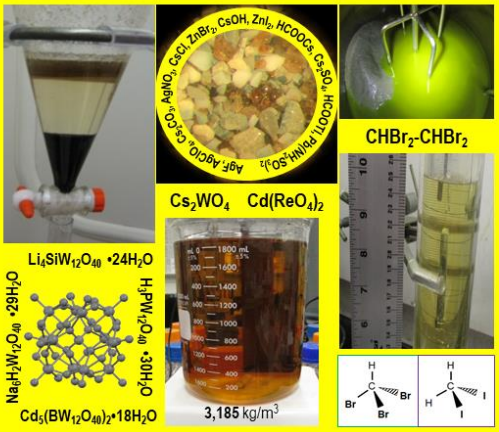
FEBRUARY 2026

CHEMISTRY | METALLURGY | MATERIALS SCIENCE

François Cardarelli

Heavy Liquids for the Separation of Minerals:
Their Preparation, Properties, and Uses



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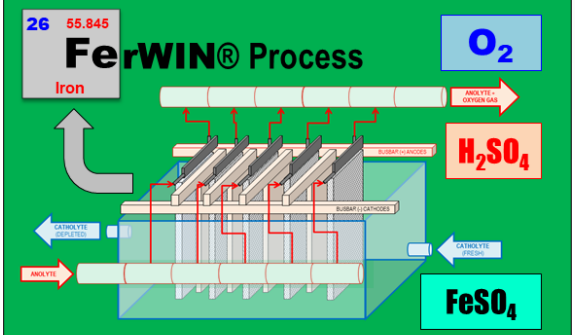
Electrowinning Iron and Recycling Sulfuric Acid from Iron Sulfates: A Zero-Carbon Iron-Making Process



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

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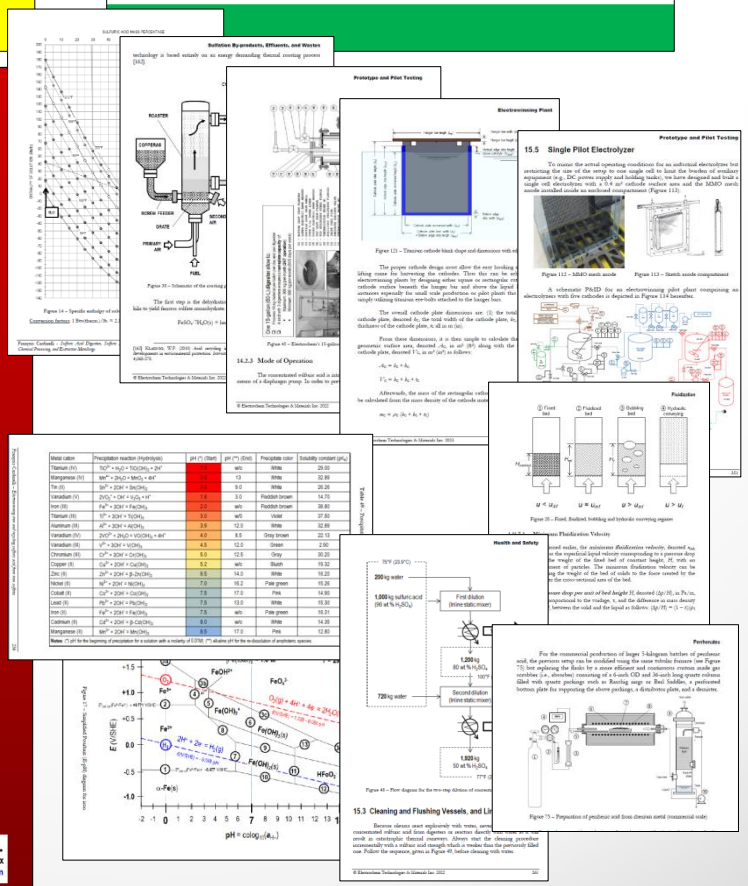

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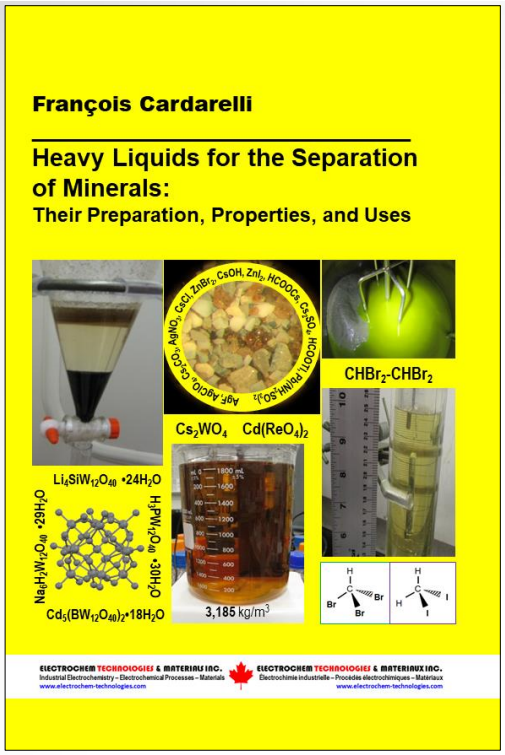


Heavy Liquids for the Separation of Minerals: Their Preparation, Properties, and Uses

Author: **François Cardarelli**
Publisher: Electrochem Technologies & Materials Inc., Montreal
Pages: xxiv, **537** pages, **285** tables, **76** figures B/W and Color
Format: 6 inches x 9 inches (15.24 cm x 22.86 cm)
Publication: March 24, **2025**

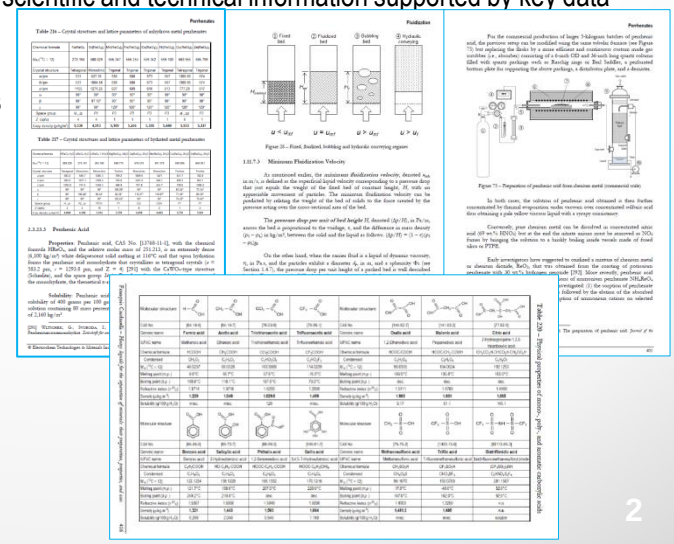
ISBN 978-1-7775769-6-7 Softcover
ISBN 978-1-7775769-8-1 Hardcover
ISBN 978-1-7775769-7-4 eBook

This monograph describes the main physical and chemical properties of heavy organic liquids, dense aqueous solutions of inorganic salts, and heavy suspensions used in mineralogy, gemology, mining, metallurgy, and chemistry for the separation by gravity of minerals, metallic ores, graphite, coal macerals, fossils, diamonds and gemstones along with plastics, glass, ceramics and other synthetic materials.
Moreover dense solutions of cesium and rubidium salts used in biology for the separation of nucleic acids, and other biological molecules by centrifugation using density gradients are also described.

For several heavy liquids, it provides a detailed description of the laboratory methods, and industrial processes utilized for their preparation along with the most efficient recovery and recycling techniques. Moreover, when available the occupational health and safety information for toxic and hazardous chemicals used as heavy liquids is also provided to ensure safe practices in the work place.

Finally, their potential utilization in others fields such as X-ray and radiography contrast agents, radiation shielding agents, non-destructive testing, water-in-salt electrolytes for energy storage applications, oil drilling fluids, ballasts and counterweights due to their high density are described. The information has been presented in such a form that mineralogists, chemists, geologists, paleontologists, biologists, metallurgists, mineral processing engineers, scientists, professors, and technologists will have access to relevant scientific and technical information supported by key data gathered from several disseminated sources.
The following topics are covered:

- ❑ Dense media separation of minerals and ores
- ❑ Sink-float method, elutriation, centrifugation;
- ❑ Heavy halogenated organic solvents;
- ❑ Dense aqueous solutions of inorganic salts:
- ❑ Dense salts in non-aqueous solvents;
- ❑ Deuterated solvents and solutions;
- ❑ Dense molten salts and eutectics;
- ❑ Suspensions of heavy solids;
- ❑ Liquid metals and low melting point alloys;
- ❑ Non-conventional heavy liquids;
- ❑ Other uses;
- ❑ Appendices;
- ❑ Bibliography.



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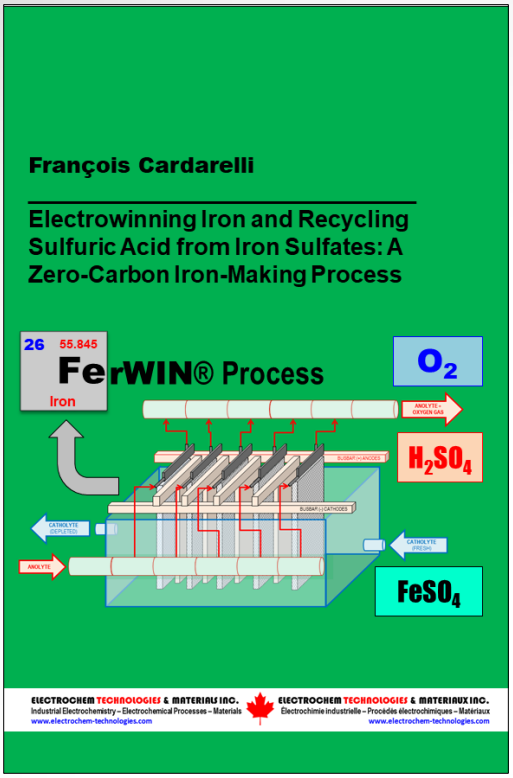


Electrowinning Iron and Recycling Sulfuric Acid from Iron Sulfates: a Zero-Carbon Iron-Making Process

Author: **François Cardarelli**
Publisher: Electrochem Technologies & Materials Inc., Montreal
Pages : xxviii, **471** pages, **181** tables, **140** figures B/W and Color
Format: 6 inches x 9 inches (15.24 cm x 22.86 cm)
Publication: November 7, **2023**

ISBN 978-1-7775769-3-6 Softcover
ISBN 978-1-7775769-5-0 Hardcover
ISBN 978-1-7775769-4-3 eBook

This comprehensive monograph is primarily intended to describe the patented **FerWIN® technology**, a green and zero-carbon iron-making process, which consists to perform the electrowinning of iron metal and the recycling of sulfuric acid from iron sulfates that are by-produced at the million tons scale worldwide while releasing pure oxygen gas.

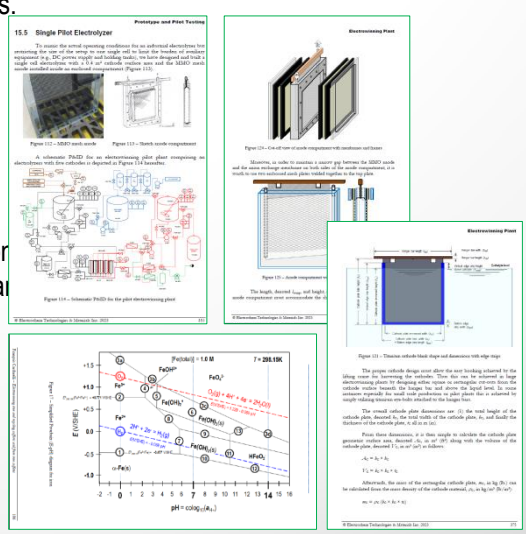
The information has been presented in such a form that industrial electrochemists, chemical engineers, metallurgists, and other practicing engineers, scientists, professors, and technologists will have access to relevant scientific and technical information supported by key experimental data that were obtained from extensive laboratory, prototype, and pilot testing. It also includes comprehensive electrochemical and engineering calculations, costs and benefits analysis, financial and sensitivity analysis.

This monograph will be of value also to men and women engaged in the traditional iron and steelmaking industries that want to understand this novel electrochemical technology outside their conventional blast furnace, direct reduced iron, and electric arc smelting processes.

Finally, the monograph may be of interest to persons in the steelmaking industries occupying managerial positions such as chief executives, chief operating officers, and V.P. of operations.

The following topics are covered:

- ❑ Background, markets, and prior art;
- ❑ Electrochemical definitions;
- ❑ Thermochemistry of electrochemical reactions;
- ❑ Transport phenomena; Electrode kinetics;
- ❑ Electrochemical figures of merit; Electrochemical calculation
- ❑ Selection of electrolytes, industrial electrodes, and membra
- ❑ Electrochemical reactor design and performances;
- ❑ Industrial electrowinning plant calculations;
- ❑ Prototype and pilot testing;
- ❑ Costs and benefits analysis;
- ❑ Financial and sensitivity analysis; Implementation strategy;
- ❑ Bibliography; Appendices; Index.



ELECTROCHEMISTRY | CHEMICAL ENGINEERING

CHEMISTRY | METALLURGY | MINERAL PROCESSING

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

Author: **François Cardarelli**
Publisher: Electrochem Technologies & Materials Inc., Montreal
Pages : xvi, **285** pages, **93** tables, **76** b/w figures
Format: 6 inches x 9 inches (15.24 cm x 22.86 cm)
Publication: December 17, **2022**

ISBN 978-1-7775769-0-5 Softcover
ISBN 978-1-7775769-2-9 Hardcover
ISBN 978-1-7775769-1-2 eBook

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.

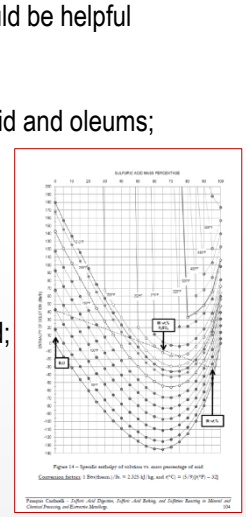
The information has been presented in such a form that industrial chemists, chemical engineers, and other practicing engineers, scientists, professors, and technologists will have access to relevant scientific and technical information supported by key data gathered from several disseminated sources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

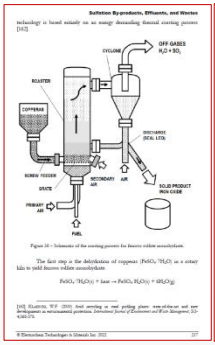
This monograph will be of value also to men and women engaged in other branches of chemistry and metallurgy that want to understand these techniques outside their field of expertise.

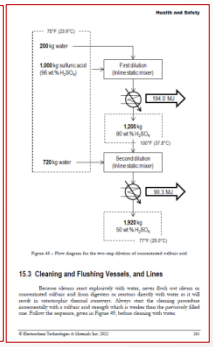
Finally, the monograph may be of interest to persons in the chemical and metal industries occupying nontechnical positions such as executives, patent attorneys, traders, purchasing agents, salesmen and women, to whom a general knowledge of the technical aspect of their business would be helpful

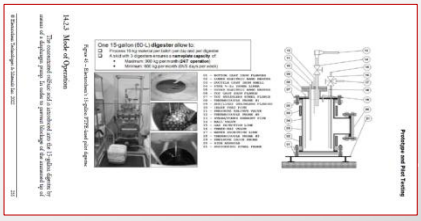
The following topics are covered:

- ❑ 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;
- ❑ Health and safety;
- ❑ Economic data;
- ❑ Appendices;
- ❑ Index.









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