

# wim2010

**Proceedings of the 2nd International  
Congress on Water Management in  
the Mining Industry**

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EDITOR Jacques Wiertz

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Gecamin is a private, Chilean company created in 1998 that annually organises international technical events with the aim of informing and inspiring mining industry professionals, fostering the exchange of information, and sharing best practices and new technologies applied in mining. The goal of each conference is to bring together engineers, scientists, researchers, managers and operators to enable a focused discussion on the latest developments and innovations with the ultimate purpose of establishing interdisciplinary networks of research and knowledge exchange. Through these conferences and training programmes Gecamin seeks to help the industry to openly address its most pressing concerns and find more sustainable solutions.

Gecamin organises seminars in partnership with institutions of strong technical excellence in mining such as the Universidad de Chile, the Pontificia Universidad Católica de Chile, the Universidad de Concepción, Chile, the Universidad Técnica Federico Santa María, The University of Western Australia and The University of Queensland, Australia, among others.

In 12 years of operation, more than 12,000 professionals have attended our events and have been trained in areas of paramount importance to the mining industry. These areas include the following: Geology, Mining Unit Operations, Mine Planning, Mineral Processing, Hydrometallurgy, Paste and Thickened Tailings, Mine and Plant Maintenance, Automation and Control, Water and Energy Management in Mining, Mine Closure, Environmental and Social Impacts Assessment.

Each event organised by Gecamin features a great diversity of technical papers presenting case studies, applications as well as theoretical research and scientific findings. Every conference is documented by the proceedings containing carefully selected peer-reviewed papers. Prominent industry experts and academics bring their knowledge and experience to our events ensuring high standards of the proceedings and the technical programmes.

The next few years are expected to bring a much more positive economic outlook, allowing mining companies worldwide to activate or reconsider alternatives for greenfield and brownfield projects. Sustainability, water in mining and efficient energy use will remain the key focus areas throughout the major part of the industry. For this reason, Gecamin believes it is of great importance to share experiences and discuss alternatives and opportunities for improving operational processes and best practices with colleagues from around the world.

Learn more about our events by visiting [www.gecamin.cl](http://www.gecamin.cl)

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## FOREWORD

I invite you to read this book, prepared thanks to the contributions of the outstanding professionals who participated in the 2nd International Congress on Water Management in the Mining Industry WIM 2010, held from 9 to 11 June in Santiago, Chile.

The WIM conferences are a very unique opportunity for professionals and specialists to become acquainted with state-of-the-art technologies, best practices and future challenges involving water in mining around the world. The quality of the presentations, the data and the conclusions of each paper demanded a noteworthy effort to put together and are of great value to all of us.

The mining sector in Chile has been very proactive regarding the use of water in their operations and has clearly taken the lead. In fact, during the year 2000, a Clean Production Agreement was voluntarily signed by the mining companies-members of the Chilean Mining Council. This agreement includes voluntary commitments for water efficiency and consumption, energy efficiency per production unit, reduction of greenhouse gas emissions, industrial solid and liquid waste management, acid drainage and mine closure management.

In 2008, this agreement was audited by an independent auditing company with the following results: In 2000, the average national water consumption in the mining sector was 90.98 cubic metres per metric tonne of copper; by 2006, the number was reduced to 60.72, which implies a reduction of 33% over six years. If we take the water consumption of different metallurgical processes, we can conclude that copper concentrates showed a reduction of 0.81 cubic metres per tonne (a 26.4% reduction from the year 2000), and hydrometallurgical processes showed a reduction of 0.14 cubic metres per tonne (a 53.3% reduction).

In Chile, the majority of the mining operations are located in the most arid desert in the world, making water one of the key issues to continue exploring, operating and planning for future projects. For this reason, Chile's mining industry faces the issue with great responsibility and is promoting new technologies for water exploration, higher recirculation, more efficient use and new water sources.

Securing a long-term, sustainable water supply is going to be one of the most important challenges for us in the future. It is imperative that all of us work and think together —government, communities and companies— in order to provide innovative and smart solutions.

World leaders should foster initiatives aimed at increasing water efficiency and new water sources, including, but not limited to, desalination, sustainable management of watershed, deep groundwater reserve management, ways to minimise losses in distribution systems, incentives for efficient water use, effluent water characterisation and treatment for recirculation, all coupled with the challenges of climate change.

This matter is a major challenge for Chile and the world. Water will be a highly demanded natural resource in an environment with

**Francisco J. Costabal**

**CHAIRMAN**  
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restricted water supply. Therefore, any efforts that we can make today to prevent future conflicts by providing guidance for sustainable solutions are crucial in facing our planet's water challenges.

Mining is responsible for less than 2% of water consumption in countries like Chile, Australia and South Africa. Nevertheless, we can play a key role in transferring technology and management practices to other businesses around the world.

This Water in Mining Congress in Chile is an excellent window to review our status and compare it with the reality in other countries. It is also a chance to look for new ideas as well as new research and development opportunities.

We hope all participants of this Congress had an enjoyable stay in Chile and a very productive three days working together with top specialists in matters related to water in mining.

## PREFACE

### Protecting water quality – reconstituting the natural world

Water, once considered a never ending, easily available and manageable resource, has now emerged as one of the most important environmental concerns for the mankind, in general, and for the mining industry, in particular. In several countries mining activity takes place in arid and semi-arid regions where water threatens to become a limiting factor for the development and even the survival of the mining operations. During the last years, the industry efforts have been focused on efficient water use throughout the different mining and metallurgical processes. These efforts have not always been recognised by the community and are in part offset by the inevitable, gradual but continuous decrease of ore grades. Even in regions where water is not yet considered a scarce resource, the impact of mining on natural water quality and availability for alternative uses is one of the major concerns for the surrounding community.

Aside from the technical efforts to reduce water consumption, the mining industry has adopted a different strategy towards the so called “social licence to operate”. A responsible, sustainable and transparent water management, recognised as such by the stakeholders, is a key factor of this emerging strategy. This requires the development of efficient water management tools focused on sustainable supply, efficient use and quality protection of water in mining projects. The traditional water balance has been gradually replaced by a true water accounting across the whole mining and metallurgical process, which lays the basis for building sustainable water management. The cumulative impacts of water management are also an emerging issue that requires special attention.

When it comes to water supply, the mining industry is committed to achieving a better understanding and management of natural water resources at watershed scale. Sea water desalination, or the direct use of sea water as process water, also represent interesting water supply alternatives. However, the energy required for both the desalination process and the water transport from sea level up to the project location may also entail indirect but significant environmental impacts.

The characterisation and treatment of complex mining effluents are no longer inaccessible technological challenges, and new efficient processes have been developed that are now being tested at the industrial level.

The 45 peer-reviewed technical papers and four keynote presentations, written by authors from 13 countries and included in these proceedings, reflect the mining industry’s efforts to improve water management methodologies addressing such concerns as limited use, rights, access, distribution and community involvement. It should be of interest to all the professionals involved in the design and operation of mining projects and in particular to those committed to adopting sustainable water management practices.

**Jacques Wiertz**

**HEAD EDITOR**  
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- Mr. Francisco J. Costabal, Congress Chairman, for his great enthusiasm and continuous support, despite his very busy agenda.
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- The Gecamin team for their meticulous planning, hard work, professionalism and continuous commitment to making this conference a success.
- Technical and Advisory Committees for their helpful advice and assistance in promoting the conference.
- And to you, readers and participants, whose interest and enthusiasm made this event possible and the whole experience extremely rewarding and enriching.

We truly hope that with your support the Water in Mining congress series will continue to be an important venue for discussing innovations that improve water use efficiency, and help us preserve and protect this much valued resource.