Lead-Zinc 2000 Symposium &The Fourth International Symposium on Recycling of Metals and Engineered Materials

	Sunday-October 22	Monday-October 23		Tuesday-October 24		Wednesday-October 25	
	PM	AM	PM	AM	PM	AM	PM
Mezz-anine Foyer	Registration 12:00NOON-6:00PM	Registration 7:00AM-5:00PM		Registration 7:00AM-5:00PM		Registration 7:00AM-10:00AM	
Chartiers		Slide Preview 7:00AM-5:00PM		Slide Preview 7:00AM-5:00PM		Slide Preview 7:00AM-5:00PM	
Rivers		Authors Coffee 7:30AM-8:30AM		Authors Coffee 7:30AM-8:30AM		Authors Coffee 7:30AM-8:30AM	
LeBateau	Welcoming Reception 6:00PM-8:00PM	***Recycling*** Consumer Battery Recycling	***Recycling*** Aluminum By-Product Recovery	***Recycling*** Precious Metals Recycling	***Recycling*** Electronics/ Plating By-Products Recycling	***Recycling*** Refractory Recycling	***Recycling*** Magnesium Recycling
Kings Gardens	Welcoming Reception 6:00PM-8:00PM	***Recycling*** Aluminum Recycling - Introduction	***Recycling*** Aluminum Scrap Recycling - I Scrap Preparation and Processing	***Recycling*** Automotive Materials Recycling	***Recycling*** EAF Dust Processing - I	***Recycling*** EAF Dust Processing - II	***Recycling*** EAF Dust Processing - III
Kings Terrace			***Recycling*** Secondary Zinc				
Brigade		***Recycling*** General Recycling	***Recycling*** Secondary Copper, Nickel, and Cobalt - I	***Recycling*** Secondary Copper, Nickel, and Cobalt - II	***Recycling*** Secondary Lead - I	***Recycling*** Secondary Lead - II	***Recycling*** Spent Catalyst Recycling
Ballroom 1		***Recycling*** Plenary Session		***Recycling*** Aluminum Scrap Recycling - II Melting Technology	***Recycling*** Aluminum Dross Processing	***Recycling*** Aluminum Scrap Recycling - III Quality Considerations in Recycling	***Recycling*** Aluminum Scrap Recycling - IV Process Analysis
Ballroom 3		***Lead-Zinc*** Plenary Session Global Factors Affecting Lead and Zinc	***Lead-Zinc*** Session 2 - Modern Lead Smelting Technologies I	***Lead-Zinc*** Session 4 - Modern Lead Smelting Technologies II	***Lead-Zinc*** Session 6 - Imperial Smelting Technologies	***Lead-Zinc*** Session 8 - New Developments in Lead and Zinc	***Lead-Zinc*** Session 10 - New Electrowinning Technologies for Lead and Zinc
Ballroom 4		***Lead-Zinc*** Plenary Session Global Factors Affecting Lead and Zinc	***Lead-Zinc*** Session 3 - Zinc Operations I	***Lead-Zinc*** Session 5 - Zinc Operations II	***Lead-Zinc*** Session 7 - Zinc Electrowinning	***Lead-Zinc*** Session 9 - New Zinc Processing Technologies	***Lead-Zinc*** Session 11 - Environmental Aspects of Lead and Zinc Production

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Lead Zinc 2000

Fourth International Symposium on Recycling of Metals and Engineered Materials

Lead-Zinc 2000 Symposium Technical Program

Session 1 – Global Factors Affecting Lead and Zinc

Monday AM 9:00 AM – 12:00 Noon
October 23, 2000 Location: Ballroom 3 & 4

Session Co-chairs: C. Y. Choi, Korea Zinc Company Ltd., 142 Nonhyon-Dong, Gangnam-ku, Seoul, Korea; D. Magoon, Cominco Limited, Trail, British Columbia, Canada V1R 4L8

9:00 AM Opening Comments

9:05 AM
Market Fundamentals and the Evolution of Lead and Zinc Supplies: C. Hassall[1]; H. Roberts[1]; [1]CHR Metals Limited, Hamble House, Meadrow, Godalming, United Kingdom GU7 3HJ

The opening years of the new millennium will be characterised by the closure of many lead and zinc mines because of reserve depletion. However, weak commodity prices through the second half of the 1990s have slowed project evaluation and have made it difficult to raise finances for the development of new mines required to replace lost output and to meet increasing demand for metal in the future. Growth of lead and zinc demand will be determined by the pace of global economic activity, especially in the emerging economies. How rapidly demand grows will have a key bearing on the possible shortfall in mine output and the response of prices to the implied tightening of metal supplies early in the new millennium. These issues are the focus of a discussion of the critical lead and zinc supply developments which will unfold post 2000, taking into account project lead times and the role that recycled metal plays in meeting market demand.

9:40 AM
Lead Product Development in the Next Millennium: R. D. Prengaman[1]; [1]RSR Technologies, Inc., 2777 Stemmons Freeway, Suite 1800, Dallas, Texas, U.S.A. 75207

Lead usage in paint, anti-knock gasoline additives, pipes, seals, and solder has declined markedly over the past 30 years. Products utilizing the unique properties of lead and its ability to be recycled have survived and grown. These products include shielding, glass (particularly TV and computer screens), sheet for roofing, stabilizers for PVC, insoluble anodes for metal production, electronic solders and lead acid batteries. With the loss of markets many companies have decreased lead product development efforts. Much of the patent lead materials development is devoted to lead acid batteries. In the past 25 years, the automobile battery has been almost doubled in power and reduced in weight, leading to a nearly three-fold increase in performance. Corrosion-resistant lead alloys and improved battery designs have made battery lead usage more efficient. The same corrosion-resistant battery alloys are utilized to increase the life of electrowinning anodes. The challenge for lead product development is not only to maintain and improve the existing lead products, but also to develop the growing lead acid battery market for telecommunications, uninterruptive power sources, remote area power, hybrid and electric vehicles.

10:15 AM Break

10:45 AM
Zinc Applications: A World of Performance: E. Gervais[1]; [1]International Zinc Association, Avenue de Tervueren, 168/Box 4, B-1150 Brussels, Belgium

Modern life in inconceivable without zinc. Zinc provides the most cost-effective and environmentally efficient method of protecting steel from corrosion. Zinc is also used to power electric vehicles and computers, to make brass, automotive equipment, household appliances, fittings, tools and toys, and to support the building and construction industries. It is also used in pharmaceuticals and cosmetics, in rubber, in fertilisers and in animal feeds. The links between properties, applications and performance, as well as zinc demand and market dynamics, will be reviewed along with market development opportunities and successes. The presentation will also include a progress report on the five-year plan of the International Zinc Association to increase the global market for zinc, over and above the natural growth, by 500,000 tonnes/year by 2002.

11:20 AM
Lead and Zinc: A Study of Toxicological Contrasts and Shared Regulatory Concerns: C. J. Boreiko[1]; [1]International Lead Zinc Research Organization, Inc., P.O. Box 12036, Research Triangle Park, North Carolina, U.S.A. 27709

Traditional patterns of lead and zinc utilization are being evaluated in accordance with new paradigms that seek to ensure the long-term compatibility of global industrial activity with precepts of sustainable development and sustainable consumption. As a consequence, both industry sectors are experiencing intense scrutiny from the international community, and numerous regulatory options are being considered that may impact upon international industry practice. This paper reviews the growing expectations being placed upon industry, and highlights some of the common regulatory concerns being expressed regarding both metals despite their differing toxicological profiles.

Session 2 – Modern Lead Smelting Technologies I

Monday PM 2:00 PM – 5:00 PM
October 23, 2000 Location: Ballroom 3

Session Co-chairs: P. J. Moor, Britannia Refined Metals, Botany Road, Northfleet, Kent DA11 9BG England; V. Ramachandran, Asarco Service Center, 3422 South 700 West, Salt Lake City, Utah, U.S.A. 84119

2:00 PM
Primary Lead Production – A Survey of Existing Smelters and Refineries: A. H.-J. Siegmund[1]; [1]RSR Technologies, Inc., 2777 Stemmons Freeway, Suite 1800, Dallas, Texas, U.S.A. 75207

Since the last survey of lead smelters in 1987, the lead industry has experienced many changes. Technological innovations, in combination with a dramatic shift in the market structure as well as more stringent government regulations, caused major upheavals in many different areas. Therefore, a new survey was performed to review the progress in the technology of lead recovery over the least decade. The newly conducted survey reflects all current phases of the world's primary lead production, from charge preparation to refined metal shipment. It was prepared by sending questionnaires to individual companies, and the detailed statistical data of this survey are presented. In considering the data developed from the survey, it should be recognized that the primary lead industry is at a crossroad where novel technologies will gradually substitute the sinter machine-blast furnace operation in the new millennium.

2:25 PM
Operations at the Doe Run Company's Herculaneum Primary Lead Smelter: N. D. Schupp[1]; [1]The Doe Run Company, 881 Main Street, Herculaneum, Missouri, U.S.A. 63048

The Doe Run Company's Herculaneum, Missouri lead smelter has existed in continuous operation since 1892. Throughout the history of the plant extensive developments have been made to improve throughput, increase productivity, decrease operational costs and improve technology, while remaining an environmentally responsible producer of high quality primary lead in the international market. This paper provides an overview of the Herculaneum smelter, focusing on the most recent configuration of the operations. The paper includes discussion on all the aspects of primary lead production at the Herculaneum smelter.

2:50 PM
Modern Lead Smelting at the QSL-Plant Berzelius Metall in Stolberg, Germany: R. Püllenberg[1]; A. Rohkohl[1]; [1]Berzelius Metall GmbH, Binsseldhammer 14, D-52224 Stolberg, Germany

The QSL plant at "BERZELIUS" Stolberg GmbH in Stolberg, Germany was commissioned in 1990, introducing a new era of lead smelting in the more than 150-year-old history of the lead smelter. The lead smelter in Stolberg has changed its appearance several times during its existence. Therefore, at many locations on the site, old and obsolete buildings and equipment parts can still be seen. They are often located side by side with new modern constructions like the QSL-plant and the mercury removal plant, and reflect the specific contrast between tradition and modern technology. After a brief description of the development of the smelter and its decision to implement the current novel plant, the most recent operating results are reported. Following some modifications to the process and equipment, which had become necessary along with the implementation of the new technology, the plant is in operation today at approximately 30% above its design capacity. These achieved production levels are not restricted by the QSL-reactor but by precedent and subsequent available equipment. The QSL-plant entirely complies with the demands of modern, energy-saving, ecologically compatible lead production technology. Stringent environmental standards are maintained on a continuing basis. The demonstrated viability and flexibility of the overall process permits the operation to adapt quickly to the prevailing economical situation worldwide.

3:15 PM Break

3:45 PM
A Review of Ausmelt Technology for Lead Smelting: E. N. Mounsey[1]; N. L. Piret[2]; [1]Ausmelt Limited, A.C.N. 005 884 355, 12 Kitchen Road, Dandenong, Victoria, 3175, Australia; [2]Piret & Stolberg Partners, Im Licht 12, D-47279 Duisburg, Germany

Ausmelt technology is successfully used to process primary and secondary materials to produce lead in large-scale commercial operations and to meet stringent environmental standards. The development and commercial data covering these applications and the results with respect to metallurgical, cost and environmental performance are reviewed in commercial operations. A new smelter is scheduled for commissioning in 2000 at Korea Zinc's Onsan site to process lead fume and other secondary materials to produce 50,000 tonnes per annum of lead bullion. The unique features of Ausmelt technology also allow for the efficient processing of polymetallic concentrates and secondary materials, particularly copper and lead, through the effective separation of these elements into metal, slag and fume species. This capability has been successfully demonstrated at a commercial scale and the results and implications for the industry are discussed.

4:10 PM
Cominco's New Lead Smelter at Trail Operations: D. W. Ashman[1]; D. W. Goosen[2]; D. G. Reynolds[2]; D. J. Webb[2]; [1]Cominco Research, P.O. Box 2000, Trail, British Columbia, Canada V1R 4S4; [2]Cominco Limited, P.O. Box 1000, Trail, British Columbia, Canada V1R 4L8

Cominco Limited operates an integrated zinc-lead complex at Trail, British Columbia, Canada. Central to the successful operation of this complex is the treatment of zinc leach residues through the lead smelter. In 1997, Cominco started up a new lead smelter using KIVCET flash smelting, a state-of-the-art conventional slag fuming furnace, and a new drossing plant. The smelter has fully met the requirements for environmental performance, reduced energy consumption, and lowered labour costs. This paper provides a description of the new smelter and discusses the problems encountered during the start-up, as well as the solutions to those problems. Recent operating results are presented.

4:35 PM
Commissioning and Optimisation of the New Lead and Silver Refinery at the Pasminco Port Pirie Smelter: P. Kapoulitsas[1]; M. Giunti[1]; R. Hampson[1]; A. Cranley[1]; S. Gray[1]; B. Kretschmer[1]; R. Knight[2]; J. Clark[2]; [1]Pasminco Pty. Ltd., Level 7, 380 St Kilda Road, Melbourne, 3004 Australia; [2]Britannia Refined Metals, Northfleet, England

In 1997 Pasminco's Port Pirie Lead Smelter began a modernisation of its lead and precious metals refinery operations. Driven by the anticipated closure of its Broken Hill mine, the new refining process replaced the locally developed continuous process, which had been in operation since the 1950's. Commissioning of the new plant was staged, beginning in late 1997, and finishing early in 1999. The new plant provides for batch refining of lead, and the use of vacuum induction retorting and bottom blown oxygen cupel technology in the silver refining area. The project has resulted in an increase of lead production capacity of 11% and allows the treatment of a wider range of concentrates than was formerly possible. The most significant change has been to double the smelter's silver capacity to over 400 tonnes per annum. This paper describes the successful implementation and optimisation of the new refinery, which is now consistently meeting design capacity.

Session 3 – Zinc Operations I

Monday PM 2:00 PM – 5:00 PM
October 23, 2000 Location: Ballroom 4

Session Co-chairs: E.H. O. Meyer, Zinc Corporation of South Africa, Plover Street, Struisbult, P.O. Box 218, Springs 1560, South Africa; R. Menge, Metaleurop Weser Zinc, Johannastrasse 2, 26954 Nordenham, Germany

2:00 PM
Zinc Production – A Survey of Existing Smelters and Refineries: S. E. James[1]; J. L. Watson[2]; J. Peter[2]; [1]Big River Zinc Corporation, 2401 Mississippi Avenue, Sauget, Illinois, U.S.A. 62201; [2]Department of Metallurgical Engineering, University of Missouri-Rolla, Rolla, Missouri, U.S.A. 65409

A survey of operating zinc smelters and refineries throughout the world has been done in conjunction with the Lead-Zinc 2000 Symposium. This survey follows the examples set by The Japanese Mining Industry Association in 1985 and 1995. Questionnaires were sent to operating zinc plants that covered feed materials, process details, energy consumption and labor requirements. The voluntary responses to the survey were tabulated. Key operating parameters including feed grade, production capacity, quality of the intermediate products and quality of the final products have been compared for both hydrometallurgical and pyrometallurgical processes.

2:25 PM
Use of Data Reconciliation: A Zinc Plant Case Study: T. J. Auping[1]; M. A. Reuter[1]; S. C. Grund[2]; K. Born[3]; [1]TU Delft, Raw Materials Processing, 120 Mijnbouwstraat, Delft 2628RX, The Netherlands; [2]Consultant, Alter Postweg 12, Dorsten 46282, Germany; [3]Ruhr-Zink GmbH, Wittener Strasse 1, Datteln 45711, Germany

Process control, environmental monitoring, budgeting and accounting are based on process data. Without appropriate tools for data analysis, the process data could remain unused and wasted. This paper demonstrates how ***data reconciliation*** can be used as a tool to develop closed mass balances. Mass balances are the initial step in plant optimisation (technical, economical or environmental). From mass balances, fundamental process models can be developed. These balances link process parameters (e.g., feed materials) to process performance (e.g., recovery of valuable elements). Some of these models could find their way into simulators useful to plant operators. Classical regression methods regularly fail when they are applied to complex non-linear problems involving a large number of variables. Alternatively, ***multi-parametrical regression analysis*** can be successfully applied with the aid of neural networks based on reconciled data. Both methods have been applied to plant data originating from the hydrometallurgical zinc plant at Ruhr-Zink, which in this paper serves as a case study. Very promising and useful results were obtained from this study.

2:50 PM
Recent Operations at the Hikoshima Smelter: T. Iwamoto[1]; H. Akiyama[1]; K. Eto[1]; [1]Hikoshima Smelting Co. Ltd., 1-1-1 Nishiyama-cho, Hikoshima, Shimonoseki, Yamaguchi, Japan

The Hikoshima smelter carried out an expansion project in 1997 and increased its production from 59,200 t/y to 71,000 t/y. The leaching process and the casting process had production capacities of 84,000 t/y, but because of the electric power situation in Japan, the production capacity in the electrolysis process was limited to 59,200 t/y to justify the production cost. Electrolysis was the bottle neck of the plant. In order to eliminate a part of this bottle neck, and considering the electric power situation in Japan, a way to increase the production during the time when the electric power rate is low was sought. In practice, we increased the number of cells by 36, and further improved the operation procedures in the cellhouse. For example, we improved the working efficiency of the cells, improved the productivity during the night time, decreased the unit power consumption and improved labor productivity. Accordingly, this paper describes the recent operations at the Hikoshima plant.

3:15 PM Break

3:45 PM
Improvements in the Leaching Circuit of Immsa's Zinc Plant in San Luis Potosí, México: P. Alfaro[1]; C. Moctezuma[1]; S. Castro[1]; [1]IMMSA, Planta de Zinc, C.P. 78180, Apdo. 1305, San Luis Potosí, S.L.P., México

IMMSA operates a conventional roasting-leaching-purification-electrolysis plant for the production of zinc from concentrates in San Luis Potosi, Mexico. The leaching circuit was designed to take into consideration a feed mixture to the roaster with a maximum iron content of 7%. Since the start-up of the plant in 1982, the zinc recovery increased to 94.5%. However, an increase in the iron content in 1997 caused an important decrease in the global zinc recovery. Two new steps were added to the leaching circuit and modifications were made to the other steps in order to increase zinc extraction. Two new automated press filters were installed to replace the original vacuum drum filters and to minimize soluble zinc losses. Additionally, the residue treatment steps in purification were modified and a calcium removal circuit is just starting operation. These actions, besides improving the operations, have as the main objective to increase the global zinc recovery to levels above 94.5%.

4:10 PM
Expansion Plans at CPM's Electrolytic Zinc Refinery: T. Takayama[1]; W. Magalhães[1]; J. Welsh[1]; T. Newton[2]; S. J. Thiele[2]; [1]Companhia Paraibuna de Metais, Br 267, km 119, Igrejinha, 36.001-970, Juiz de Fora, Minas Gerais, Brazil; [2]Egis Consulting Australia Pty Limited, 19th Floor, Central Plaza Two, 66 Eagle Street, Brisbane, Queensland, 4001, Australia

Companhia Paraibuna de Metais (CPM) is presently pursuing a zinc production expansion project. Besides increasing production, the goal of the project is to address existing problems while providing a platform for a proposed twofold increase in production in 2003/2004. Therefore, the current expansion strategy was formulated to address present and future requirements. Computer simulation modeling and full scale plant testing are being used to generate data to optimize the operating conditions and to perform a sensitivity analysis. The initial phase of the project, which will boost CPM's capacity to 86,000 t/y of marketable zinc, is to be completed in September 2000.

4:35 PM
The Boleslaw Electrolytic Zinc Plant: D. Krupka[1]; B. Ochab[2]; J. Miernik[2]; [1]Silesian Technical University, 2A Akademicka Street, 44-100 Gliwice, Poland; [2]ZGH BOLESLAW, 37 Kolejowa Street, 32-332 Bukowno, Poland

The electrolytic zinc plant, with a capacity 75,000 tonnes per year, is part of Zaklady Gorniczo-Hutnicze BOLESLAW. It is the biggest zinc producer in Poland. The electrolytic zinc plant started up in 1955 with a capacity 15,000 tonnes per year, and multiplied its production by 5 till nowadays. At the beginning, the plant processed only calcine from zinc oxides (60% Zn, 3-4% Pb, 0,03 % Cd) which were produced from Waeltz fumes by calcination in a rotary kiln. Participation of calcine from zinc sulfide concentrates in the feed grew during the BOLESLAW plant expansion. Currently, only roasted sulphide concentrates, calcine from fluid-bed roasters, is processed. This paper presents a general description of the ZGH BOLESLAW plant and discusses the processes of roasting, leaching, purification and electrolysis. Also shown are the chemical analyses of the various process materials.

Session 4 – Modern Lead Smelting Technologies II

Tuesday AM	9:00 AM – 12:00 Noon
October 24, 2000	Location: Ballroom 3

Session Co-chairs: N. L. Piret, Piret & Stolberg Partners, Im Licht 12, D-47279 Duisburg, Germany; D. M. Henke, Doe Run Company, 881 Main Street, Herculaneum, Missouri, U.S.A. 63048

9:00 AM
Health and Hygiene in the Modern Lead and Zinc Industry: D. N. Wilson[1]; [1]Lead Development Association International, 42 Weymouth Street, London W1N 3LQ, United Kingdom

The potential risks of working with lead have been recognised for centuries, but it is only with the development of sensitive measuring techniques in relatively recent years that it has been possible to establish effective approaches for the monitoring and control of lead exposure. This paper examines the principal control measures employed today – lead in air and lead in blood – and reviews the evolution of numerical standards, with particular reference to the latest understanding of health effects. In addition to lead, a large number of other metals are commonly encountered when producing lead and zinc – both primary and secondary – and the health effects of many of these are discussed. Modern hygiene practices and technologies, which have proved successful in reducing worker exposures, are reviewed. The paper concludes with a look at how exposure standards are likely to change in the near to medium future.

9:25 AM
Cominco's Trail Operations: an Integrated Zinc-Lead Operation: E. T. de Groot[1]; D. L. Verhelst[1]; [1]Cominco Limited, Trail, British Columbia, Canada V1R 4L8

With the successful start-up of Cominco's new KIVCET smelter, the final key component is now in place for Trail Operations to operate efficiently as a modern integrated zinc-lead facility. Unique metallurgical, operational, planning and management issues apply to this operation. Along with presenting the current flowsheet for Trail Operations, this paper discusses issues such as the impact of recycles, operational re-stabilization following significant process changes, plant operation with just-in-time inventories, real-time process optimization, and management philosophy.

9:50 AM
The Lead Bath Smelting Process in Nordenham, Germany: M. Sibony[1]; N. Basin[1]; J. Lecadet[1]; R. Menge[2]; S. Schmidt[2]; [1]Metaleurop Recherche, 1, avenue Albert Einstein - BP 120, 78193 Trappes Cedex, France; [2]Metaleurop Weser Blei, Johannastrasse, 2, 26954 Nordenham, Germany

In 1996, Metaleurop replaced its conventional sintering and blast furnace lead smelting activity in Nordenham, Germany by Sirosmelt/ Ausmelt technology. Following some alterations to the process and the equipment, the bath smelting plant reached its design capacity for the treatment of lead concentrates, lead sulphate paste from spent batteries, secondaries and internal by-products. A reliable metallurgical process has been established, and thus higher process stability has been achieved, increasing simultaneously the refractory life. Nevertheless, improvements are needed to control the process with a better automation system and reliable expert-systems, because of the intensity of the smelting process. The introduction of the Sirosmelt process for the pyrometallurgical production of lead instead of the prior conventional process has also demonstrated the following advantages: reduced emissions of heavy metals and gaseous compounds, reduction of the specific energy consumption, minimization of residues and a reduction of staff and maintenance costs. The environmental performance of the plant meets the requirements of the German regulations.

10:15 AM Break

10:45 AM

QSL Lead Slag Fuming Process Using an Ausmelt Furnace: M. B. Kim[1]; W. S. Lee[1]; Y. H. Lee[2]; [1]Korea Zinc Co., Ltd., 142 Nonhyun-Dong, Seoul 135-749, Korea; [2]Chonbuk National University, Chonju 561-756, Korea

The "Slag Fumer" is the first Ausmelt furnace system adopted at Onsan Refinery of Korea Zinc. This plant continuously treats QSL lead smelting slag in the molten state. It has developed up to now since its first commissioning in October 1992 and has built up a confidence that it can produce an environmentally acceptable slag for use in cement manufacture and recover zinc and lead in the slag as fume oxide. This paper provides the operating experiences accumulated during the last 8 year-operation, a summary of problems and solutions and the current status of the operation.

11:10 AM

Recent Developments in the Lead Refining Operations at Britannia Refined Metals Ltd.: P. J. Moor[1]; [1]Britannia Refined Metals Limited, Botany Road, Northfleet, Kent, United Kingdom DA11 9BG

Britannia Refined Metals Ltd. was built in 1931 to refine the lead bullion produced at the Mt. Isa mine in Queensland, Australia. Several periods of expansion and development have taken place over the intervening years, leading to major increases in the refining capacity for both lead and silver. A plant for treating recycled lead-acid batteries was added in 1976. This was redeveloped in the early 1990's to utilise Isasmelt technology for the smelting operations. Most recently the No. 2 refinery kettle floor was extended to enable it to process lead bullion produced from two Imperial Smelting Furnaces (ISF), at Britannia Zinc Ltd. in Avonmouth, England and at MIM Hüttenwerke in Duisburg, Germany. This expansion included the provision of a plant for the hygienic handling of drosses and skims. This paper briefly describes the present primary refining operations and gives an update on the most recent developments in the process metallurgy and operating practices that have taken place.

11:35 AM

Analysis of Dust Formation in the Oxygen Flash Smelting of Lead-Bearing Feeds in the Kivcet Smelter: M. A. Lyamina[1]; V. A. Shumsky[1]; I. P. Polyakov[1]; N. M. Ospanov[1]; N. N. Ushakov[1]; [1]VNIItsvetmet Institute, 1, Promyshlennaya St., Ust-Kamenogorsk 492020, Kazakhstan Republic

Studies on the kinetics of the competitive processes of PbS volatilization and PbS oxidation, as applied to the heat and mass transfer conditions in the flame of the Kivcet furnace, revealed that the rate-determining factor is the supply of heat. Therefore, low yields of fume in the autogenous flash smelting of lead sulphide feeds are noted despite the high volatility of PbS at 1,300-1,4000°C. Dust formation in the autogenous flash smelting of Kivcet-smelters does not exceed 5-7%, of which fumes amount to ~ 80%. Using extra fuel during autogenous smelting involves the mismatch of the sulphide oxidation rate and the release of heat in the flame, and increases the fume yield. This is a major cause of the high dust formation in pilot plant trials. The analysis of dust formation in the Kivcet smelting of oxidized lead feeds in an industrial-scale smelter shows an overall increase of dust formation (up to 10% of the feed), with fumes constituting ~ 80% of the dust. A pronounced increase of the zinc component of the fumes is also noted.

Session 5 – Zinc Operations II

Tuesday AM   9:00 AM – 12:00 Noon
October 24, 2000   Location: Ballroom 4

Session Co-chairs: C. Canoo, UM Zinc, Zinkstraat 1, B-2490 Balen, Belgium; M. Agnew, Noranda Inc., CEZinc, 860 Cadieux Boulevard, Valleyfield, Quebec, Canada J6S 4W2

9:00 AM

Recent Operations at the Iijima Zinc Refinery: T. Yamada[1]; S. Kuramochi[1]; R. Togashi[1]; [1]Iijima Zinc Refinery, Akita Zinc Co., Ltd., 217-9 Shimo-Kawabata, Furumichi, Iijima, Akita 011-0911 Japan

In 1972, the Akita Zinc Co., Ltd. commenced operations with an annual capacity of 86,000 tonnes of electrolytic zinc, and it has operated with an annual capacity of 156,000 t-Zn since 1974. The business surroundings for non-ferrous metals production have become more severe with the high Yen rate for the dollar and low domestic demand in the last few years. Consequently, the company tried to survive with some improvements and succeeded to reduce operating costs and to improve profitability as follows: 1) expansion of its production capacity to 196,000 t-Zn annually, 2) saving man-power by the introduction of fully-automated machines for cathode handling in the cellhouse, 3) improvement of the hematite process by means of the recovery of rare-metals. These improvements made Akita Zinc a competitive refinery in the modern world. We have been trying to improve the operations more and more. One of the challenges is to purify the iron oxide made in the hematite process by applying an As removal process, which is coming into operation in the near future.

9:25 AM

Improvements at the Electrolytic Zinc Plant of Big River Zinc Corporation, Sauget, Illinois, U.S.A.: S. E. James[1]; L. L. Ludwig[1]; B. L. Motycka[1]; [1]Big River Zinc Corp, 2401 Mississippi Avenue, Sauget, Illinois, U.S.A. 62201

Significant modifications to the electrolytic zinc plant operated by Big River Zinc Corporation were made at the end of the 1990's resulting in increased capacity and improved efficiencies. A new cell room, with the innovative use of acid-resistant concrete cells and a modern ventilation system, was installed to raise the capacity from 80,000 tonne/y to 106,000 tonne/y of finished zinc. Improvements to the leaching section include the conversion from a single to a two-step process, with associated equipment changes, to improve the quality of the residues produced. Another key change is the construction of a facility to allow the use of zinc oxides from secondary sources as a feed to the plant. This paper describes these improvements and the current operations.

9:50 AM

Recent Process Improvements in the Kokkola Zinc Roaster: J. Nyberg[1]; M.-L. Metsärinta[2]; A. Roine[2]; [1]Outokumpu Zinc Oy, P.O. Box 26, FIN-67101 Kokkola, Finland; [2]Outokumpu Research Oy, P.O. Box 60, Kuparitie 5, FIN-28101 Pori, Finland

The Kokkola roasting plant uses more than 20 different zinc concentrates every year. During recent years there has been an increase in the variation in concentrate quality; in particular, the amount of fine-grained and low-grade concentrates has increased. Therefore, a great deal of development work has been carried out to improve the operational flexibility, on-line availability, production capacity and calcine quality of the roasting plant. This work consisted of a heat and material balance model of the roasting based on HSC Chemistry software, a new water admixture system for the concentrate feed, a new oxygen feed system for the process air line, improved cooling of the furnace and boiler and improved operational practices, dust removal and concentrate mixing. These new process control tools and other improvements, as well as some test results, will be described in this paper. The oxygen feed may be used to improve production capacity and to decrease the sulfide content of the calcine. The water feed may be used with fine concentrates to decrease both dust carry-over and the temperature in the top part of the furnace. Improved cooling of the furnace and boiler helps to increase production capacity.

10:15 AM Break

10:45 AM
Oxygen Enrichment of Fluo-Solids Roasting at Zincor: C. MacLagan[1]; M. Cloete[1]; E. H.O. Meyer[1]; A. Newall[2]; [1]Zinc Corporation of South Africa Limited, P.O. Box 218, Springs, Republic of South Africa, 1560; [2]Process Consultants, P.O. Box 97955, Petervale, Republic of South Africa, 2151

This paper initially gives a brief overview of Zinc Corporation of South Africa Limited (Zincor). The original design parameters of the Zincor roasters are compared to the current operation, and the requirements for efficient roasting are listed. Roaster operational problems experienced during the early to mid 1990's are outlined. A description of the investigation and the outcome to increase overall roaster availability are given. The history and the development of the use of oxygen at the Zincor roaster operation, with an account of the associated operational experiences, are explained.

11:10 AM
Method for Processing Siliceous Zinc Ores: S. Ikenobu[1]; [1]Kamioka Mining & Smelting Co., Ltd., 1-1, Shikama, Oaza, Kamioka-cho, Yoshiki-gun, Gifu, Japan

This paper describes a method for processing high-silicate zinc concentrates by hydrometallurgical zinc refining. Silica in concentrates reacts to form zinc silicate during roasting. The zinc silicate readily dissolves and slowly precipitates in sulfuric acid solutions during leaching. However, if proper operating parameters are not maintained, the colloidal silica may form an unfilterable gel. That is, according to the investigation results obtained, the silica concentration in the reactor has to be maintained at 5 g/l or less (preferably 2 g/l or less) by promoting the precipitation reaction. The proposed method has made it possible to precipitate silica in a form having excellent solid-liquid separation characteristics, without the need for facilities having a high filtration capacity, and to maintain a low silica concentration in the reactor by feeding a composition containing pre-adjusted silica contents.

11:35 AM
Leaching and Purification at Cominco's Trail Zinc Operations: D. J. McKay[1]; G. Sterzik[1]; T. L. Salway[1]; W. A. Jankola[1]; [1]Cominco Limited, P.O. Box 2000, Trail, British Columbia, Canada V1R 4L8

At Trail, British Columbia, Cominco's zinc leaching and solution purification processes include direct pressure leaching of zinc concentrates, leaching of fume from the lead smelter, leaching of calcine and electrolyte purification. These processes have been adapted to match the unique characteristics of Cominco's integrated zinc and lead operations. Recent modifications include changes to the purification process and iron-residue handling circuits. In 1997, a new five-compartment autoclave, complete with ancillary equipment, was installed in the pressure leaching plant. This paper discusses these changes, the current flowsheet and further improvements.

Session 6 – Imperial Smelting Technologies

Tuesday PM 2:00 PM – 5:00 PM
October 24, 2000 Location: Ballroom 3

Session Co-chairs: J. F. Pusateri, Zinc Corporation of America, 300 Frankford Road, Monaca, Pennsylvania, U.S.A. 15061; Y. Umetsu, Tohoku University, 1-1 Katahira, 2-chome, Aoba-ku, Sendai, Japan 980-8577

2:00 PM
The Continuing Evolution of the Imperial Smelting Process: R. W. Lee[1]; [1]Imperial Smelting Processes, Stoke Orchard, Cheltenham GL50 2LS, United Kingdom

The first prototype plant using the Imperial Smelting Process commenced operation in 1950. It is timely therefore to review the developments that have occurred with the process over the past half-century. A major advantage claimed initially for the process was its ability simultaneously to recover zinc and lead from bulk concentrates. This has remained a fundamental advantage, but it has been extended by the increasing treatment of secondary materials containing zinc and lead. This has been facilitated by the development of hot briquetting and tuyere injection. These techniques and their impact on the technology of the operation will be described. The other major advantage claimed for the process was its potential to achieve new levels of productivity in the pyrometallurgical smelting of zinc. This has been realised with operating furnaces producing up to 400 t/d of zinc. The technical developments that have enabled this scale of operation will be reviewed.

2:25 PM
Impurity Distribution in the ISP Process at the Harima Works of Sumitomo Metal Mining Co., Ltd.: O. Kitamura[1]; H. Kubota[1]; [1]Harima Works, Sumitomo Metal Mining Co., Ltd., 364-4 Miyanishi, Harimacho, Kakogun, Hyogo, Japan

The Harima Works started its ISP operation in 1966 and been expanding its production capacity from 3,000 tonne Zn/month and 1,500 tonne Pb/month to 7,500 tonne Zn/month and 2,500 tonne Pb/month. It is not only treating zinc, lead and bulk concentrates but also secondary materials like Waelz kiln oxide from the Shisaka Works of Sumitomo Metal Mining, waste treatment sludges, industrial wastes and others. Its final products cover Prime Western Grade (PWG) zinc, Special High Grade (SHG) zinc, continuous galvanizing grade zinc, electrolytic lead, cadmium, indium, thallium and sulfuric acid. This paper briefly describes the smelter's historical and present operations. The key data for the current impurity control management and for the distribution of impurities such as copper, iron and arsenic are presented.

2:50 PM
Optimization of the New Jersey Refining Process: G. Hanko[1]; A. Lebleu[2]; M. Sibony[3]; J. Lecadet[3]; [1]Department of Non-ferrous Metallurgy, University of Leoben, A-8700 Leoben, Austria; [2]Metaleurop Nord, 1 rue Malfidano, BP1, 62950 Noyelles-Godault, France; [3]Metaleurop Recherche, 1 ave Albert Einstein, BP120, 78193 Trappes Cedex, France

The New Jersey distillation process is today the most important pyrometallurgical method for the production of zinc of very high purity. The flexibility of the pyrometallurgical zinc production process, especially its ability for recycling, makes it competitive, although it is energy intensive. A deeper knowledge of the New Jersey process is necessary to further increase its technical performance by ensuring its global safety. A project, integrated in the European research program EUREKA, has been started in order to define the process chemistry of distillation. Experimental measurements have been carried out with a column at the laboratory scale, and the results, linked with industrial measurements, support the development of a model based on material and thermal balances. The first conclusions indicate that the key parameters for process optimization are the column geometry and the distribution of the thermal losses.

3:15 PM Break

3:45 PM
A Study of the Changes in the Permeability of the Sintering Bed in the Imperial Smelting Process: K. Kawanaka[1]; Y. Mori[2]; [1]Niihama Research Laboratories, Sumitomo Metal Mining Co., Ltd., Niihama, Japan; [2]Hyuga Smelting Co., Ltd., Hyuga, Japan

The permeability changes during the sintering of the feed for the Imperial Smelting Process (ISP) were investigated using an experimental sintering pot, as well as with a mathematical model. The results obtained were as follows. The blowing resistance in the sintering bed changes as the sintering reaction proceeds. It increases at the beginning of the reaction when the temperature of the bed is still low. Then it decreases as the reaction continues, accompanied by an increase of the bed temperature. The increase of the blowing resistance in the bed during the sintering process mainly occurred in the drying zone, and was comparatively small in the reaction and cooling zones. Based on Erugen's equation, the change of the permeability during sintering is explained by the decrease of the apparent fractional void volume in the drying zone of the bed.

4:10 PM

Changes in the Physical and Mechanical Properties of SiC Trays Caused by Ageing in Zinc Refinery Operations: A. Piant[1]; M. Fritz[1]; M. Boussuge[1]; M.-D. Dupuits[2]; [1]Ecole des Mines de Paris, Centre des Matériaux P.M. Fourt, B.P. 87, 91003 Evry cedex, France; [2]Société Française de Céramique, 23 rue de Cronstadt, 75015 Paris, France

This paper summarises a part of the work that has been essentially carried out at the Ecole des Mines de Paris in the framework of an Eureka European programme funded by the French Ministry of Industry, in partnership with Metaleurop and Carborundum (subsidiary of Saint Gobain). It deals with the measurement of different properties (density, thermal linear expansion, elastic modulus, strength) of a SiC-based refractory constituting the trays that are used in the refining columns in the New Jersey zinc distillation process, especially in the boiling section. These parameters have been investigated to check the homogeneity of the as-received trays as well as to estimate the influence of aging of the material under operating conditions. With this aim, specimens have been sampled in used trays having more than two years of operation. The as-received trays exhibited a good homogeneity, the strength being slightly lower in the direction in which they are compacted. Despite microstructural changes, most of the properties measured at room temperature are not significantly affected by aging. High temperature tests involved thermal treated under vacuum to remove metallic zinc before testing at high temperature. An increase in temperature, as well as aging, induces a decrease in the elastic modulus and strength.

4:35 PM

Development of Mechanization Facilities in the Non-Ferrous Metallurgical Field: Y. Sako[1]; K. Muraguchi[1]; K. Shibata[1]; E. Nomura[2]; [1]MESCO, Inc., 2-10-5 Ryogoku, Sumida-Ku, Tokyo, Japan 130-8531; [2]Mitsui Mining & Smelting Co., Ltd., 1-11-1 Ohsaki Shinagawa-ku, Tokyo, Japan 141-8584

In 1998, Mitsui Mining & Smelting Co., Ltd. (MMS) produced 70,000 tonnes of lead, 231,000 tonnes of zinc and 214,000 tonnes of copper. MESCO, Inc. has been in charge of the automation and mechanization of smelting facilities promoted by MMS as well as the construction of facilities for chemical production and electronics materials plants, by which MESCO has contributed to the development of MMS. Initially, MESCO developed a casting machine for refined lead in the early 1960's, and thereafter, it developed a casting machine for refined zinc, a stripping machine for zinc tankhouses and energy saving facilities. In the field of copper smelting, it has also developed automation and mechanization facilities.

Session 7 – Zinc Electrowinning

Tuesday PM 2:00 PM – 5:00 PM
October 24, 2000 Location: Ballroom 4

Session Co-chairs: P. Wollants, Katholieke Universiteit Leuven, W. de Croylaan 2, B-3001 Leuven, Belgium; J. A. Gonzalez, Cominco Research, P.O. Box 2000, Trail, British Columbia, Canada V1R 4S4

2:00 PM

Review of Engineering and Construction Factors in Building a Zinc Cellhouse: J. G. Cooper[1]; P. Mercille[1]; M. F. Nasmyth[1]; [1]SNC-Lavalin Inc., 455 Rene-Levesque Boulevard West, Montreal, Quebec, Canada H2Z 1Z3

The turn of the century sees considerable activity in the zinc industry for the replacement or expansion of existing cellhouses, and the building of new cellhouses as part of new zinc projects. Aside from the cellhouse technology itself, numerous engineering and construction issues play a major role in the success of a project for replacing or building new cellhouses. The purpose of this paper is to bring to light and to address the engineering and construction factors which go beyond the selection of a cellhouse technology and which remain of key importance in implementing such projects. In addition, some implications of these factors for project costs will be illustrated.

2:25 PM

Asturiana De Zinc Expansion at the San Juan De Nieva Plant for a Zinc Production of 440,000 Tonnes per Year: F. San Martin[1]; F. Tamargo[2]; Y. Lefèvre[2]; [1]Asturiana de Zinc, S.A., 33417 San Juan de Nieva, Castrillon, Asturias, Spain; [2]Asturiana de Zinc Tecnologia, San Juan de Nieva, Apdo. 178, 33400 Aviles, Asturias, Spain

The San Juan de Nieva smelter was commissioned in 1960 with an electrolytic zinc capacity of 15,000 t/y. After a number of minor expansions, the capacity was increased to 320,000 t/y in 1991 and will reach 440,000 t/y by August 2001. The expansion involves the construction of a 900 t/day Lurgi roaster and a new acid plant. The leaching will be fully revamped and modernised, including the construction of a new building for residue treatment and for jarosite precipitation with a separate circuit for silver-containing concentrates. The project also includes the construction of a fully automated 137,000 t/y zinc cathode tankhouse fitted with 3.4 m^2 cathodes designed by Asturiana de Zinc, and based on the existing tankhouse and introducing some improvements. New melting and casting facilities, also designed by Asturiana, will be constructed.

2:50 PM

Zinc Autostripping at Falconbridge Limited Kidd Metallurgical Division: J. Lenz[1]; D. Ducharme[1]; [1]Falconbridge Limited, Kidd Metallurgical Division, PO Bag 2002, Timmins, Ontario, Canada P4N 7K1

Operation of the Kidd electrolytic zinc plant commenced in 1972 with a cellhouse capacity of 105,000 tonnes of zinc cathode. The original cellhouse layout consisted of 42 parallel rows for a total of 588 cells. As leaching capacity increased, the cellhouse was expanded to 630 cells. Zinc cathode was manually stripped from plant start-up until the development of a mobile automated stripping system in 1994. Machine development continued until a second unit was placed in production in 1996, from which point, 60% of the cellhouse was being stripped with the automated system. The final phase of the project was implemented in 1999 with the commissioning of two more automated strippers. This paper describes the implementation of the automated stripping system and its impact on cellhouse productivity.

3:15 PM Break

3:45 PM

Cellhouse Ventilation: J. A. Davis[1]; J. de Visser[1]; [1]DESOM Environmental Systems Limited, 1211 Gorham Street, Newmarket, Ontario, Canada L3Y 7V1

Since the mid 1970's, development of zinc electrowinning (EW) facilities has out-paced its counterparts in the copper and nickel electrowinning industries in the design of efficient, compact, and automated production plants. Recent advances in process automation have provided opportunities to increase current efficiency, productivity and cathode quality, while reducing the footprint of the plant and the number of operating personnel working on top of the cells. Usually, the practice has been to allow a totally contaminated building structure, combining the plant ventilation system with the process cooling air. As a result, facilities employing this practice are finding difficult to meet their process design criteria and the stringent labor and environmental requirements. This paper provides an overview of the problems and disadvantages associated with these older process designs. It also describes new developments in ventilation systems, particularly building design developments and cost savings that are possible when improved ventilation systems are introduced into efficient process operations.

4:10 PM

New Wrought Pb-Ag-Ca Anodes for Zinc Electrowinning to Produce a Protective Oxide Coating Rapidly: R. D. Prengaman[1]; A. Siegmund[1]; [1]RSR Technologies, Inc., 2777 Stemmons Freeway, Suite 1800, Dallas, Texas, U.S.A. 75207

Lead anodes used in zinc electrowinning generally contain 0.5 - 1.0 % silver to reduce the rate of corrosion over the service life. For good quality zinc, the cathodes must contain less than 10 ppm lead. In order to reduce the lead contamination of the cathode, the lead anode must become coated with a protective layer of PbO_2/MnO_2. The formation of this layer may take as long as 30 - 60 days, during which time zinc production is substantially reduced and the cathodes are contaminated with lead. To improve the mechanical properties of Pb-Ag-anodes alloying elements such as calcium, strontium, barium and others are added. The production of cast lead-silver or lead-silver-calcium anodes often results in the formation of numerous holes, voids or laps in the anode surface that can initiate localized internal corrosion. Based on the experience as the major supplier of rolled anodes for copper electrowinning, RSR Technologies has developed an improved anode for zinc electrowinning. The anode consists of a rolled Pb-Ag-Ca-alloy with a controlled surface grain structure. It forms an adherent protective oxide coating within 2 - 3 days when placed in an electrowinning cell. The preferred calcium and silver contents of the alloy are 0.03 - 0.08 % and 0.3 - 0.4%, respectively. Rolling sheets significantly reduces the presence of internal porosity or laps. The lack of defects results in long anode life. The rolling also produces a uniform grain structure to which the corrosion product readily adheres, thus significantly reducing the conditioning period.

4:35 PM
Mechanical Properties and Electrolytic Behavior of Pb-Ag-Ca Ternary Electrodes for Zinc Electrowinning: Y. Takasaki[1]; K. Koike[1]; N. Masuko[2]; [1]Faculty of Engineering and Resource Science, Akita University, Akita, 010-8502 Japan; [2]Chiba Institute of Technology, Chiba, 275-0016 Japan

At the Zinc&Lead'95 symposium, one of the authors presented several modifications of Pb-Ag-Ca alloy anodes for the zinc electrowinning process, and also, the behavior of some organic additives in the electrolyte. In this study, the mechanical properties of the electrode materials composed by Pb-0.5 wt% Ag-(0~0.8) wt% Ca were studied by the tensile and Vickers hardness methods. Furthermore, experimental research on the influence of rolling and annealing treatments on the electrolytic behavior and mechanical properties of these alloys was carried out. The tensile strengths of the annealed Pb-0.5 wt% Ag-(0.1~0.8) wt% Ca alloys were the same or higher than those of the as-cast Pb-0.9 wt% Ag anodes. The anode potential using the as-cast Pb-0.5 wt% Ag-0.6 wt% Ca alloy decreased compared to the as-cast Pb-0.9 wt% Ag alloy. Moreover, the annealed Pb-0.5 wt% Ag-0.6 wt% Ca anode after rolling showed a lower anode potential than the as-cast Pb-0.5 wt% Ag-0.6 wt% Ca anode.

Session 8 – New Developments in Lead and Zinc

Wednesday AM 9:00 AM – 12:00 Noon
October 25, 2000 Location: Ballroom 3

Session Co-chairs: A.H.-J. Siegmund, RSR Technologies Inc., 2777 Stemmons Freeway, Dallas, Texas, U.S.A. 75207; D. Ashman, Cominco Research, P.O. Box 2000, Trail, British Columbia, Canada V1R 4SR

9:00 AM
Equilibrium versus Kinetics in Lead Refining: T.R.A. Davey[1]; [1]METACON Consulting Services, Unit 220, 57 Gloucester Ave, Berwick, Victoria, Australia 3806

It is often important in the study of a process to determine whether the limitations are governed by equilibrium or kinetic considerations. Sometimes it is possible to devise a design of the process or the equipment so that the apparent limitations set by equilibrium considerations are overcome. In this paper, detailed consideration is given to the lead refining processes of sulfur-decoppering and of vacuum dezincing to illustrate this, and possible implications for other refining processes are indicated.

9:25 AM
Direct Zinc Smelting in an Iron Oxysulfide Bath: R.-Q. Li[1]; J. G. Peacey[2]; P. Hancock[3]; [1]Kvaerner, Metals E&C Division, 12657 Alcosta Blvd., San Ramon, CA 94583, USA; [2]Noranda Inc., 240 Hymus Boulevard, Pointe Claire, Quebec, Canada H9R 1G5; [3]Noranda Inc., Brunswick Smelting Division, Belledune, New Brunswick, Canada E0B 1G0

A pyrometallurgical process for the direct recovery of zinc from zinc concentrates and zinc/iron residues has been proposed and tested extensively by Noranda. The process consists of smelting bone-dry zinc containing materials (sulfide concentrates and secondary zinc/iron materials) in a molten iron oxysulfide bath to volatilize metallic zinc into a SO_2-free offgas. Sulfur contained in the feed materials is fixed as an iron oxysulfide matte for disposal. Thus, this process not only is capable of treating zinc sulfide concentrates and secondary zinc materials simultaneously, but also eliminates the need of sulfuric acid production. Detailed thermodynamic analysis and experimental test work are described in this paper.

9:50 AM
The Influence of New Technology at Sulphide Ore Mine Sites on Metals Production and Recoveries, with its Commercial Significance: H. Fletcher[1]; P. Gray[2]; [1]ZINCOR Ltd., 65 Wickersley Road, Rotherham, S. Yorkshire, U.K. S60 3PX; [2]Zinc Metallurgy Ltd., 2, The Avenue, Backwell, Bristol, U.K. BS48 3NB

Process and engineering development of the Warner Zinc Process over the past two decades has proceeded alongside the world-wide collection and analysis of operating and cost data of current processing practices from sulphide ores to refined metals. Study of these data shows that recoveries are dependent on mineralogical characteristics of the sulphide matrix and point to the inadequacy of differential flotation as a tool for preparing feed for smelters. The paid-for return at the mine on the combined metal values in zinc rich sulphide ores rarely exceeds 80% and increasingly runs as low as 50-60%. Surveying the possible alternative ways of improving these performances leads to the conclusion that the Warner Process is the only technology in sight that could meet a target of 90% paid-for recovery and that its development has now reached a point where it can be a fully practicable process for all mixed sulphide ores.

10:15 AM Break

10:45 AM
Recovery of Zinc and Cadmium from Lead Smelter Furnace Dusts at Met-Mex Peñoles by a Solvent Extraction Process: I. S. Fernández del Río[1]; [1]Met-Mex Peñoles S.A. de C.V., Av. Metalúrgica #550 Col. Metalúrgica, Torreón, Coahuila, México 27370

This paper describes a process for the treatment of the dusts generated during the operation of blast and reverberatory furnaces in the lead smelter, to remove zinc, cadmium, arsenic and halides from the circuit. The process consists of a Peñoles' developed leaching/purification stage and a solvent extraction process developed by Lurgi. The plant capacity is 5,000 tonnes Zn/year. The feed to solvent extraction contains 8 g/l Zn. Impurities such as copper, iron, arsenic and cadmium are removed by conventional cementation processes. The cadmium product is 99.99% pure. The solvent extraction process consists of two extraction stages, one washing stage and two stripping stages. D2EHPA is used as the extraction agent and 25% ammonia as the neutralizer. The rich-zinc solution is sent to the electrolytic zinc plant for zinc recovery. The raffinate produced, which is a mixture of ammonium sulfate and chloride, is used for agricultural applications.

11:10 AM
The Kivcet Treatment of Polymetallic Feeds: L. V. Slobodkin[1]; Yu. A. Sannikov[2]; Yu. A. Grinin[2]; M. A. Lyamina[2]; V. A. Shumsky[2]; N. N. Ushakov[2]; [1]OAO "Kazzinc", 1 Promyshlennaya Street, 492020 Ust-Kamenogorsk, Kazakhstan Republic; [2]Vniitsvetmet Institute, 1 Promyshlennaya Street, 492020 Ust-Kamenogorsk, Kazakhstan Republic

This manuscript describes the Kivcet treatment of lead-bearing materials having high contents of copper and zinc. The tests were carried out on bulk concentrates from the Zyrianovsk Mining and Concentrating complex, "Kazzinc" JSC (Kazakhstan) with the following composition: Pb 37.6%, Cu 10.4% and Zn 6.8%. Two properties of the concentrate were under investigation: their calorific value and their desulphurization rate. By adding flux, the charge properties were brought close to the properties of high-grade lead sulphide concentrate. The charge was melted with high productivity. To ensure high copper recovery, Waelz residue was added to the charge. The residue contained more than 20% carbon and about 30% iron metal. The residue was partially replaced by coke that facilitates high copper recovery into the matte. The smelting achieved a production rate of 20 t/h with one burner. Lead recovery into the lead bullion was 88.8%; copper recovery into matte was 92.3%; zinc recovery into slag was 75.5%; and zinc recovery into the fume was 5.1%.

11:35 AM

A Mathematical Model for the Electric Furnace in the Kivcet Process: G. S. Hanumanth[1]; G. A. Irons[1]; [1]Department of Materials Science and Engineering, McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada L8S 4L7

A three-dimensional mathematical model for the electric furnace of Cominco's Kivcet process was developed to compute the electric field intensity, power dissipation, temperature and velocity distributions in the furnace. A number of simulations of the electric furnace operation were carried out for various electrode immersion depths and electrode currents. The results showed that the current penetrated the bullion layer, generating high current densities in a layer approximately 0.3 m thick located in the slag/bullion interface region. An increase in the electrode immersion depth increased the furnace power as well as slag temperatures, and generated more vigorous bubble stirring and thermal homogeneity in the slag. For a given applied current, the computed power was in reasonable accord with the measured power input. The calculated temperatures were in rough agreement with the tapping temperatures of slag and bullion.

Session 9 – New Zinc Processing Technologies

Wednesday AM 9:00 AM – 12:00 Noon
October 25, 2000 Location: Ballroom 4

Session Co-chairs: A. Malsnes, Norzink, Eitrheim, N-5751 Odda, Norway; B. Blanpain, Katholieke Universiteit Leuven, W. de Croylaan 2, B-3001 Leuven, Belgium

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9:00 AM

Atmospheric Leaching of Zinc Sulphide Concentrates Using Regenerated Ferric Sulphate Solutions: C. J. Ferron[1]; [1]Lakefield Research Limited, 185 Concession Street, P.O. Box 4300, Lakefield, Ontario, Canada KOL 2HO

Most of the world's zinc metal is produced via the roast- leach-electrowinning (RLE) process. The process is well established, but most of the sulphur in the sphalerite concentrates reports in the acid, which has to be stored and/or sold. There are significant incentives to develop a simpler process with much reduced acid generation. Ferric ion is a well known oxidant for most sulphides, in particular sphalerite, and it converts the sulphide to elemental sulphur. Based on stoichiometry, however, the amount of ferric ion needed to achieve acceptable zinc extractions is prohibitive for downstream zinc recovery from the leach solutions. The process suggested here makes use of less-than-stoichiometric ferric sulphate additions because the ferric ion is regenerated by sparging SO_2/O_2 mixtures. This regeneration can be effected in-situ in the leach vessel or outside the leach vessel. An example of the application of this new process is presented for a Canadian sphalerite concentrate assaying 60% Zn. The effects of temperature, ferric concentration and ferric ion regeneration are presented. Options to recover zinc from the leach solution are also briefly discussed.

9:25 AM

Comparison of Direct Pressure Leaching with Atmospheric Leaching of Zinc Concentrates: K. R. Buban[1]; M. J. Collins[1]; I. M. Masters[1]; L. C. Trytten[1]; [1]Dynatec Corporation, Metallurgical Technologies Division, 8301 - 113 Street, Fort Saskatchewan, Alberta, Canada T8L 4K7

Both pressure leaching of zinc concentrate, in an autoclave, and atmospheric leaching, in stirred tanks, have been employed in the expansion of zinc production at plants employing roast-leach-electrowin technology. These direct leaching methods result in the conversion of the sulphur in the feed to the elemental form, rather than to sulphur dioxide, decoupling zinc production from acid production. Atmospheric and pressure leaching methods are also readily implemented over a wide range of production rates. In choosing the best technology for expansion, capital and operating costs, zinc recovery, byproduct quality and the compatibility of recycle streams with the existing refinery must be compared. Leach testwork with several zinc concentrates using both methods has been performed by Dynatec. Recent results are presented, along with a discussion of their implications for process selection.

9:50 AM

Treatment of Secondary Zinc Oxides for Use in an Electrolytic Zinc Plant: S. S. Chabot[1]; S. E. James[1]; [1]Big River Zinc Corporation, 2401 Mississippi Avenue, Sauget, Illinois, U.S.A. 62201

A recent survey of major steel companies worldwide revealed the importance of recycling zinc units from electric arc furnace (EAF) dust, mill scale, blast furnace dust and other zinc containing streams within the steel industry. Many processes have been developed and installed in response to this challenge. The most successful approach involves the production of a crude zinc oxide and its sale to primary zinc producers to recover the metal values. The problem with this process is the high concentration of halides in the crude oxide. This type of material cannot be processed directly in an electrolytic zinc plant because of the corrosion problems it will cause in electrolysis. In 1999, Big River Zinc installed a zinc oxide receiving and washing plant to minimize the impact of halides in its electrolysis circuit. A description of the washing plant and the initial operating results are presented in this paper.

10:15 AM Break

10:45 AM

Upcoming Zinc Mine Projects: The Key for Success Is Zincex Solvent Extraction: M. A. García[1]; A. Mejías[1]; D. Martín[1]; G. Díaz[1]; [1]Técnicas Reunidas, S.A. R&D Division, C/ Sierra Nevada 16, Pol. Ind. San Fernando II, San Fernando de Henares, Madrid 28830, Spain

During 1997 and 1998 two successful zinc feasibility studies, Skorpion and Sanyati, were carried out by Técnicas Reunidas based on the modified ZINCEX® technology. The technical viability of each project was proved during more than 600 h of continuous running in a pilot plant. The Skorpion zinc project would recover 150,000 t SHG Zn/y from an oxidized zinc ore of a Namibian mine. The economical study showed that the plant would have the lowest production costs in the world. The Sanyati zinc project would treat a bleed from an existing copper refinery in Zimbabwe to recover 5,000 t SHG Zn/y. In the first case the electrowinning cellhouse was supplied by Union Miniere and in the second by Técnicas Reunidas. This article highlights the pilot plant results and the advantages of the proposed process over conventional zinc production practices.

11:10 AM

The Galvanic Stripping Treatment of Zinc Residues for Marketable Iron Product Recovery: J. A. Barrera-Godínez[1]; J. Sun[2]; T. J. O'Keefe[2]; S. E. James[3]; [1]Departamento de Ingeniería Metalúrgica, Facultad de Química, UNAM C.U., Mexico, D.F. 04510, Mexico; [2]Graduate Center for Materials Research, University of Missouri-Rolla, Rolla, Missouri, U.S.A. 65409-1170; [3]Big River Zinc Corporation, Sauget, Illinois, U.S.A. 62201

The solvent extraction separation of iron from a zinc sulfate medium using DEHPA was investigated. After loading, the ferric ions were reduced in the organic phase using metallic zinc. The ferrous ions produced could be easily stripped into a sulfate solution with pH values in the range of 1.4 to 2.0. The small, laboratory scale pilot system used in this study allowed for continuous cycling of the organic and strip aqueous solutions. It was possible to establish and evaluate a series of steady state conditions under selected operating parameters. The effects of processing parameters such as solution chemistry, flow rates, zinc metal loading and pH on iron recovery and efficiency were also evaluated. Under proper conditions, it was possible to remove about 5 g/L iron from the organic phase in one stage and to produce a concentrated iron sulfate strip solution containing ferrous ion concentrations in the range of 90 to 130 g/L. Preliminary feasibility tests were also made on electrowinning metallic iron from the strip solutions and crystallizing ferrous sulfate as a means of making a marketable iron product.

11:35 AM

Separation of Iron from a Zinc Sulphate Electrolyte by Combined Liquid-Liquid Extraction and Electro-Reductive Stripping: K. Verbeken[1]; M. Verhaege[1]; E. Wettinck[1]; [1]Ghent University, Laboratory of Non-ferrous Metals, Technologiepark 9, B-9052 Zwijnaarde, Belgium

Iron (III) can easily and selectively be removed from acidic sulphate solutions with organo-phosphoric acids like Di-2-Ethyl-Hexyl-Phosphoric Acid [D2EHPA]. Stripping of the iron (III) loaded organic, however, is difficult unless highly concentrated inorganic acid solutions are used. In this paper results are shown for the enhanced stripping of iron from loaded D2EHPA by electro-reduction. The loaded solvent is contacted with a 2 M H_2SO_4 solution, which is continuously recycled in an electrochemical reactor where iron (III) is reduced to iron(II). As iron (II) is not extracted by D2EHPA, the equilibrium for iron (III)-D2EHPA is shifted towards the aqueous iron (II)-sulphuric acid solution. The electro-reduction unit is a vessel with separated catholyte and anolyte chambers. The catholyte is the actual stripping solution where iron (III) is reduced to iron (II) on a stainless steel electrode. The anolyte is a 2 M H_2SO_4 solution where oxygen is evolved on a lead alloy electrode. A sintered glass plug separates the compartments. With this unit, enhanced stripping of iron from the solvent is possible under mild acid conditions [2 M H_2SO_4], and a concentrated ferrous sulphate solution can be obtained. The results shown have mainly been obtained by studying the parameters affecting the electro-reductive stripping of a D2EHPA loaded organic phase in a batch reactor. From an iron (III)-saturated 20 vol. % D2EHPA solvent containing ~ 12.5 g/l Fe (III) over 90% of the iron can be stripped in one stage with a 2 M H_2SO_4 solution at 50°C. It is shown that in this way it should be possible to obtain a concentrated ferrous sulphate solution which can be processed downstream to recover a pure iron product.

Session 10 – New Electrowinning Technologies for Lead and Zinc

Wednesday PM 2:00 PM – 5:00 PM
October 25, 2000 Location: Ballroom 3

Session Co-chairs: T. J. O'Keefe, University of Missouri-Rolla, 1870 Miner Circle, Rolla, Missouri, U.S.A. 65409; G. L. Bolton, Dynatec Corporation, 8301-113 Street, Fort Saskatchewan, Alberta, Canada T8L 4K7

2:00 PM

New Clean Technologies to Improve Lead-Acid Battery Recycling: C. Frías[1]; M. García[1]; G. Díaz[1]; [1]Técnicas Reunidas, S.A., (R&D Centre), Sierra Nevada 16, 28830 San Fernando de Henares, Madrid, Spain

Advances in hydrometallurgy promoted by Técnicas Reunidas are providing increasingly simple and clean means for controlling the entire lead recycling chain. Used in parallel with pyrometallurgy, these processes allow furnace temperatures to be reduced and fumes and atmospheric pollution to be minimised. Furnace slags are digested, and residues (mainly gypsum) are non-toxic and convertible into marketable products. In addition, the global economy of the process is substantially improved by reducing the operating cost, increasing the lead recovery above 99% and obtaining a 99.99% pure lead product. These new PLACID and PLINT processes may provide the cleanest and healthiest practicable means for recycling lead from batteries.

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Electrowinning of Lead Battery Paste with the Production of Lead and Elemental Sulphur Using Bioprocess Technologies: M. Olper[1]; M. Maccagni[1]; C. J.N. Buisman[2]; C. E. Schultz[2]; [1]ENGITEC srl, Via Borsellino e Falcone, 31, 20026 Novate Milanes, Italy; [2]Paques Bio Systems B.V., P.O. Box 52, 8560 AB Balk, The Netherlands

The key point of the CX-EWS process is the conversion of lead compounds, contained in the active mass of spent batteries, into lead sulphide. The obtained lead sulphide is leached with ferric fluoborate electrolyte to dissolve lead and oxidize the sulphur from sulphide to the elemental form. The lead-rich solution is fed into a diaphragm electrolytic cell depositing lead and regenerating ferric fluoborate. The introduction of sulphate reducing bacteria technology in the sulphidization step of the battery paste improves dramatically the economics of the CX-EWS process, reducing the costs of chemicals, avoiding gypsum disposal and minimising the unit operations of the process. This paper describes in detail this technology change with reference to the economics of the process.

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Performance of a Conventional Cell Design for Zinc Chloride Electrowinning: C. Allen[1]; [1]Noranda Inc., Technology Center, 240 Hymus Boulevard, Point-Claire, Québec, Canada H9R-1G5

A series of zinc chloride electrowinning tests was carried out in a laboratory scale cell to evaluate the effect of temperature, current density, electrolyte composition, gas sparging and additives on the performance of the cell with respect to current efficiency, voltage, specific energy consumption and deposit morphology. The anode material was DSA for chlorine evolution and the cathode was made of aluminum. At 400 A/m^2 current density, a current efficiency of 90.9%, a voltage of 3.4 V and an energy consumption of 2.78 kWh/kg were observed. Air sparging was found beneficial but was not pursued for health and safety reasons. Various additives in the same chemical family as tetrabutyl ammonium chloride (TBACl) were tested. Both TBACl and tetrabutyl ammonium bromide were found to be equally effective. Attempts to carry out the electrolysis at 1200 A/m^2 were not as successful.

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Spouted Bed Electrowinning of Zinc from Chloride Electrolytes: J. W. Evans[1]; A. Roy[1]; C. Allen[2]; [1]Department of Materials Science and Mineral Engineering, University of California, Berkeley, California, U.S.A. 94720; [2]Noranda Inc., Technology Center, Pointe Claire, Québec, Canada H9R 1G5

A spouted bed electrode (SBE) has been used, in laboratory experiments, to electrowin zinc from zinc chloride electrolytes with the objective of determining the suitability of this electrode for commercial application. Zinc was successfully electrowon at current densities ranging up to 4,381A/m^2, which are an order of magnitude larger than those used at present in the zinc industry. Current efficiencies, for the cell with the SBE, have been as high as 90% and DC energy consumption as low as 2.8 kWh/kg zinc deposited. The performance of the cell has been measured as a function of current density, anode type, cell diaphragm, addition of tributyl ammonium chloride and purging of the electrolyte (to remove dissolved chlorine).

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The Effect of Microstructure on the Electrochemical Behavior of Lead-Silver Alloy Anodes during Zinc Electrowinning: S. Jin[1]; E. Ghali[1]; G. St-Amant[2]; V. Cloutier[3]; G. Houlachi[4]; [1]Department of Mining and Metallurgy, Laval University, Ste-Foy, Quebec, Canada, G1K 7P4; [2]LTEE, Hydro-Quebec, 600 Avenue de la Montagne, C.P. 900, Shawinigan, Quebec, Canada, G9N 7N5; [3]Noranda Inc., CEZinc Division, 860 Cadieux Boulevard, Valleyfield, Quebec, Canada J6S 4W2; [4]Noranda Technology Center, 240 Hymus Boulevard, Pointe Claire, Quebec, Canada H9R 1G5

During the casting of lead-silver anodes, variations in cooling rates result in the formation of an uneven microstructure. The slowly cooled areas (SCA) have a coarser microstructure than that of the remaining part (called "the general zone"). The effect of anode microstructure on the electrochemical behavior was investigated using galvanostatic, potentiodynamic and electrochemical impedance techniques. The results show that the resistances for the two steps of the oxygen evolution reaction on the slowly cooled areas of Pb-Ag anodes are higher than that on the general zone. The double layer capacitance for the first step of the oxygen evolution reaction (OER) and the pseudocapacitance of the second step of OER on SCA are smaller than those on the general zone. The potentiodynamic results show that the amount of lead dioxide formed on the SCA is greater than that of the general zone of the anode. The potential decay curves after 30 minutes of galvanostatic polarization at 45 mA/cm^2 show that the corrosion potential of the SCA is 200 mV lower than that of the general zone. This can lead to perforation because of the formation of a galvanic cell with a small anode and a large cathode.

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Effect of Polymer Additives on Zinc Electrowinning: T. Ohgai[1]; H. Fukushima[1]; N. Baba[1]; T. Akiyama[2]; [1]Department of Materials Process Engineering, Kyushu University, 6-10-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan; [2]Department of Industrial Chemistry, Kyushu Sangyo University, 2-3-1 Matsukadai, Higashi-ku, Fukuoka 813-8503, Japan

The electrodeposition behavior of Zn and the morphology of the deposited Zn were studied in electrowinning solutions containing polymer additives such as gelatin and polyethylene glycol (PEG). The cathode potential was shifted in a less noble direction and the polarization resistance for Zn deposition increased with increasing concentrations and molecular weights of both gelatin and PEG added to the electrolytic solutions. However, when the molecular weights of these additives exceeded about 1x10^4, the cathode was depolarized and the polarization resistance for Zn deposition decreased with increasing molecular weight. The crystal grain size and the (002) orientation of the deposited Zn became smaller when the concentration and molecular weight of the additives increased, and the cathode was polarized.

Session 11 – Environmental Aspects of Lead and Zinc Production

Wednesday PM — 2:00 PM – 5:00 PM
October 25, 2000 — Location: Ballroom 4

Session Co-chairs: M. A. Reuter, Delft University of Technology, Mijnbouwstraat 120, 2628 RX Delft, The Netherlands; S. E. James, Big River Zinc Corporation, 2401 Mississippi Avenue, Sauget, Illinois, U.S.A. 62201

2:00 PM
Effluent Treatment at the Pasminco Clarksville Zinc Plant: S. Subhawong[1]; [1]Pasminco Clarksville Zinc Plant, Clarksville, Tennessee, U.S.A., 37041

Following the startup of the zinc plant in Clarksville, Tennessee, in 1978, the original effluent treatment plant did not perform as designed. The sludge, produced in a conventional lime neutralization treatment, settled poorly and began to fill the permitted lined impoundment within two years, well short of the original design capacity. Another sludge pond had to be constructed. This led to a new process modification of the original design. Although the design is still based on the conventional lime precipitation of heavy metals, the current effluent treatment plant has evolved into a hydrometallurgical circuit, capable of producing good quality water without generating sludge. Undesirable elements are bled from the zinc circuit and are rejected through the effluent treatment operations. Wallboard grade gypsum is produced, instead of sludge, and all the gypsum is sold to cement and wallboard plants. This operation also recovers and returns more than 1,500 tonnes of zinc annually to the 105,000 tonne/y zinc plant.

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Development, Testing and Full-Scale Operation of a New Treatment Method for Selenium Removal from Acidic Effluents: G. A. Monteith[1]; G. Houlachi[2]; M. Pineau[3]; M. Laliberté[3]; [1]Noranda Inc., CEZinc Division, 860 Cadieux Boulevard, Valleyfield, Quebec, Canada J6S 4W2; [2]Noranda Inc., Noranda Technology Center, 240 Hymus Boulevard, Point-Claire, Quebec, Canada, H9R 1G5; [3]SNC-Lavalin Inc., 455, René-Lévesque Boulevard West, Montreal, Quebec, Canada, H2Z 1Z3

Conventional physico-chemical treatment methods, either hydroxide or sulfide precipitation, can hardly achieve a high removal of selenium from the liquid effluents which can be generated in some metallurgical operations. In weak acid solutions, selenium exists mainly as anionic species (selenite SeO$_3$-2 and selenate SeO$_4$-2) which, therefore, cannot precipitate as metal hydroxide or metal sulfide compounds. At the same time, neither selenite nor selenate form stable precipitates with the common cations (Ca, Mg, Fe, etc.) that are typically used in water treatment. At Noranda Inc., CEZinc Division in Valleyfield, Canada, the introduction of new discharge requirements for effluent toxicity initiated a R&D program which resulted in the full-scale implementation of a new treatment method for selenium removal. The goal of this paper is to present this new method which is now being patented by CEZinc. The process chemistry will be presented along with pilot-scale developments and full-scale operational results.

2:50 PM
Recovery of Sulfides from Sulfate-Containing Bleed Streams using a Biological Process: C. F.M. Copini[1]; G. H.R. Janssen[2]; C. J.N. Buisman[2]; S. Vellinga[2]; [1]Budel Zink, P.O. Box 2001, 6020 AA Budel, The Netherlands; [2]PAQUES B.V., P.O. Box 52, 8560 AB Balk, The Netherlands

Non-ferrous metallurgical plants are often confronted with the need to neutralize bleed streams or effluents containing sulfates. The treatment of these streams could produce large amounts of gypsum. With a biological sulfate-reduction process, the production of gypsum is avoided and the metals can be recovered as sulfides. In this paper, the biological treatment of an industrial stream is presented. The bleed solution from a roaster gas scrubber was treated by means of a two-step process. First, the acid was neutralized with calcine. The resulting zinc sulfate solution was converted to ZnS with bacteria using PAQUES-THIOPAQ® technology. The precipitated ZnS was de-watered to 70 wt% solids, and was returned to the roasters. The quality of the effluent stream complied with the environmental regulations.

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Goethite: From Residue to Secondary Building Material – Union Minière's Graveliet® Process: J. Winters[1]; L. Vos[2]; C. Canoo[2]; [1]Union Minière – UM Research, Kasteelstraat 7, B-2250 Olen, Belgium; [2]Union Minière – UM Zinc, Zinkstraat 1, B-2490 Balen, Belgium

Committed to a sustainable development of zinc applications, Union Minière is investigating processes for the minimisation of waste and residues originating from the classic hydrometallurgical zinc process. In that context, Union Minière has developed a method for the cold inertisation and solidification of goethite, the Graveliet® process. The result is a hard and inert gravel that can be used in the building industry. During the past two years, a pilot plant for the production of Graveliet® has been built and operated. In the present paper, the Graveliet® process and the pilot plant are described after which the properties of the produced gravel are discussed, from both a mechanical and an environmental point-of-view. Graveliet® fulfils the criteria for use as a secondary building material. The Graveliet® process is a viable technology to avoid stockpiling of goethite residues and it thus assures the long-term development of the hydrometallurgical zinc process.

4:10 PM
A Mineralogical Study of Jarofix Products for the Stabilization of Jarosite Residues for Disposal: T. T. Chen[1]; J. E. Dutrizac[1]; [1]CANMET, 555 Booth Street, Ottawa, Ontario, Canada K1A 0G1

Noranda Inc., CEZinc presently employs a cement-stabilization (jarofix) process to stabilize its jarosite residues for direct disposal. In this process, Portland cement partly decomposes Na-jarosite to form $Ca_6Fe_2(SO_4)_3(OH)_{12}.nH_2O$, ferric hydroxide and sodium sulphate which further reacts to form gypsum; approximately one-third of the Na-jarosite reacts in the current commercial product. The cured jarofix products also contain minor amounts of various Ca-Al-Fe silicate-sulphate-hydrate phases and traces of calcite. Together with gypsum and a Ca-Fe sulphate phase, these species bond the various particles together, imparting mechanical strength and reducing the permeability. Water-soluble Zn and Mg are stabilized in the Ca-Al-Fe silicate-sulphate-hydrate phases. The freshly cured products usually contain small amounts of moisture and traces of residual Portland cement, which provides additional alkalinity for the neutralization of any residual acid species. Jarofix products stored for more than six years in the laboratory, after curing, are usually dry and exhibit the same micro-textures as those of the freshly cured products. However, the stored products are depleted in the $Ca_6Fe_2(SO_4)_3(OH)_{12}.nH_2O$ and Portland cement phases, and are enriched in gypsum and calcite which reflects the highly alkaline environment of the jarofix products. The aged products also have increased amounts of the Ca-Al-Fe silicate-sulphate-hydrate phases which have elevated Zn and Mg contents. This implies a further immobilization of residual water-soluble Zn and Mg during storage.

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Disposal of a Lead Sludge: R. J. Wesely[1]; [1]Kvaerner Metals E&C Division, 12657 Alcosta Boulevard, San Ramon, California, U.S.A. 94583

Non-ferrous smelters traditionally have a hot gas handling system. In these systems, the dust is captured as a dry material which is often recycled to the process. Some smelters use wet gas cleaning methods with the recovery of the dust as a wet sludge. Although this sludge can be recycled to the process, in some cases it is preferable to dispose of the sludge. This paper will discuss the disposal methods available and specifically will deal with one type of sludge which has a high arsenic and high lead content. Problems with this sludge were investigated and methods were tested with the aim of stabilizing the sludge so that it passes the EPA TCLP test. Results of the laboratory tests are given.

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Notes