The words in  
Isaiah 42.16 have continued to give me hope and courage.*

# Preface

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My very first contact with the area of industrial explosion hazards was during my post graduate studies at King's College, London 1966–68. In the early 1970s, Norwegian process industries experienced a series of serious dust explosions, which faced me with the challenge of establishing dust explosion prevention and mitigation as a new field of research and consultancy in Norway, based at the Christian Michelsen Institute in Bergen. A few years later, when the oil and gas industry on the Norwegian continental shelf evolved at great pace, I was faced with the further challenge of starting up CMI's comprehensive research program on prevention and mitigation of accidental gas explosions.

In 1991 I approached the University of Bergen (UoB) to discuss the possibility of establishing process safety technology as a new field of teaching and research there. I was appointed part-time professor in 1992 and full-time professor in 1996, with my activity based in the Department of physics and technology. While building up my own activity at UoB, I was also taking a central role in establishing a common framework program of process technology at large within our faculty of mathematics and natural sciences. We were convinced that our candidates should build their process safety studies on a basement of general process technology (chemical engineering). The final result of a joint effort by many people is a complete five-year study program in process technology, comprised of a three-year bachelor program providing the general basis, followed by a two-year master program providing the specialities. Process safety technology is one of several options for the master studies.

During my time as part-time professor, I developed a short course on "Electrical apparatuses for hazardous areas", published as a 160-page basic textbook in Norwegian (Tapir, Trondheim, 1996). After joining UoB full time I used this book as a central element in a basic bachelor-level course on explosion hazards in the

process industries but I then had to hand out supplementary material on case histories and prevention/mitigation. I therefore decided to write a complete textbook, comprising all the material needed for this course. Since the book might also be useful outside Norway, I chose to write it in English.

Whereas the present book covers accidental gas/vapor, spray/mist, dust, and explosives/pyrotechnics/propellants explosions it does not treat various types of accidental physical explosions, BLEVEs and explosions due to run-away chemical reactions.

It is my plan to produce a Powerpoint presentation covering the material in this book, with some of the photographic material in color, and with additional illustrative material. This will primarily be for my own use, but such a presentation may also be helpful for other teachers wanting to use my book in their classes. At UoB we are also building up a set of about ten laboratory-scale experiments on initiation and propagation of gas and dust explosions, which the students shall have to carry out and report on in writing as part of the course.

I am deeply grateful to the companies, research institutions, standardization organizations, publishers etc., that granted permissions to use some of their valuable material for the book, and to the many skilled persons, not least some of my students and colleagues at UoB, for providing valuable information and advice.

—Rolf K. Eckhoff

## About the Author

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Rolf K. Eckhoff is professor of process safety technology in the department of physics and technology, at University of Bergen, Norway, concurrent professor at Northeastern University, Shenyang, China, and scientific adviser at Øresund Safety Advisers AB, Malmö, Sweden. He is the author of “Dust Explosions in the Process Industries” first published 1991. An extended third edition (720 pp) appeared in 2003. He is also the author and co-author of more than eighty technical and scientific publications and more than 130 research reports. He has advised industry on numerous occasions, and lectured to courses, conferences, and seminars in a number of countries in Europe and in Bahrain, Israel, China, India, Australia, Canada, and the United States.