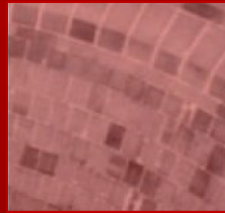


François Cardarelli

Sulfuric Acid Digestion, Sulfuric Acid Baking, and Sulfation Roasting in Mineral and Chemical Processing, and Extractive Metallurgy



François Cardarelli

**Sulfuric Acid Digestion, Sulfuric
Acid Baking, and Sulfation
Roasting in Mineral and Chemical
Processing, and Extractive
Metallurgy**

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Units Policy

In this monograph all the units of measure used for describing physical quantities and properties were those recommended by the *Système International d'Unités* (SI) except in some few instances where some units from the *US Customary System* (USCS) are used in conjunction. For accurate conversion factors between these units and the other non SI units (e.g., cgs, fps, Imperial, and US customary systems) please refer to the reference book of the same author:

CARDARELLI, F. (2005) *Encyclopaedia of Scientific Units, Weight and Measures. Their SI Equivalences and Origins*. Springer, New York, London, xxiv, 848 pages; ISBN 978-1-85233-682-0.

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2008-2010 Recycling manager, 5N Plus Inc., Ville Saint-Laurent (Quebec), Canada, in charge of the recycling of end-of-life cadmium telluride (CdTe) thin-film photovoltaic solar panels and the hydrometallurgical recovery of tellurium and cadmium.

2007-2008 Principal electrochemist, Materials and Electrochemical Research (MER) Corp., Tuscon (Arizona), USA, working on the electrowinning of titanium metal powder from composite Ti_2OC anodes in molten salts, and other materials-related projects.

2000-2007 Principal chemist (materials), technology department, Quebec Iron and Titanium (QIT) now Rio Tinto, Sorel-Tracy (Quebec), Canada, invented the electrowinning of titanium metal from molten titanium slags and on other novel electrochemical processes.

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1990-1992 Research scientist, Laboratory of Electrochemistry (Université Pierre & Marie Curie, Paris, France) for the development of a beta nuclear scintillation detector used for electrochemical experiments involving radiolabelled compounds.

"The true university of these days is a collection of books"

Thomas Carlyle

Preface

This monograph is primarily intended to serve as a concise review of the industrial utilization of sulfuric acid and the plethora of sulfation techniques used extensively in the mineral, chemical, and metallurgical industries across the world for more than two centuries.

The information has been presented in such a form that industrial chemists, chemical engineers, and other practicing engineers, scientists, professors, and technologists will have access to relevant scientific and technical information supported by key data gathered from several disseminated sources along with a brief description of each major industrial processes, and novel sulfation technologies that might be implemented commercially in the near future.

I hope this monograph will be of value also to men and women engaged in other branches of chemistry and metallurgy that want to understand these techniques outside their field of expertise.

Finally, the monograph may be of interest to persons in the chemical and metal industries occupying nontechnical positions such as executives, patent attorneys, traders, purchasing agents, salesmen and women, to whom a general knowledge of the technical aspect of their business would be helpful.

Montréal, Québec, Canada

François Cardarelli, December 2022

Dedication

To my former colleague and friend the late Dr. Michel GUÉGUIN who devoted his entire career to invent, patent, implement, and improve the sulfation and chlorination techniques used extensively across the titanium dioxide pigment industry and also to all the men and women who as chemists, engineers, scientists, and technologists from the mineral, chemical, and metallurgical industries devoted their career to invent, devise, implement, and improve industrial sulfation techniques.

Acknowledgements

I want to express my deepest thanks to my late mother Claudine, my father Antonio who together with my late uncle Consalvo supported me in the early 1980s in establishing a basic mineralogical, chemical, and metallurgical laboratory, and scientific library. It is during this period that I was first acquainted with the sulfuric acid digestion, the high pressure sulfuric acid leaching inside an autoclave, and the sulfation roasting of several minerals and ores originating from France (Ardèche) and Italy (Dolomites).

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About the Author



Dr. François Cardarelli, President and Owner of the Canadian company *Electrochem Technologies & Materials Inc.*, is an industrial chemist with a strong physical-chemistry background and a doctorate in chemical engineering from the University Paul Sabatier (UPS) Toulouse III, and he is the inventor and co-inventor of 14 patents, and the sole author of three reference handbooks published worldwide by Springer since 1996.

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François Cardarelli

Sulfuric Acid Digestion, Sulfuric Acid Baking, and Sulfation
Roasting in Mineral and Chemical Processing, and Extractive
Metallurgy



This monograph is primarily intended to serve as a concise review of the industrial utilization of sulfuric acid and the plethora of sulfation techniques used extensively in the mineral, chemical, and metallurgical industries across the world.

The information has been presented in such a form that industrial chemists, chemical engineers, and other practicing engineers, scientists, professors, and technologists will have access to relevant scientific and technical information supported by key data gathered from several disseminated sources along with a brief description of each major industrial processes, and finally novel sulfation technologies that might be implemented in the near future.

This monograph will be of value also to men and women engaged in other branches of chemistry and metallurgy that want to understand these techniques outside their field of expertise.

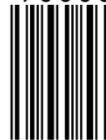
The following topics are covered

- Physical and chemical properties of sulfuric acid and oleums;
- Corrosion resistant materials;
- Thermochemistry of sulfation reactions;
- Industrial sulfation processes;
- Novel sulfation processes;
- By-products, effluents, and wastes;
- Concentration and regeneration of sulfuric acid;
- Prototype and pilot testing;
- Appendices.

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