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*ENVIRONMENTAL TECHNOLOGY MONITOR**

prepared by

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*This document has not been edited.

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SUMMARY AND OVERVIEW

This set of abstracts of technical reports was prepared by the Industrial Cooperation and Consultations Service of UNIDO in cooperation with the Industrial Information Section to serve as a background paper for the conference on Global Consultation on Environmental Management in tne Metallurgical Industry to be held in Vienna, Austria on the 16-17 October 1995.

The material was reviewed from the perspective of energy conservation, pollution control and waste minimization opportunities in the metallurgical industry with emphasis on cleaner production as a practical approach for achieving ecologically sustainable industrial development.

This guide includes information available to UNIDO/INTIB and material obtained from the third phase of UNIDO/IPCT project: A Methodological Approach in Assessing New and Existing Technologies for the Steel Industry , TF/GLO/89/901 and the Environmental Management System for the Iron and Steel Industry in South-East and East Asia.

UNIDO/ITPD/ICC hopes that this document will assist companies and institutions at national, regional and international level in this important industrial sector, to make decisions that are both economically and environmentally sound and which contribute to the further development of a sustainable iron and steel industry.

This document has not been formally edited.

CONTENTS

1 STEEL AND THE ENVIRONMENT

By Nobuyoshi Tanaka

The environmental impact of steel is a key issue for our industry. Steel has a central role to play in a sustainable development strategy for the world. Steel can be proud of its environmental achievements over the last twenty years. In its use of abundant raw materials such as coal and iron ore and its high degree of recyclability, steel has many inherent advantages from an environmental point of view and news steel technologies are essential in meeting needs for sustainable development including cleaner, more efficient transportation, energy generation and manufacturing systems

However, it would both be naive and wrong to generalize for the whole world Each country has a different set of priorities for environmental improvements and control These priorities reflect differences in the level of income, geographic and social circumstances and the choices made by individual governments and citizens Therefore IISI has not sought to establish norms for specific areas of environmental control. Rather, it has focused on encouraging the establishment and operation of management principles, designed to ensure that the impact of steel on the environment is taken fully into account in all aspects of the operations of an individual steel company's business

Since its foundation, attention to the importance of improving environmental practice in the industry has been central to the work of the International Iron and Steel Institute Our first Statement on the Environment was first published in 1972. A new Statement on the Environment was agreed by the Board of Directors of the Institute at their meeting in April 1992 to underline the importance steel industry attaches to environmental issues IISI believes that steel's key role in economic development can be consistent with the utmost care of the industry's impact on the environment

IISI's Statement on the Environment sets out the principles which it believes represent excellence in environmental management in our industry. IISI's presentation to the SEAISI's Conference will outline the ten principles which include the following items (1) Sustainable development, (2) Decisionmaking, (3) Environment protection, (4) Environmental management systems, (5) Environmental technologies; (6) Resources management, (7) Energy management; (8) Education, training and information; (9) Research, innovation and technical cooperation; and (10) Government requirements

The presentation will also illustrate these principles with examples of how they have been used by individual steel companies

2 UNIDO'S TECHNICAL ASSISTANCE TO THE IRON AND STEEL SECTOR IN DEVELOPING COUNTRIES WITH EMPHASIS ON ENERGY- AND ENVIRONMENT -RELATED PRODUCTS

By Jan V Krouzek

The paper outlines the UNIDO approach towards environment and energy-related projects in the iron and steel sector; it illustrates the objectives and characteristics of the projects and activities. Examples for technical assistance projects are provided for various developing countries/regions, with annexed lists of ongoing and completed projects as well as a list of documents/meetings related to iron and steel industry development. One chapter is devoted to the possibilities for project financing and UNIDO's investment promotion activities.

In the conclusions, the importance of energy-conservation measures and pollution control in plant restructuring and rehabilitation is stressed

3 ENVIRONMENTAL MANAGEMENT AND CLEANER PRODUCTION IN THE IRON AND STEEL INDUSTRY

By Masakazu Ichimura

UNCED's Agenda 21 provides a basis for action by all stakeholders in industrial development It emphasizes the importance of appropriate industrial policies and operations to reduce impacts on the environment especially through the use of more efficient production processes and preventive strategies i e Cleaner Production

Iron and steel is a sector with major environmental implications It is energy intensive and waste emissions are difficult to control at low cost Cleaner Production is a systematic approach to

environmental issues at every stage of production of which options include good housekeeping, process modification, materials substitution and new technology research and development. Technology options for iron and steel include innovative combustion systems, energy-saving processes, internal recycling practices.

To ensure that such technologies are applied in an effective way proper management needs to be in place e.g. establishment of environmental responsibilities in line with a formal company action plan, environmental audits, chemical safety procedures and training of staff. This approach decreases the plant malfunction and needs for end-of-pipe control and result in an improvement of the companies competitiveness.

UNEP IE/PAC's Cleaner Production Programme promotes an integrated preventive strategy for industrial development in all sectors. Through information exchange, awareness raising and technical assistance the programme helps industry in developing countries particularly, to implement cleaner production policies and activities. Among these interdependent activities, an information clearing house plays a vital part.

4 ENERGY-SAVING MEASURES AT NIPPON STEEL

By Akira Yamada and Kyosuke Hazama

Since the oil crisis, Nippon Steel has positively carried out energy-saving measures for energy cost reduction and has achieved about 20% saving in real terms to date.

Recently, however, given the spread of the energy-saving equipment and facilities throughout the company, and also given the energy increase necessitated by the need to provide increasingly higher added values to products, energy consumption is beginning to level off.

This report gives an overview of the major energy-saving measures implemented by Nippon Steel, such as conservation efforts in mill operations, process elimination and other equipment measures and waste heat recovery equipment installation and discuss future tasks and problems in our conservation efforts.

5 ENVIRONMENTAL MANAGEMENT PRACTICES AT OPEN CUT COAL MINES IN CENTRAL QUEENSLAND, AUSTRALIA

By Peter A. Roe, Ian M. Dymock and Peter T. Isles

Modern open cut coal mining commenced in the Bowen Basin in Central Queensland, Australia, in the early 1960's to provide high quality coking coal to the blossoming Japanese Steel Industry. Today there are more than fifteen open cut mines ranging in capacity from Goonyella/Riversides' 10 mtpa to small semi-anthracite operations producing 200,000 - 300,000 tonnes per year. In addition there are six underground operations, three utilizing long walls, and another two longwall mines under construction. Total exports of coking thermal coals in the year to June 1992 exceeded 62 million tonnes. Exports account for more than 80% of the production in the region.

Practices to manage environmental issues associated with the mining operations have become an integral part of the life cycle of the mines. Climatic conditions in central Queensland are quite severe, ranging from long periods of hot and dry conditions sometimes interspersed with short duration high intensity storms to cyclonic rainfall events. Average annual rainfall is of the order of 600 mm. Overburden materials range from very erodible tertiary sediments through sandstorms. The combination of climate and spoil type leads to challenging, if not unique, conditions for rehabilitation of the disturbed lands. Practically all of the mines in Central Queensland lie within the Fitzroy River Catchment. Water management on site, and water discharges from mines need to be controlled so as not to degrade regional water quality.

This paper discusses practices in Central Queensland, Government requirements and some current research initiatives.

6 MEASUREMENT AND MONITORING SYSTEM FOR AIR POLLUTANTS

By Nobuhiro Tsuboi

Mizushima Works was quick to establish a monitoring system for air pollutants and has actively introduced and improved measures for environmental protection based on the data thus obtained.

The SO_2 content of exhaust gas is continuously measured at the sintering machines and coke ovens. At other facilities, the S content of the fuel is measured. SO_X volume is basically determined from measured SO_X concentration and exhaust gas volume and calculated based on the measured fuel consumption of each facility.

NO_X concentration and volume are monitored in the same way as SO_X. However for other facilities excluding the sinter machine and coke ovens, measurements of NO_X concentration are taken in batch fashion.

These data are transmitted to the Energy Center for centralized monitoring. When abnormalities occur, an alarm and screen message are given.

7 CURRENT TECHNOLOGY AND FUTURE TRENDS IN ENVIRONMENT-AL CONTROL FOR MINI-MILLS

By L. L. Teoh

Increasingly, steel producers come to consider the environment as one of the three or four most important issues facing their industry in the 1990s. This can be attributed to the stringent pollution legislation regulations and standards and ever higher penalties for polluting. It is widely expected that more stringent legislation will be introduced in the future and that they will be more strictly enforced.

The traditional emphasis on pollution abatement involves treating emissions and wastes as they are discharged from the production unit by adding end-of-pipe measures. It has the merits of not interfering with existing production systems requiring less initial investment and carrying fewer risks. But it suffers from serious drawback in that people involved in controls are not unilaterally motivated to reduce wastes and pollutants. A more rational and profitable approach to environmental problems is to understand exactly about where, how and why emissions and wastes are generated.

Many viable measures, process modifications and operating practices have been available to ensure environmental acceptability for a mini-mill. These can be made through improved efficiency at all stages of its process, reduced waste generation use of recycled materials as raw materials, lower waste disposal and effluent treatment costs. Developmental works are being devoted to make working condition as agreeable and fulfilling as possible within a mini-mill.

The development of cleanest technology at the least cost requires the multidimensional consideration of technical, economic, social, political regulatory and legal factors. In the near future, it is likely to concentrate on four underlying areas: (i) Efficient use of all resources; (ii) Improvement of existing environmental performance; (iii) Resource recovery and safe waste management; (iv) Environmentally sound design for all future technology.

8 ENVIRONMENTAL AND ENERGY IMPACT OF THE COREX TECHNOLOGY

By Siuka Dieter

The application of the COREX process for the production of hot metal has been demonstrated to be both technically and economically feasible on the first large scale plant of ISCOR Works at Pretoria/South Africa since 1989. Using coal instead of coke, a COREX plant additionally produces a high-quality export gas of approximately 7000 kJ/N cu metre, which can be utilized for energy production and metallurgical purposes.

Owing to its high degree of cleanliness and energy, this gas has as a tremendous potential for power generation especially in gas turbine based combined cycle schemes. Its high degree of reduction potential - after CO_2 removal - allows also the production of DRI additional to the hot metal as a second opportunity. Thus, for the consumption of coal as the primary energy source, highest efficiency is obtained.

High flexibility with respect to gas quantity and quality combined with environmental compatibility show substantial benefits for numerous applications.

9 EOF AND WAELZ-PROCESS - ATTRACTIVE CONTRIBUTIONS FOR THE IRON AND STEEL INDUSTRY

By Heinz Walden, Gurudas Samant and Ralph Weber

The scenario of the iron and steel industry is worldwide, effected by two important issues, namely the stringent and steadily increasing environmental regulations as well as the required reduction of raw material and energy consumption for economical production costs.

Environmental regulations ask for the utilization of waste materials to the greatest possible extend and to decrease the disposal of hazardous wastes respectively. The WAELZ-PROCESS represents a proven application for the reprocessing of zinc and lead containing steel works wastes. The contaminants of the steel plant waste are separated and a valuable feed material for the non-ferrous metal industry produced.

The cleaned waste materials can be reused in the steel industry or utilized as absolute inherent material for the construction of roads and other infrastructure applications.

The EOF represents an advanced "Energy Optimized Furnace" Process with respect to the utilization of low cost feed materials and waste energy to a great extent.

The application of both processes should be carefully studied for the various projects with regard to fully use their benefits.

10 CONSTEEL - THE EFFICIENT FLEXIBLE AND ENVIRONMENT-FRIENDLY PROCESS

By Masaaki Nakamoto and John A. Vallomy

The 120 tonne/hour CONSTEEL system at Nagoya Plant of Kyoei Steel Ltd. started operation on October 3, 1992. The DC furnace, 7,300 mm in diameter with 55MW of installed power supplied by NKK uses 41 MW to operate in CONSTEEL mode at 120 mt/hr with the scrap preheated at 600° C. The preheater, designed by Intersteel Technology uses only the carbon monoxide produced by the injection 25 Nm^3/mt of oxygen to preheat the scrap up to 600° C. The preheater complies with local environment protection regulations.

A 54 mt/h CONSTEEL system has been in commercial operation for years at Florida Steel Corp. Charlotte, NC, USA. The plant has exceeded guaranteed values of productivity and specific consumptions. The process is designed to comply with the most rigorous environmental regulations.

New Jersey Steel decided in early October, 1992 to retrofit their existing AC furnace with a Consteel system. The retrofitted Consteel system will have a capacity of 612,000 metric tonnes of liquid steel per year. The start-up is scheduled for early January 1994.

Nucor Steel of Darlington, SC, where the first Consteel prototype was tested in 1987, will build a new meltshop based on a Consteel system coupled with a DC furnace. This unit will produce 680,000 mt/year of liquid steel in the first stage. The start-up is scheduled for early September 1993.

This paper describes (1) history of the CONSTEEL process development and evolution, (2) basic concept of the CONSTEEL process, (3) merits and demerits in combining the CONSTEEL process with an AC or DC arc furnace and (4) features and flexibility of the CONSTEEL process.

11 ASPECTS OF ENVIRONMENT AND ENERGY IN THE IRON AND STEEL INDUSTRY

By Nick Standish and Budi Notowidjojo

Following a reference to the 1990 Jakarta Seminar on Alternative Ironmaking where an assessment of ironmaking process criteria involved environmental and energy aspects, it is stated that environment is a global problem but that this, on its own, is unlikely to bring about fast amelioration. It is then concluded that environment is also a political problem and that this will bring about amelioration much more rapidly than anything else. It also stated that sustainable development is only meaningful to those companies which are not going to be closed down as a result.

The energy saving is both short-term and long-term. It is shown it is only the longterm approach to the question that can bring about a lasting and economic

energy saving The smelting-reduction process is given as an example

12 SAVING ENERGY IN THE SINTERING PROCESS

By Peter R. Dawson

Considerable progress has been made in decreasing the energy requirements for iron ore sintering over the last decade Today some sinter plants can produce high quality product using only 40 kg coke breeze/t 2 Nm^3 COG/t and less than 30 kWh electricity/t This is equivalent to a total energy input of approximately 1 300 MJ/t sinter Ten years ago most plants consumed more than twice this amount of energy

The main measures responsible for this improvement are heat recovery, improved ignition systems decreased air leakage, increased bed depth and optimization of raw material properties This review describes the developments which have taken place around the world and their effect on sintering energy requirements

13 RECOVERY OF SENSIBLE HEAT OF COKE OVEN GAS USING A POROUS ASCENSION-PIPE HEAT EXCHANGER

By Heung Soo Park and Jae-ou Choi

An experimental study on a porous ascension-pipe heat exchanger of coke oven was carried out for the purpose of recovery of the sensible heat of COG as well as prevention of the surface from the carbon adhesion A gas, heat transfer medium passes through the annular chamber between the porous pipe and outer casing and is heated up, while a part of the gas is injected to the COG stream through the surface of the porous pipe

From the model test with SiC pipe of porosity 27%, it was found that the carbon adhesion on the surface could be prevented by injection of the gas lower than 5% of the mass flow of the main stream The recovered heat amounted up to 30% of that of the main stream (equivalent to 50-60M cal/(t-dry coal) and the temperature of the heat transfer medium reached to 300-350° C

It is considered that the fuel gas of the coke oven, COG or BFG can be directly preheated, which makes the heat recovery system more compact compared with the conventional one by eliminating the heat exchanger of radiant section

14 DEVELOPMENT OF THE ENERGY-SAVING TECHNOLOGY AT NO. 2 STEELMAKING PLANT IN KIMITSU WORKS, NIPPON STEEL CORPORATION

By Masakuni Morioka, Zenji Kajita, Yukinori Shigeyama and Hidoe Ogi

The two main counter measures for energy-saving subject have been focused in Kimitsu No 2 steelmaking plant One is the achievement of saving energy and reducing heat loss through pursuit of very high productivity by increasing operation rate Consequently the crude steel of more than 420 kt/M can be produced with 1/2 converter operation and 2 slab casters The other is individual measures for "Energy Saving" with regard to each productive technology involving improvement of exhaust gas recovery establishment of direct hot charge rolling system and so on

The efficient heat recovery of latent energy had made progress by improving the control technique in so-called OG system Furthermore, as an individual measure, OG boiler equipments have been installed for recovering sensible heat energy The steam quantity generated from this process is approximately 68 kg/crude steel T

The effects of OG boiler are expected to be the recovery of steam from sensible heat of exhaust gas and in addition increased cooling efficiency which contributes to the suction capacity of Induced Draft Fan The oxygen flow rate can be increased successfully so that the blowing time has been reduced As a result the highly developed steelmaking plant for energy saving has been realized

15 OPERATION RESULTS OF THE NEW DC ARC FURNACE

By Makoto Takahashi

Nippon Steel Corporation Daido Steel Co Ltd and

Usinor-Sacilor (France) have jointly developed the New Direct Current Arc Furnace (hereinafter referred to as "DC furnace") to established the further possibility of electric steel-making

In Hoshizaki Plant of Daido Steel the DC furnace equipped with single graphite electrode has been operated since August 1989. The studies on the characteristics and behavior of direct current through test operation have proved numerous advantages of the DC furnace in comparison with the conventional alternate current arc furnace (hereinafter referred to as "AC furnace") And the DC furnace in Nakayama Steel that Nippon Steel Corporation supplied has started to operate since April 1991.

In our paper, the advantages of the DC furnace based on operation results at Hoshizaki Plant and Nakayasna Steel are described

16 CONTINUOUS CASTERS WITH REPEATED OPERATION OF TUNDISH UNDER HOT CONDITIONS

By A. Osayama, Y. Nakamura, K.Imiya, K. Matsuo, M. Kimura and M.Shimizu

The new slab casters equipped with tundishes which continuously repeat their operation under hot conditions started up at Kobe Steel's Kakogawa Works in June 1989 and January 1992

The continuously-repeating tundish operates under hot conditions as follows Soon after casting the tundish is tilted to discharge residual molten steel and slag and after quick maintenance by the casting operators the molten steel of the next heat is received from the ladle while the refractory is still at a high temperature The same tundish is used for 400 heats under hot conditions On the other hand, with a conventional type tundishes, are all cooled every three or four heats for repair at the maintenance yard

This tundish-repeating operation can reduce molten steel heat loss to less than half of that of the conventional type By adopting a tundish which continuously repeats its operation under hot conditions energy consumption is reduced to 14% compared with that of the conventional type and the energy cost is reduced by 291 million yen per year

This paper will explain features of this type of caster which continuously repeats its tundish operation under hot conditions

17 ESTABLISHMENT OF ACTIVATED SLUDGE TREATMENT OF AMMONIA LIQUOR FROM A COKE PLANT

By Hiroshi Kamori, Osamu Miki and Masahiro Fujii

For the activated sludge treatment of ammonia liquor from a coke plant, it is essential to establish a method for evaluating the effect of toxic waste water on activated sludge and a method for recovering in a short time from abnormal phenomena developed in the course of the treatment

Technology has been established for evaluating the toxicity of the ammonia liquor by measuring its BOD curve and the respiration rate of activated sludge As the metabolic mechanism of activated sludge suggests that the addition of phytic acid is effective in recovering from the abnormal phenomena, a study has been made of the addition of phytic acid rice bran that contains a large amount of phytic acid Phytic acid and rice bran have proved effective in recovering early from such abnormal phenomena such as the bulking of activated sludge and inadequate decomposition of thiocyanate as well as in increasing the growth rate and activity of activated sludge and improvement of activated sludge treatment effluent

18 APPLICATION OF MEMBRANE SEPARATION TECHNOLOGY TO INDUSTRIAL WASTEWATER TREATMENT

By C.G.Kim and H.D.Chun

Industrial wastewater treatment by reverse osmosis (RO) membrane technology was carried out for three kinds of the final effluents We conducted cell test for both CA (Cellulose Acetate) and PA (Polyamide) membrane with effective area of 66.6 cm^2 and bench scale test for spiral wound type module with dimension of 4" X 40" which was made of PA membrane

Through these tests, it was found that PA membrane was more adaptable than CA membrane because of

its higher salt rejection rate and product flowrate

Salt rejection rates of all effluents were about 90% and product flow rate was 0.14 - 0.18 m^3/hr. As the product quality was better than that of process water, we concluded that it was possible to totally recycle it as a process water.

Cleaning test showed that NaOH, STP (Sodium triphosphate) and HCl, could remove the membrane foulants in the sandfilter effluent of Pohang Works and in the effluents of sand filter and carbon filter of Kwang Yang works respectively. At each case, membrane regeneration efficiencies were 44%, 82% and 94%.

Also, from the computer simulation with mass transfer model for BW8040 membrane, the optimum combinatorial membrane array was 13/7/4/1 and then resulting in the wastewater recovery of 91%, product flow rate of 15 ton/(day * element) and product TDS of 101 ppm. From these results, it was calculated that at least 1,210 membrane modules with dimension of 8" x 40" were required to treat wastewater of 20,000 ton/day.

We have been doing on-site test in bench scale for the effluent of Pohang Works since August 1992.

19 RECYCLING OF DUST AND SLUDGE FOR SINTER FEED MATERIALS

By Seiichi Kamei

Dust and sludge which are collected from various plants in steel works contains valuable components (e.g. iron). From the viewpoint of resources saving more effective utilization of them are desired since high Zn dust or sludge like converter thickener cake causes bad effect to the operation of blast furnace. This recycling plant which recovers low-Zn dust and sludge from high-Zn dust and sludge separately has been in operation from 1983.

In this paper, the outline of the equipment and the operation of the recycling plant is described.

20 DEVELOPMENT OF MANUFACTURING TECHNOLOGY FOR BLAST FURNACE SLAG AND STEEL SLAG AT KAKOGAWA WORKS

By Shigenobi Shimazaki, Jun-ichi Matsumoto, Kouta Hanao and Ikyuki Mizuguthi

Since the start-up of its blast furnace operation, Kakogawa Works has been manufacturing B.F. air-cooled slag from molten slag and producing coarse aggregate and base for road.

In order to reduce manufacturing costs and take advantage of value-added profits slag, Kakogawa Works has been trying since 1978 to shift manufacturing process from molten slag to water granulated slag by developing a new Kobe Steel Process. By improving operation skills and modifying the manufacturing process, in 1992 Kakogawa Works managed to produce granulated slag which used more than 90% of the molten slag and to sell it as fine aggregate for concrete and as a material for B.F. slag cement.

At the same time, there was the need to dispose of the remaining steel slag as landfill because of its limited utilization. But as the disposal cost was too high and room for landfill was limited , Kakogawa Works started to develop new uses for it.

As a result of several years of research and experimentation, the company developed a process for stabilizing the free lime in steel slag called Aging Process and then established a process for manufacturing a compound base for road by mixing steel slag, B.F. air-cooled slag and granulated slag.

21 RECENT TECHNOLOGY AND DEVELOPMENTS FOR EFFICIENT SLAG PROCESSING AND UTILIZATION

By K. Tanigawa, K. Okuda and T. Kumamoto

Japan produces approximately 80 million tons of pig iron and 105 million tons of crude steel annually. This results in the generation of 25 million and 13 million tons of slag respectively.

Because land and resources are scarce in Japan, processing and utilization of this tremendous amount of slag are essential for protecting the environment and conserving energy.

The problem of utilizing blast furnace slag has been solved. In Japan, 100% of the generated blast furnace slag is efficiently utilized, mostly in the

cement industry. However the processing of other kinds of slag remains a problem

Nippon Magnetic Dressing Co. with its experience and technology, is the leading slag processing company in Japan processing more than 3 million tons of various kinds of slag annually, which then becomes high-quality value-added products for its customers.

In this report, the authors will discuss non-blast furnace slag processing and introduce some recent development in the company's technology.

22 IMPROVEMENT OF SLAB RE-HEATING ENERGY CONSUMP-TION IN PLATE MILL

By Osamu Yamamoto, Tutomu Yoshizato and Hiroshi Nishizati

Considerable energy saving in slab reheating process has been achieved in Plate Mill, Mizushima Works, Kawasaki Steel Corp

Energy cost yet occupies 20% of the total manufacturing cost in steel works and especially in plate mill, to reduce energy consumption of reheating furnace is important for cost saving.

To meet this demand, HCR (Hot Charge Rolling) has been developed but, by the restriction of rolling chance and also reheating chance, the average slab charging temperature was lowered at about 400° C

To relax these restrictions the authors have developed work roll bending system and "Flexible charging system" which consider the required heat input of the slabs instead of its thickness

By these systems, rolling width restriction and slab thickness restriction were much relaxed and it contributed to reduce the waiting time loss of HCR

As a result, the average charging temperature of HCR has achieved up to 520° C and the energy consumption of continuous type reheating furnace was reduced to lower than 8.4×10^2 J/t

This paper outlines the concept and result of these improvements

23 COMBUSTION CHARACTERIS-TICS OF THE RADIANT TUBE BURNER WITH SELF-BIASED FUEL NOZZLE

By Yong Kuk Lee, Lil Won Cho and Heung Soo Park

Radiant tube (R/T) burners are widely used in heat treating facilities such as continuous annealing lines and continuous galvanizing lines in steel works. The major concerns in R/T burner operation are NO_x emission and temperature distribution on the R/T. The purpose of this study is to reduce the NO_x emission and enhance the temperature uniformity on the R/T with simple change of the R/T burner structure.

To do this, a self-biased fuel nozzle which injects more to the lower cross-section of the R/T was designed. Combustion tests for the self-biased nozzle and a conventional one, injecting fuel uniformly, were carried out using a two-stage R/T burner as the basis. A pull type experimental furnace with a 7 inch W-shaped R/T was used for the experiment. The NO_x emission and the temperature distribution on the R/T were measured with varying the combustion load and the air ratio. Coke oven gas was used as the experimental fuel.

Compared with the experimental results for the conventional nozzle, over 30% reduction of NO_x emission and the improvement of temperature uniformity on the R/T was achieved with the self-biased nozzle. It is thought that the self-biased fuel nozzle could be applicable for the performance enhancement of R/T burners.

24 ENERGY SAVING DEFORMATION IN 3-ROLL MILLS FOR WIRE ROD AND BAR PRODUCTS

By W. Juergen Ammerling

Besides the need of producing highly tolerance finished wire rods and bars in "free size" and "just in time" rolling modes, the process economy is of further utmost importance

The paper describes the features of the 3-roll technology in this respect. Its much higher deformation efficiency results in approximately 30%

less energy consumption as compared to the same reduction in the traditional 2-high mill. It will furthermore be demonstrated by production results that the use of 3-roll stands in the intermediate and finishing area of rod and bar mills for specialty steel ensures very high product yield and time utilization even when rolling 3 or 4 diameter cycles per month and a huge number of small order lots.

25 THE ENHANCEMENT OF STRIP COOLING EFFICIENCY BY SUCTION TYPE COOLING ROLL

By Hironori Fujioka, Keiji Mizuta, Toshikazu Kaihara, Tsuguhiko Nakagawa and Koshi Kuramoto

The energy saving efficiency of the new roll cooling system using the suction type cooling roll (suction roll) used in the rapid cooling section in a Continuous Annealing Line (CAL) is evaluated theoretically and experimentally.

The results showed that the running power necessary for the suction roll cooling system was about one-fortieth of that for the gas jet cooling system and also showed that the strip on the roll was free from cooling buckle phenomenon at least when the wrapping angle was less than 80° C where the critical angle of a conventional cooling roll was about 30° C for the strip of thickness down to 1 mm.

26 A WORLDWIDE SUCCESSFUL TECHNOLOGY IN THE ROLLING MILLS: DANIELI COMPACT CANTILEVER ROLLING UNITS

By Alfredo Poloni

Danieli presents the canlilever ESS (energy saving stands). These stands represent a revolution in rolling mill design and offer important advantages:

- Reduction in consumed electric power and reheating energy.
- Shorter change-over time improves mill efficiency.
- Smaller foundations and buildings due to compact design.
- Lower investment in capital spares.
- Simple few exposed moving parts limits the need for maintenance.

27 TRIPLE PASS HEAT PIPE ASSISTED RECUPERATOR

By Pal-Hsiang Wang.

The performance of heat exchanger is highly dependent upon the heat recovery efficiency and compactness. For revamping an existing recuperator, a heat pipe assisted recuperator system considering both above factors was proposed and its experimental performance is presented in this paper.

A prototype test was conducted in C.S.C pilot plant to obtain heavy recovery efficiency and compactness. Results of this test showed that compared to regulator recuperator, the heat recovery efficiency was raised from 28.9% to 53.5% with this heat pipe assisted system at normal flow rate conditions. Compactness comparison result between heat pipe heat exchanger and recuperator indicates that the former is much superior to the later. Compactness ratio of triple pass heat pipe assisted recuperator to fourfold pass recuperator is 1.7 under similar heat exchange loading conditions.

28 THE ENERGY SAVING MEASURES OF ON-SITE POWER PLANT

By Yoshihide Kawano, Hitoshi Narita and Shinichiro Hanada

Ohgishima thermal power plant at NKK Keihin Works is one of the largest capacity on-site power plants in Japan of which total output is 410,000 kW and its main fuels are byproduct gases.

At the power plant, each unit has 10 large-scale auxiliary equipments with a capacity of over 300 kW each.

These auxiliary equipments occupy most part of the auxiliary electric power. Therefore the various measures have been enhanced such as rotation control of large-scale fans which has resulted in large-scale saving energy of auxiliary electric power.

And variable pressure control was adopted to reduce

power station fuels. These measures have resulted in large-scale saving energy of the power plant.

29 IMPROVEMENT OF BILLET QUALITIES WITH IN-MOLD ELECTROMAGNETIC STIRRER

By Y. Kiyosawa, H. Mimori, Y. Suda, K. Kobayashi and M. Yamagishi

In-mold electromagnetic stirrer (M-EMS) is becoming a standardized system for commercial grade steel as well as special grade steel to meet user's higher quality demands.

Oyama No.3 continuous billet caster of Tokyo Tekko, which casts billet 150 x 150 mm for commercial bar with straight molds, applied M-EMS in October 1991.

For quality improvement, Tokyo Tekko has been taking various measures such as increase of high grade scrap ratio, nitrogen gas bubbling in furnaces and ladles, Ca-Si wire injection into ladles and nitrogen gas shroud between tundishes and molds.

It is found that M-EMS combined with the above mentioned measures greatly contributes quality improvement of billets as follows.

- Pinholes in the surface of cast billets are reduced.
- Longitudinal corner cracks of cast billets are decreased.
- Equiaxed crystal ratio of cast billets is increased.

As a result, bar qualities have been improved as well.

30 THE DEVELOPMENT OF THE NEW AIR SEPARATION PLANT

By Makoto Kida

In January 1992, a new air separation plant started operation at Kakogawa Works.

This plant is the fourth one constructed at this works. As designed it made full use of the long years of experience of the existing three plants which started operations 1970-1973. This new plant has many improved items, the following are the main ones.

- An achievement of a high efficiency argon recovery caused by the best designed columns - a lower column, an upper column a rough argon column.
- An improvement of a plant efficiency and a simplification of operation by an adoption of Molecular Sieves (M.S.) type as a raw air purification process, the existing ones have adopted Reversing Heat Exchanger (R.H.E.) type.

The plant, showing an excellent performance from the start has saved an amount of raw air equivalent to 700kW energy, and increased an amount of argon production by 540Nm^3/h compared with existing ones at Kakogawa Works.

Moreover, a rare gas (kryputon, xenon) recovery process is added to this plant. This process has run smoothly.

In this paper, a description highlighting the operating of this new air separation plant is given and a summary of its excellence performance is provided.

31 AIRFINE - SINTER PLANT WASTE GAS PURIFICATION TECHNOLOGY

By Walter Gebert, Manfred Lixl and Franz Parzermair

Voest Alpine Industrieanlagenbau GmbH (VAI) has developed a new gas purification technology in cooperation with Voest Alpine Stahl Linz GmbH. The system, named AIRFINE, was developed especially for separating aerosols from sinter plant waste gases. In addition, concentration of gaseous contaminants such as HF, HCl, SO_x and organic substances such as dioxide and furane can also be reduced.

AIRFINE offers a keen advantage in that the useful components of the removed substances (predominantly Fe_xO) can be recycled to the sinter belt. The volume of material to disposed of can be significantly reduced in this way.

The heart of the AIRFINE system is a scrubber with dual flow nozzles, which form a water spray using compressed air. The very fine drops of the formed droplet spectrum separate the aerosols from the waste gas stream. The separation efficiency is very good (greater than 95%) across the entire grain spectrum even at low energy consumption rates. A waste water treatment plant separates the accumulating sludge into reusable and waste products.

The process has been tested on a pilot scale. The first large-scale plant for the purification 470,000 Nm^3/h with raw gas dust contents 450 - 1,000 mg/Nm^3 to less than 50 mg/Nm^3 will be put into operation by mid 1993.

The main benefits of the system are:

- Observance of Limit Values for dust, HCl, heavy metals, dioxine and furane emissions. If necessary, low-cost installation of an SO_2 separation step;
- Waste volumes are reduced and heavy metals are chemically bound in such a way that they can be disposed of in the plant's waste dumps;
- A maximum degree of recycling can be achieved by separating Fe-components and returning them onto the sinter belt;
- Reliability and availability through use of proven components;
- Future low-cost modifications possibly in accordance with changing regulations.

Due to the high degree of separation efficiency and the flexibility of the AIRFINE technology, its applicability to other processes is being investigated.

32 INTRODUCTION OF A HIGHLY EFFICIENT ELECTROSTATIC PRECIPITATOR AT TOBATA NO.3 SINTERING PLANT

By Junichirou Ikenaga, Kouichi Ohyama, Junichi Sakuragi, Tadahiko Kitamura, Masamitu Baba and Mutsuo Maki

The electrostatic precipitator at Tobata No. 3 sintering plant had to be replaced in 1991 because the dust collection efficiency had been reduced by corrosion on dust collecting electrodes. Considering both, the construction costs and the trend towards environmental control, a rotary collecting-electrode type electrostatic precipitator has been in place since September, 1991.

The electrostatic precipitator has two features.

1. Whenever the surface of the collecting-electrode is brushed clean, reverse ionization is eliminated resulting in high dust collection efficiency even for dust with a high specific resistance.

2. As the dust is scraped off outside of the dust collecting region, the scattering of collected dust is held to a minimum.

The dust concentration at the outlet was 30-50 mg/Nm^3 at the operating point before the introduction of the highly efficient electrostatic precipitator. Now it is less than or equal to 10 mg/Nm^3.

The electrostatic precipitator has displayed a high level of dust collecting performance without any trouble since it was introduced.

33 ENVIRONMENTAL PROTECTION FACILITIES OF THE SINTERING PLANT AT NKK

By Yoshifumi Matsunaga, Michinori Hattori, Atsushi Yamaguchi and Kouichi Kimura

Various environmental facilities have been installed to satisfy the severe environmental regulation in NKK Keihin works. Especially, a desulfurization and denitrification equipment have made a great contribution to the environmental protection. As a result, SO_x, NO_x has reduced considerably.

De-SO_x process is performed by utilizing ammonia contained coke oven gas and by recovering ammonium sulfate through the reaction of ammonia with the sulfur dioxide gas in sinter waste gas.

De-NO_x process is performed by decomposing nitrogen oxides in sinter waste gas into N_2 and H_2O with ammonia addition under the existence of iron ore catalyst in the De-NO_x reactor.

These large facilities have been in good operation

since their start-up. The efficiency of desulfurization and denitrification have been kept in high levels and the quality of byproduct ammonium sulfates haven been excellent and stable.

34 AN APPLICATION OF COAL FLASH PYROLYSIS PROCESS FOR STEEL INDUSTRY

By Shigeru Hashimoto, Hiroyuki Kozuru, Takafumi Kawamura and Hiroshi Iida

Coal flash pyrolysis is one of the good means to obtain the high yield of valuable coal volatiles such as gas and liquid and has the potential advantage of obtaining the maximum value from coals at low cost. However, to make it feasible commercially, it is necessary to construct the efficient utilization system of pyrolysis products in a steel industry. The authors summarized the previously developed coal pyrolysis process and pointed out the necessary conditions for the development of a new process applicable for the steel industry.

From the laboratory experiments equipped with entrained flow reactors, the gas, tar and char yields of several kinds of coals were determined as a function of operating conditions such as temperature, pressure and pyrolysis atmosphere. The tar yield reaches the maximum at around 700° C and has a tendency to decline as the pressure increases. Hydrogen atmosphere at more than 25% concentration enhances the BTX yields comparing with an inert nitrogen atmosphere.

On the basis of the laboratory data, the authors proposed the coal flash pyrolysis process that has the essential feature of rapid heating of coals in a hot stream generated by the gasification of char produced. An attempt has been made to take mass and heat balances of the process and to show how it applies to steel workers.

35 SYDNEY MINI MILL

By John Prestige, Alan Blackshaw and Enzo Sgammotta

A mini mill has been built in the suburban area of Sydney, Australia in close proximity to residential housing. Stringent environmental regulations were set as part of the approval process. The plant has been operating since September 1922 and the strict acoustic and emission control standards have been satisfactorily met.

36 ENVIRONMENTAL BENEFITS AND ASSOCIATED WITH ENERGY SAVING PRACTICES AT A HOT STRIP MILL IN P T KRAKATAU STEEL - CILEGON - INDONESIA

By M Nurdin

The implementation of energy conservation in industry will give the positive impact to environment because it will reduce the loss of energy such as waste, heat and noise.

Energy saving in iron and steel industry can be done by executing the improvement to the system and technology of production process.

The potential of energy saving at Hot Strip Mill in PT Krakatau Steel generally can be applied at the processes which use heat and electricity.

Energy saving at the process which use heat can be reached by:

- Regulation of the air pressure in the furnace;
- Regulation of the temperature and fuel consumption;
- Using the heat from waste gas for regulating the temperature of slabs.

Through these ways, the consumption of fuel for heating process will be saved.

Energy saving at the process which use electricity can be reached by:

- Operating the motors at nominal maximum voltage condition will reduce the heat loss.
- Regulation to the motors' speed by adjusting the 'eddy current'.
- Installation of the addition regulator for on-off position of 'eddy current' simultaneous with the motor operation. This will eliminate the 'eddy current' which still appear at the same time when the motors are in 'off' position.

Using the waste heat and electrical saving will give many benefits by reducing the consumption of specific energy and this means the production cost will be decreased.

37 PRODUCTION OF COMPOSITE WIRES WITH PARTICULAR ATTENTION PAID TO ENVIRONMENTAL PROTECTION AND THE SAVING OF ENERGY

By Joerg Scharf, Folker Flemming, Juergen Grunwald and Volker Mueller

Already for a long time protection of the environment and exploitation of our natural resources in a rational way have become one of the most essential global problems.

In solving these problems, investment goods manufacturers have to take extraordinary responsibility.

The companies affiliated to SKET AG in Germany have therefore decided to face this challenge by using, as far as possible, only such processes which are not harmful to our natural environment.

Moreover the introduction of new materials itself implies the possibility to achieve essential savings in materials provided these are optimally adapted to their particular applications. This can be considered a valuable contribution to the environmental challenge and the energy saving problem.

It is the intention of the following presentation to inform you, on the one hand, about manufacturing processes and their practical implementation by means of most suitable machinery, and to give you, on the other hand, an idea of the properties, applications and advantages of these very interesting materials.

38 AIR POLLUTION COUNTERMEASURES BY USING A DUST DISPERSION SIMULATION MODEL

By Kazuo Hoji, Kunihiko Otsuka and Kazuo Higashi

Atmospheric diffusion simulation models are used to estimate the quantity of the pollutant from each source at some points. Simulation models of gaseous materials such as SO_X and NO_X are used generally. But there is no useful dust dispersion simulation model, so Wakayama Steel Works of Sumitomo Metals designed an original simulation model.

The dispersion formula of this model is based on the kinematic equation of a dust particle and normal distribution of wind velocity and wind direction. Effective stack height of point source is calculated from modified Moses-Carson equation. Dispersion height of area source was decided from field tests and wind tunnel experiments. 202 point-sources and 24 area-sources were calculated in actual simulation.

The calculation result corresponds to the observation values of fall dust concentration in monthly tendency, in the correlation of annual average values at eight points and the correlation of monthly average values at one typical point.

This model is useful for selecting the facilities that countermeasures should be taken and estimating the effect of countermeasures.

39 USE OF BAG FILTERS FOR THE DEDUSTING OF IRON ORE WINDBOX GAS STREAM

By P. Le Louer, P. Romelot, M. Buchon and J.P. Depauw

Worldwide, the most widespread dedusting process for sinter strand windbox gas stream remains electrostatic precipitation. But in spite of improvements, modern sintering strands are still significant emitters of pollution.

Public authorities are considering drastic limitation of the present emission of sintering air pollutants in the future. This prospect requires a new strategy for pollution control.

In this context, LECES has committed itself to a research programme to evaluate the feasibility of bag filtration.

A "pulse jet" pilot of 4,000 Nm^3/h was built and instrumented for continuous operation on a sinter strand. The pilot consists of a precollector and two independent filtration units (30 m^2 each).

The pollution abatement is efficient, less than 5

mg/Nm^3 for dust and acid aerosols, organic compound are partially caught, but the deposit of alkaline salts and organic compounds on the bags led to excessive pressure drop and operation difficulties.

Different actions have been implemented to improve the filtration with the participation of PROCEDAIR, new bag cleaning system, test of various fabric metals (woven glass, Tefaire, P84 and polyester felts), precoating of the bags.

The results obtained now with the precoating of the bags are satisfactory and will enable consideration of an industrial development of the process.

40 DEVELOPMENT OF IN-PLANT POLLUTION CONTROL SIMULATION OF EAF STEELMAKING PLANTS

By Masayuki Ueta, Toshimichi Maki, Noboru Suyama and Masato Kyui

This paper introduces NKK's application of computer simulation in solving environmental problems of EAF Steelmaking plants. With a view to grasping the total environmental system in a plant, NKK has analyzed the environmental situation from three angles and constructed this simulation. Due to this scientific analysis this simulation can be used not only for improving the work environment but also for constructing a plant with a futuristic vision.

Heretofore, the capacity of the dedusting system has been set up based on empirical knowledge only. But the recent movement towards environmental improvement has required more progressive and accurate methods. To meet these needs, NKK has developed the method described below:

- to clearly determine the amount of heat and dust emitted from the electric arc furnace by actual surveys in plants,
- to make sure computer simulations are possible;
- to determine if the new method is useful in improving facilities.

This simulation is based on such factors as air flow, air temperature and dust density, resulting in more realism than if it were based on air flow balance alone.

41 DEVELOPMENT OF HIGH EFFICIENCY AND LOW NO_x BURNERS

By Motofumi Kaminaka and Hiroyuki Takashima

At Sumitomo metals, we have developed several high efficiency burners using various fuels. The six main types are:

- an SNT burner which produces a strong swirl flame;
- an SSF burner which produces a bright stable flame when using pulverized coal;
- an SSC burner producing a variable length flame with extremely low NO_x emission;
- an SCF burner producing a variable length curtain flame;
- an SLG burner which produces a stable flame when using lean gases;
- an SNM burner which produces a reducing and direct heating flame in continuous heat treatment furnaces.

The purpose of this paper is to produce the details of the structure and combustion of these burners and to outline their use in the factory.

42 FLUID FLOW ANALYSIS IN DC ARC FURNACE BATH

By Kazuki Igarashi, Tsuyoshi Nakamura, Kohji Ishihara and Masahiro Kawakami

A mathematical model has been developed in order to clarify the fluid flow in DC arc furnace bath, combining electromagnetic fluid field and flow analysis. The model has been confirmed by measuring the velocity profile in Wood's metal bath of one tenth dimension of 30t DC arc furnace, with the aid of an electromagnetic velocity sensor.

A large circulating flow downward at the center is revealed in Wood's metal bath by the model when a small upper electrode and a large bottom electrode are used. The maximum velocity is computed as 30

mm/s. On the contrary, the similar large circulating flow and a small eddy of reverse direction are revealed when small upper and bottom electrodes of the same size are used. The computed flow field is fairly in agreement with the measured one.

The external magnetic field was imposed by putting coil beneath the bath bottom. The same quantity of current as that supplied to the furnace was supplied to the coil. The externally imposed magnetic field made a horizontal circulating flow around to central axis. The flow made a large circulating flow upward at the center when a small electrode and a large bottom electrode was used. The computed flow was also fairly in good agreement with the measured one.

43 ELECTRODE CONNECTING ROBOT FOR ELECTRIC ARC FURNACE - ON THE AUTOMATIC ELECTRODE LENGTH CONTROL SYSTEM

By Shin-Ichi Tsukizaki

Steelmaking by Arc Furnace has a history of nearly 100 years and its production now reaches a 30% share in Japanese steel production, which was mainly contributed by the application of large scale furnace and high power operation.

It is time, in several years from now on, for many steelmakers by Arc Furnace to renew their facilities. In the meantime, the reduction of working time and the elimination of dangerous, dirty and hardworking conditions have become serious subjects to be considered.

To cope with this, the electrode connecting robot which eliminates the work by manpower operation on the furnace roof was developed.

The following items can be expected by the robot:

- to eliminate the works in hot and dangerous places;
- to reduce the number of workers;
- to enable connecting work of large diameter electrode which is difficult work for workers;
- to reduce the time for electrode connection;
- to obtain a stable and reliable connection.

44 EFFECT OF M-ELMS AND ALUMINIUM ADDITION OF BILLET QUALITY

By Osamu Itu, Yoshinori Sunaga and Tomoaki Ohkubo

The formation of pinholes and slag patches on the surface of the continuously cast billet is a very important problem in open continuous casting of slightly deoxidized steel.

In this study, the effect of electromagnetic stirring in the mold and the aluminium addition into the molten stream on the billet surface quality for pinholes and slag patches was investigated with the molten steel of different method of deoxidation and seal.

The results obtained are summarized as follows.

- pinholes are almost suppressed with the molten flow at the certain M-ELMS intensity for the molten steel with auxiliary deoxidation and seal;
- pinhole formation for the molten steel without auxiliary deoxidation and seal cannot be successfully suppressed even though aluminium wire is added in the mold more than three times as much as the case of the molten steel with auxiliary deoxidation and seal;
- the pinhole formation site moves near the corners of the billet with increases in M-ELMS intensity;
- slag patches can be almost suppressed by the aluminium addition and M-ELMS.

45 THE SHEERNESS SHAFT FURNACE

By John W. Clayton, John C. Twiselton, Joachim K. Ehle and Hubert Knapp

An electric arc furnace with integrated scrap preheating, a so-called SHAFT FURNACE designed by Fuchs Systemtechnik, went into operation at Sheerness Steel, Great Britain in March 1992, selling a new standard in electric steelmaking.

With this method a great part of the energy potential of the off-gases is utilized for preheating of the scrap before it is melted, with electric power.

Reducing the amount of energy requirement to melt the scrap as well as reducing the amount and temperatures of the off-gases are considered as beneficial to the environment.

Productivity is increased by the same manner and thus the overall economies of the plant as well as the operating environment are improved considerably.

Owing to certain mechanical restrictions of the existing meltshop, this furnace shows unique construction features which will be reported. Operational results will be given as well as an outlook to utilize the DOUBLE SHAFT FURNACE technology (two shells - two shafts, but one transformer) for further reduction of energy consumption and improved productivity.

Economical, operational as well as environmental aspects will be presented based on two projects, which will start-up in the second half of 1993, utilizing this technology.

46 A COMPARATIVE VIEW OF CONTROL AND REGULATING TECHNOLOGIES FOR SOME PRI-MARY SMELTING OPERATIONS

By Ahmadzai H.

A survey of regulations and state-of-the-art control technologies is presented relating to the smelting of primary Al, Cu, and recycling of residues. Some costs associated with the alternatives and trends for the coming decade in this sector are identified. 9 ref.

47 COMPREHENSIVE WATER MANAGEMENT PROGRAM FOR A PRIMARY COPPER SMELTER

By Viecelli C.P.

As Phelps Dodge Corporation addresses the environmental challenges of the 1990s, water management has become a key element in an overall waste minimization strategy. The Phelps Dodge Hidalgo Cu smelter has implemented a comprehensive water management program that includes management of both fresh and process water utilized by its pyrometallurgical operation. Two major technological strategies are being implemented. They are the design, construction and operation of a raw water pre-treatment facility to allow increased evaporation within cooling towers thereby minimizing blow down, and the use of a brine concentrator to treat and recycle significant quantities of process water. The end result of this program is a significant reduction in raw water pumped from the underlying aquifer into the facility and a decrease in process water which must be impounded or otherwise treated. 1 ref.

48 SOME ALTERNATIVE APPROACHES FOR THE TREATMENT OF ELECTRIC FURNACE STEELMAKING DUSTS

By Castro F.

Electric furnace steelmaking dust is a polluting residue that needs to be treated to recover metals contained and to produce an environmentally acceptable residue. Some hydrometallurgical approaches for its treatment have been evaluated: caustic soda leaching followed by electrolytic recovery of Zn, ammonia leaching followed by Zn compounds' precipitation and acetic acid leaching followed by Pb, zinc hydroxide and gypsum precipitation. 8 ref.

49 COPPER EXTRACTION FROM SMELTER FLUE DUST BY LIME-ROAST/AMMONIACAL HEAP LEACHING

By Yin Z., Caba E. Barron L., Belin D., Morris W., Vosika M. and Bartlett R.

Copper smelter flue dusts often cannot be directly recycled to the smelting process and accumulate as hazardous wastes requiring environmentally acceptable disposal. Because of the limited amount of flue dust, a separate Cu extraction process must be simple and require a small plant investment. A flue dust process has been developed, consisting of the following steps: roasting a pelletized mixture of hydrated lime and flue dust to fix arsenic and sulfur as insoluble calcium salts; heap leaching the roasted pellets with a buffered ammonia/ammonium salt

solution to extract Cu as an ammine complex in a lined cell that is the final repository of the leached pellets, and boiling ammonia from the lixiviant to precipitate Cu. Condensed ammonia and the filtered solution are returned to leaching. Heap leaching in the final repository cell lowers the capital investment significantly compared with competing extraction processes. Chemistry with respect to As, S, and Cu is discussedGraphs. 11 ref.

50 THE CASHMAN PROCESS TREATMENT OF SMELTER FLUE DUSTS AND RESIDUES

By Kunter R.S. and Bedal W.E.

Artech Recovery Systems, Inc has developed a low pressure and temperature leach process called the "Cashman Process" to extract metals from arsenical flue dusts and residues and fix the arsenic in an environmentally stable form as ferric arsenate (scorodite). The process was pilot tested at Hazen Research in an integrated plant including continuous recycle from August-October 1989, during which several tons of flue dust were processed. Based on this pilot program, the process was deemed technically feasible and produced commercially salable products. Residues from this pilot program were subjected to a long-term stability test jointly designed by PTI environmental services and the USEPA. The process, its versatility, and the nature of the products are discussed in some detail. Graphs. 5 ref.

51 HYDROMETALLURGICAL PROCESS OF COPPER CONVERTER DUST AT THE SAGANOSEKI SMELTER & REFINERY

By Tomita M., Higashi M., Oto S. and Okamoto, H.

One of the most essential factors for a custom smelter to strengthen its competitive power is to improve its comparative standing in purchase of concentrates from the world market. It is especially critical for Japanese smelters who depend on import for almost 90% of their raw materials. To accomplish this breakthrough, the development of the new technology which enables treating concentrates containing higher impurities is inevitable. Nippon Mining Company Ltd intensively researched processing complex ore for three years, from 1979, and successfully developed an original hydrometallurgical process to treat converter dust for eliminating impurities from the Cu smelting circuit. The commercial plant was constructed at the Saganoseki Smelter & Refinery in 1982, and its nine years operation has satisfactorily proven the advantages of the technology. The concept of this process and its operational performance are discussed. Graphs.

52 SLAG HANDLING IN THE IRONMAKING INDUSTRY

By Cooper A.W.

A review is presented of the development of blast furnace slag handling and processing technology in the ironmaking industry over the past 30 years, with an emphasis on economic and environmental factors. The requirements and practice of air-cooling slag for use as aggregate and of pelletizing and granulating slag for use in cement manufacture are described. The operation of slag pits, slag pots or ladles, the slag pelletizer and early granulation systems are compared with the new continuous granulation, dewatering and handling systems developed in the past decade. Graphs. 32 ref.

53 A FLUIDISED BED ION EXCHANGE SYSTEM FOR TREATMENT OF EFFLUENT WATER OF COKE OVEN AND BY PRODUCT PLANT

By Pandey H.D., Gupta A., Bhattacharya S., Mediratta S.R., Das B.N., Rao K.V.K. and Murty, J.S.

A fluidised bed ion exchange method for simultaneous removal of phenols and cyanide from the effluent is described. Use of an eluant enables regeneration of the resin in the continuous operation mode. The breakthrough experiments conducted both on the laboratory scale and on a pilot plant scale have shown that, while the level of phenol can be brought down from 462 ppm to approx 6 ppm, the free cyanide is almost totally removed. An examination of data indicates that the method can serve the twin objectives of pollution control and phenolic compounds recovery. Graphs. 9 ref.

54 COMPLEX PROCESSING OF ZINC-CONTAINING THE PRODUCTION WASTES OF VARIOUS INDUSTRIES

By Kozlov P.A. and Saprygin A.F.

Possible ways of Zn extraction from low-grade Zn-containing wastes of metallurgical and chemical industries are examined with emphasis on the Waeltz process. A Waeltz process for Zn extraction from the calciferous sludges of synthetic fiber production is analyzed. Results of laboratory and pilot-plant tests demonstrate the feasibility of the proposed process. Graphs. 8 ref.

55 NEW TECHNOLOGIES IN COKEMAKING

By Tiwary, M.

Technologies for increased cokemaking efficiency are discussed with particular reference to the Indian steelmaking situation. Each of these processes is aimed at (i) improvement in coke quality, (ii) use of a wide range of coals without sacrificing coke quality, and (iii) increased production/productivity of coke ovens. Particular technologies which appear to be of importance include: high capacity ovens with taller and or wider chambers, jumbo coking reactors, coke dry quenching, flood coke quenching, compaction of the coke charge inside the ovens, addition of tar/pitch to a coal blend, beehive cokemaking in improved type of ovens, and use of solvent refined coal for cokemaking.

56 REMOVAL OF HALOGENS FROM EAF DUST BY PYROHYDROLYSIS

By Downey J.P. and Hager, J.P.

In the thermal treatment of electric arc furnace (EAF) dusts, Zn is reduced, volatilized, and ultimately recovered either as liquid metal in a splash condenser or as solid zinc oxide in bag filters. During the process, the dust's Cl and fluorine content also enters the gas phase and condenses as dross in the splash condenser or as salts which contaminate the zinc oxide product. Pretreatment of EAF dust by pyrohydrolysis appeared to offer a means of minimizing the dust's halogen content. Experimental results proved that 97-99% Cl extraction and 80-85% Fl extraction are consistently achieved when EAF dusts are blended with silica and roasted at temperatures 850 - C in a furnace atmosphere of 75% steam (diluted by air). A statistical analysis further established that more than a single optimal point exists, thus affording flexibility in parameter selection (e.g. by increasing temperature, the necessary retention time and additive concentrations are decreased). The findings substantiate the feasibility of pyrohydrolysis roasting in reducing the Cl and Fl in the EAF dust to a level that will obviate industrial concerns about halogen contamination. The end-product of the pyrohydrolysis procedure is a de-halogenated, self-fluxing calcine which can be directly charged to a plasma or flame reactor. Design parameters and flow diagrams illustrating the pyrohydrolysis process integrated with the plasma and flame reactor technologies are included. Graphs. 6 ref.

57 THE COMMERCIAL DEVELOPMENT OF PLASMA TECHNOLOGY: EAF DUST APPLICATION

By Bunney D.T., Mazanek M.S. and Pargeter J.K.

In December of 1987, International Mill Service, Inc. signed an exclusive licensing agreement with Tetronics Research & Development Co. Limited of Faringdon, Oxfordshire, England, to commercialize plasma technology which had been demonstrated in an EAF dust processing application. The intent of the process is to reduce and volatize the zinc, lead, and cadmium oxides inherent in EAF dust and collect these elements as metals in an ISP (Imperial Smelting Process) Zn splash condenser, and to render the resultant slag an inert, non-hazardous material. With these objectives in mind, IMS started commissioning facilities in 1989 at Florida Steel in Jackson, Tennessee, and Nucor-Yamato Steel in Armorel, Arkansas (USA). The commercial development and progress of the technology at these two installations are described.

58 REDUCING EMISSIONS IN FOUNDRY OPERATIONS.

By Dopp R.

Germany contains approx 440 Fe-based and 660 non-ferrous foundries. These foundries generate

emissions from core and mold making melting and cleaning operations Control of emissions to conform with environmental regulations is discussed, along with measures that can be taken to remove sources of pollution Graphs 61 ref

59 CASTING AND ENVIRONMENTAL ADVANCES IN THE FRC PROCESS

By Shriver H.R., Barnett, K.W. and Archibald J.J.

The free radical cure (FRC) process utilizes sulfur dioxide gas to initiate the rapid coldbox cure of two-component acrylic - epoxy resin systems Redesign of these systems has eliminated the need for separate addition of third part adhesion promoters while also improving binder storage stability These new-generation binders can also provide decreased veining defects and increased erosion resistance in many ferrous applications Higher tensile strengths in conjunction with the benefits of recent equipment advances allow for the use of lower binder levels This in turn leads to significant improvements in shakeout rates in nonferrous applications In addition to improvements in foundry operations, these new-generation binders address the all-important issues of worker safety and compliance with environmental regulations The number of government-regulated components such as chlorinated solvents is reduced with the new binder systems without sacrificing product performance Another important development is the achievement of substantial reductions in worker exposure to sulfur dioxide during both coremaking and core storage This objective was met by curing with sulfur dioxide/nitrogen mixtures rather than with pure sulfur dioxide and fundamental changes in resin design Tests using AI356 are discussed Graphs 7 ref

60 THERMAL RECONDITIONING OF CORE SAND IN AN ALUMINUM FOUNDRY: A CONTRIBUTION TO ENVIRONMENTAL PROTECTION

By Wesp S and Engelhardt W.

Thermal reconditioning of core sand makes a valuable contribution to the topical theme of environmental protection With the aid of this reconditioning method, used foundry sand can be returned to the condition of usable sand Construction of the installation was preceded by comprehensive investigations with comparisons of data from several different thermal reconditioning plants These data were assessed with the aid of an assessment code and provided the basis for the decision of which installation should ultimately be awarded the contract Presented is a detailed description of the installation and of the process engineering involved In the cost comparison between fresh sand and reconditioned sand, it is particularly apparent that a considerable proportion of the heat arising can be passed straight on to the plant heating network This factor has particularly favorable results in overall cost The efficiency of the installation, currently at 92%, is being improved to 96% by various measures that have already been introduced Finally, details are given of practical experience gathered in the period since the installation was commissioned Graphs

61 SURFACE TREATMENTS OF METALS USING EXCIMER LASERS: POSSIBLE APPLICATIONS FOR THE AUTOMOTIVE INDUSTRY

By Bergmann H., Schutte K. and Quentsch, R

Fundamental investigations of the surface treatment of metals using excimer lasers have been carried out in recent years Excimer laser systems have now become reliable and handling problems seems to be solved The results of fundamental experiences and first possible applications, especially for the automotive industry, are presented An excimer laser working station for three-dimensional materials processing has been built to demonstrate the possibility of treatments on typical materials and parts for the automotive industry Smoothing of cam shafts, crankshafts, and gear wheels leads to a noise reduction and optimizing of the wear resistance against abrasive wear for those components Another possible process, which is discussed, is the ablation of deformation layers This process leads, especially for cast iron cylinder liners or cylinder blocks, to a laying-bare of the graphite inclusions by optical means, avoiding the pollution problems arising from chemical treatments The opened graphite spherulites or laminae acts as oil reservoirs minimizing the oil usage and improving the running-in phase of the treated motors Graphs, Photomicrographs 7 ref

62 PROGRESS IN DAVY MCKEE FGD INSTALLATIONS

By Ford P.G.

In the Wellman - Lord flue gas desulfurization process, the absorbing solution is reused, and the absorbed SO_2 recovered as elemental sulfur, sulfuric acid or pure liquid SO_2. Reductions in power, steam and caustic usage have substantially improved plant running costs. Process intensification has also reduced the capital cost. Developments in materials used in the plants have centered on the absorption system, as conditions in the regeneration plant are relatively mild. The first power plant Wellman - Lord absorbers featured 316 stainless steel valve trays in the absorber tower. Metallic materials currently in contact with the prescrubber solution are Hastelloys or equivalent. 316 stainless steels are used for the shell and internals in the absorption section. In two plants, Wellman - Lord absorbers are constructed of Palatal A 430 glass fiber reinforced vinyl ester resins. 316L, carbon steel, vinyl ester GFRP, and Hastelloy C22 and C276 ductwork corrosion experience is described. Graphs. 7 ref.

63 A NEW PROCESS OF OXIDIZED NICKEL ORE MELTING IN A TWO-ZONE MELTING

By Ryzhov, O.A., Vigdorchik E.M., Mosiondz K.I., Zheldybin O.I., Tsymbulov, L.B., Ezhov E.I. and Rusakov, M.R.

The results of extended laboratory tests of a new continuous cokeless ecologically-clean process for oxidized Ni ore processing to produce ferronickel in a two-zone unit are considered. The test results for metal extraction and for melt product composition in the process are presented. An estimate for workability of individual assemblies and the unit as a whole, and possibilities to use it to melt both oxidized raw material and sulphides are given. 3 ref.

64 AN IMPROVEMENT OF ECOLOGICAL SAFETY DURING THE HEAVY REPAIR OF ALUMINUM ELECTROLYZERS

By Demykina O.B., Mintsis M.Ya. and Tolkunov, B.I.

The results of analysis of diverse type cathode units in the upper and side current-leads are presented. The ways to decrease the quantity of fluorine-bearing waste when dismounting the electrolyzer to improve the ecological safety during the heavy repair are considered. 3 ref.

65 ADSORBING FLOTATION OF COPPER HYDROXO PRECIPITATES BY PYRITE FINES

By Zouboulis, A.I., Kydros K.A. and Matis, K.A.

The removal of Cu ions from dilute aqueous solutions by the addition of mineral (pyrite) fine particles was undertaken by following an adsorbing (scavenging) flotation mechanism. Pyrite generally constitutes a residual or a solid industrial waste by-product in mixed sulfides processing plants. A further utilization for pyrite is suggested. The dissolved-air method was applied for solid/liquid separation when the mineral particles were in the fine (subsieve) size range. Various unconventional collectors for pyrite flotation were also examined. Graphs. 24 ref.

66 THE EOS PROCESS: A NEW PROCESS FOR ENHANCED POLLUTION CONTROL IN IRON-ORE SINTERING

By Cappel F. and Weisel H.

Iron-ore sintering entails substantial off-gas volumes, the treatment of which causes considerable cost to meet evermore stringent environmental protection standards. The EOS (emission optimized sintering) process is geared to reduce the off-gas volume by 60-80% while conserving or even improving sinter characteristics. This process opens up completely new perspectives of off-gas cleaning and leads to appreciable cost savings for environmental control measures. Graphs. 1 ref.

67 EFFECT OF ULTRASOUND ON ACIDIFIED BRINE LEACHING OF DOUBLE-KILN TREATED EAF DUST

By Barrera-Godinez, J.A., O'Keefe, T.J. and Watson, J.L.

The US steel industry produces approx. 500,000

tons year of electric arc furnace (EAF) dust, which is classified as a hazardous waste. Increasing disposal costs of these dusts have encouraged studies to investigate treatment processes to render the material non-hazardous, and to possibly recover metal values. This research project was designed to examine the hydrometallurgical recovery of Zn from EAF dusts that have been treated by a double-kiln fuming process. The test work consisted essentially of acidified brine leaching of the pelletized calcine to determine the influence of traditional conditions, such as acid concentration, temperature and agitation, plus the application of ultrasound, on the Zn dissolution efficiency and selectivity. Preliminary leaching tests using acidified calcium chloride indicated that selective leaching of Zn over Fe could be attained if ultrasound was employed. The effect of air and nitrogen on the leaching process was investigated and it was established that selective leaching with ultrasound was not dependent upon external agitation or on the availability of oxygen. Without ultrasound, Zn dissolution was enhanced by the presence of O_2 while Fe dissolution was greatly retarded by the absence of O_2. The role of surface area was examined by pellet grinding and it was demonstrated that selectivity was strongly time dependent and Zn recovery and Fe rejection were enhanced at finer particle sizes. The results of the test work permitted possible mechanisms to be established for the acidified brine leaching process, and it is apparent from the results that ultrasound leaching can significantly improve the selective leaching of Zn from double-kiln treated EAF calcine. Graphs 23 ref.

68 INCREASE OF EFFECTIVENESS OF ALUMINUM ALLOY DEGASSING BY BLOWING OF INERT GASES

By Palachev V.A. and Inkin S.V. and Belov V.D. and Kurdyumov A.V.

An ecologically pure technique for Al alloys degassing was developed. The technique reduces the amount of hexachloroethane released into the atmosphere. Optimal conditions for the processing of hypereutectic Al - Si alloy KS740 were established. The effect of various additions on the hexachloroethane produced was established. Graphs 3 ref.

69 HYGIENIC ESTIMATION OF LIQUID ALUMINUM ALLOY REFINING

By Ermolenko, A.E., Grinberg, A.A., Savichev S.A. and Rabinovich, A.M.

A new ecologically safe flux was developed. The flux has a reduced amount of toxic substance evolution. The fluxes were evaluated during their use in melting of Al alloys AK12. The flux was recommended as a cleaner alternative in Al alloy refining. A detailed analysis of the evolved substances was carried out. 1 ref.

70 CONTROL OF VOC EMISSIONS FROM NONFERROUS METAL ROLLING PROCESSES

By Gov. Res. Announc. Index

The document was developed in response to increasing inquiries into the environmental impacts of nonferrous metal rolling processes that use oil as a lubricant and coolant in rolling operations. VOC emissions result from evaporative fugitive losses caused by heat generated in the rolling processes. The focus is VOC emission control techniques used by Cu and Al rolling mills. A control cost analysis is also provided for each of the control techniques addressed. The control techniques are carbon adsorption, absorption, incineration, and lubricant substitution.

71 CHEMICAL COLOURING OF STEEL AT ROOM TEMPERATURE

By Yang G.L., Guo W.Q., Chao G. and Wu D.L.

The chemical colouring solution, utilizing the system of $CuSO_4$ - H_2SeO_4, is introduced. It has the advantage of obtaining films on Si steel, 45 or A3 steels with favourable anti-corrosion and wear resistance performances. The technology is simple in operation and is non-polluting for the environment.

72 STEELS' RECLAIM TO FAME

By Dziewa R.

Any successful appliance recycling program -

current or future - must prove economically viable and, for a number of reasons, steel lends itself well to appliance recycling. When appliance producers decide on the design of an appliance, they are beginning to consider the unit's recyclability as an additional dimension for consideration. From early vendor involvement, throughout the manufacturing system, cooperative efforts between OEMs, suppliers and vendors yield important cost reductions and improved quality with considerations to CFCs. Several appliance producers are interested in using sound damped steel made of a product of constrained layer composites consisting of metal outer skins surrounding a thin viscoelastic core material. A review of appliance recycling internationally covered advances in Japan, Canada, Germany and the US.

73 "MEMBRANE-BASED" RECOVERY/TREATMENT SYSTEM FOR GOLD MILL BARREN BLEEDS

By Maracle K.J. and Cte. P.O.

Recent regulations introduced by the Ontario Provincial Government in the form of the Municipal Industrial Strategy for Abatement (MISA) will force many Au mines to implement more stringent treatment processes for cyanide and metals removal from their mill effluents (barren solutions). These barren solutions contain a multitude of substances including free cyanide and a variety of metal-cyanide complexes. Currently, the cyanide is destroyed by one or two of various processes. If this cyanide could be economically recovered and reused, a considerable savings would be recognized. The objective of this work was to study the feasibility of using hollow fiber gas membrane technology for the recovery of cyanide from acidified Au mill barren bleed solutions.
This was accomplished by modelling the hydrogen cyanide mass transfer process, confirming these results experimentally with barren solutions from two Ontario Au mills, and evaluating a complete membrane based recovery/treatment system both experimentally and economically. This system included barren solution acidification, cyanide recovery via hollow fiber gas membranes, and chemical precipitation for metals and residual cyanide removal, followed by liquid/solid separation. This paper describes the results of an economic analysis performed on the complete recovery/treatment system at full scale operations for the two Ontario Au mill barren solutions. Also presented are the cyanide recovery and cyanide and metals removal percentages obtained by this process as determined from bench scale experimentation. Graphs 11 ref.

74 MAGNOLA - AN INNOVATIVE APPROACH FOR MAGNESIUM PRODUCTION

By Celik C., Ghatas N.E., Lenz J., Letourneau C. and Santiago, R.

Presented is the proprietary innovative technology adopted by Magnola to produce magnesium metal from serpentine minerals contained in asbestos mining residues. Maps.

75 PROGRESS IN POLLUTION ABATEMENT IN EUROPEAN COKEMAKING INDUSTRY

By Fisher R.

Recent research and development work that has been carried out on the control of air and water pollution within the European cokemaking industry is reviewed. In the carbonisation process itself, diffuse emissions from battery doors, lids, and ascension pipe seals and from battery operations, such as oven charging and pushing and coke quenching, are significant sources of pollution. Collaborative investigations undertaken by various research groups are reported which demonstrate the effectiveness of modern battery design backed up by good operating practices. In the purification of carbonisation effluents, considerable advances have been made in control of treatment processes. This is highlighted by developments in the control of ammonia stripping operations and by the enhancement of biological treatment facilities to include nitrification and denitrification of the waste water. However, as environmental constraints become tougher, there will be an increasing need to consider new concepts in cokemaking technology and waste water treatment. Graphs. 27 ref.

76 PASSIVE TREATMENT METHODS FOR ACID MINE DRAINAGE

By Kuyucak N. and St-Germain, P.

Acid mine drainage (AMD) occurs at operating and abandoned mine sites as a result of oxidation of sulfide minerals, and is characterized by low pH and heavy metal contamination (e.g. iron, zinc, copper, cadmium, aluminum, manganese). It usually requires treatment before release to meet regulatory requirements. Chemical methods, such as lime neutralization and sulfide precipitation, are commonly used to treat AMD. However, the conventional processes require high capital and operating costs, and constant attention for many years into the future. In addition, the amount of sludge produced by conventional lime treatment processes poses an increasingly significant disposal problems at decommissioned mining operations. There is, therefore, an urgent need to develop passive, cost-effective processes for mitigating AMD and seepages originating from tailings and waste rock areas. Noranda Technology Centre (NTC) has been evaluating various methods being developed by other institutions, and exploring new ideas, to achieve passive in situ processes for treating AMD. These methods include anoxic limestone (ALS), lime-organic mixture (LOM), biosorbents (BIOS) and biotrench (BT). Current investigations at NTC involve preliminary bench-scale testing. Based on the outcome of the bench tests, a field test will be performed at a selected site. Details of the bench tests are discussed. 15 ref.

77 USING ZEOLITE IN THE RECOVERY OF HEAVY METALS FROM MINING EFFLUENTS

By Eyde T.H.

Natural zeolites are a less expensive and in certain applications a superior alternative to organic ion exchange resins. Mining and metallurgical waste streams are difficult to treat because the effluents which contain potentially valuable heavy metals such as copper, lead, and silver are often highly acidic and contain significant quantities of suspended solids. Under rigorous operational conditions, certain natural zeolites can remove the metals, which if desired can be recovered by either elution or conventional smelting techniques. There are significant differences in cation exchange rate, selectivity and capacity and resistance to either high or low pH, blocking cations and tolerance to elevated or depressed temperature and pressure not only between different zeolite minerals but between the same mineral from different deposits. Applying natural zeolites to the treatment of mining and metallurgical waste streams depends on matching the specific zeolite to the effluent by characterization of the zeolite minerals. 12 ref.

78 ENVIRONMENTAL LEGISLATION AND THE CANADIAN STEEL INDUSTRY

By McGuire T.E., Lockington, J.N., Madlen D.O. and Thoburn W.

Canada has initiated a programme to systematically reduce water pollution in Ontario with enforceable regulations that become more stringent as abatement technology improves. The way in which Dofasco (one of four integrated steel plants in the province and with an annual production of approx 3.9 million to of flat-rolled products) is actively contributing to the objectives of the programme is discussed. The ultimate goal is the virtual elimination of persistent toxic contaminants from all discharges into Ontario waterways. Graphs.

79 CHALLENGES AND OPPORTUNITIES IN THE STEEL INDUSTRY

By Fruchan, R.J.

US steelmaking will face increasing challenges in the next decade from environmental concerns, increasing quality demands, and international competition. Five areas are described in which engineers can make contributions to help meet these challenges. They are: new ironmaking processes such as direct ironmaking (DIOS process) or other coke free methods, increased recycling through better scrap separation, preheating, and use of coal, quality steel production through inclusion, phosphorus, and nitrogen control, near net shape casting of thin slab and strip material, and process modeling and computer control. Graphs 11 ref.

80 OPTIMISATION OF METALLURGICAL SINTER PROPERTIES

By Vegman E.F. and Rutkovski, Y.

A relationship was established between the hot strength and the FeO content in the sinter. By optimising the FeO content in the sinter produced at Hutte Kotowicze at 8-9%, the hot strength has been

maximised. An added advantage is that the carbon monoxide, CO_2, NO_x, SO_2 and SO_3 emissions have been reduced Graphs. 3 ref

81 RETROFIT OF A WET SCRUBBER TO REDUCE PAH EMISSIONS FROM HS SODERBERG POTLINES

By Garicpy R.

Reduction of PAH emissions is one of the greatest challenges for an aluminum plant using HSS technology. This challenge can be achieved by reducing anode consumption, utilizing a different anode paste, and by improving the efficiency of existing wet scrubbers through upgrading. This paper describes the retrofit of an industrial wet scrubber by the use of electrostatic technology and mechanical modifications to the Alcan Arvida HSS plant. Development steps, modifications of the scrubber and results are presented. Graphs. 10 ref

82 SILVER RECOVERY WITH ION EXCHANGE AND ELECTROWINNING

By Lindstedt J. and Doyle, M.

Silver cyanide complexes in wastewater from precious metals electroplating operations can be quite problematic, as the complexed cyanide is somewhat resistant to oxidation by conventional alkaline chlorination. Furthermore, Ag is a valuable metal with a high market value and typical precipitation and clarification techniques do not readily allow recovery of the metal. It has long been recognized that ion exchange systems can be utilized to remove the silver cyanide complex from electroplating rinsewater. These metal complexes are strongly retained by anion resins and are difficult to remove with conventional strong base regeneration, so that often the exhausted resin is simply shipped off site for Ag recovery by incineration, thereby resulting in high operating costs due to resin replacement. The results are presented of bench scale studies which examined the effectiveness of thiocyanate regeneration of the saturated resin for Ag recovery. The spent regenerant was then treated by electrowinning to recover the eluted Ag in a fairly pure state. Projected capital and operating costs for a 2 gpm regenerable ion exchange system were examined. Operating results of a full scale non-regenerated system are presented. Graphs. 3 ref

83 THE ECOLOGICAL BALANCE SHEET: A MANAGEMENT TOOL

By Emballage Digest

Sollac, a French steel producer, presented its first ecological balance sheet in December 1991. It showed how the production of beer and soft drink containers with a steel body and an aluminum lid, and the standard steel food can had caused environmental problems. The manufacture of these articles has resulted in emissions of CO_2 and SO_2, powder releases, and material suspensions in the atmosphere, as well as the production of nitrogen oxides in their transport to the market. Sollac proposed that making lighter containers would result in less pollution because less material would be made and the lighter containers would be transported in fewer trucks. Sollac has presented its conclusions to other manufacturers in Japan and the US. Graphs

84 REDUCTION OF CO_2 EMISSION IN ALUMINIUM MELTING FURNACES

By Schmitz, Ch.

In scrap, recycling organic contaminations are removed by thermal processes. The necessary after-burning equipment requires additional fuel and the generation of CO_2 is increased. A new solution has to be found! One way is the mechanical preparation of scrap for reducing the organic components. Most of these materials can be deposited without harmful effects on the environment. This method, however, requires a change in the infrastructure of the recycling industry.

85 DECOATING OF ALUMINUM PRODUCTS

By Perry O.H.

Decoating of aluminum products has three very desirable features: recycled Al requires only 5% of the energy to produce new Al for the ore, environmental pressures are reduced, and clean Al has a significantly lower metal loss than coated material in the downstream melting operation. Described is work carried out by Stein Atkinson Stordy Limited to extend the range of the decoating

process to include such material as clean foils, printed foil paper and plastic laminated foil litho plate and food containers, in addition to UBC and NCS, etc. The technology of decoating is presented and process plant designed to meet the strictest environmental regulations is described. Graphs.

86 CHLORINATION TECHNOLOGY IN ALUMINUM RECYCLING

By Neff D.V. and Cochran, B.P.

In the recycling of many aluminum alloys, the use of Cl is both advantageous and necessary for control of magnesium content (demagging for secondary foundry ingot production). Chlorine can also be used for alkali metal impurity removal, hydrogen reduction and improved molten metal cleanliness (inclusion removal by flotation as well). This paper reviews the metallurgical and environmental characteristics of Cl usage in molten Al. In particular, there are environmentally efficient processes such as the gas injection/circulation pump used in many remelting applications, and various in-line molten metal treatment devices which exist as best available technology for Cl usage in molten Al processing. Recent data are presented on emissions, efficiency, and plant economics in the remelt demagging process, using Cl in the gas injection pump in secondary Al production. Graphs, Phase diagrams. 10 ref.

87 RECENT PROGRESS OF STEEL WIRE DRAWING TECHNIQUES

By Sato H., Oka K., Toshiro H. and Sasaki S.

To meet the increasingly severe wire strength requirement, wire rod must be drawn to a higher strain level while minimizing the loss of ductility in the course of drawing. The tight labor market situation of late strongly demands high efficiency, automation and labor savings in the wire drawing operation. Environmental control considerations also have led to an increase in the mechanical descaling of rod and wire. These circumstances have combined to urge the development of techniques to draw high-strength and high-performance wire with high efficiency and without environmental pollution. Summarized is the recent progress in the development of technologies for the drawing of wire with higher strength and ductility, mechanical descaling of wire, and for the evaluation of wire drawing conditions as one step forward to the automation of wire drawing, centering on Nippon Steel's research examples. High carbon steel SWRH82A is discussed. Photomicrographs, Graphs, Spectra. 17 ref.

88 GUIDANCE ON THE OPTIMUM USE OF FILTRATION SYSTEMS FOR FUME EXHAUSTS FROM HOT DIP GALVANIZING PLANTS

By Marberg, J.

In hot dip galvanizing, steel parts are pretreated (as a rule by degreasing, pickling, rinsing, and fluxing) and then immersed in molten zinc. During this dipping process, the flux evaporates under the effect of heat. In consequence, there is emission of a relatively large proportion of the ammonium, chlorine, and Zn compounds contained in the flux. The present work reports current aspects of the operation of collection and filtration systems. It takes account of conditions in West Germany. The work does not examine all the principles of collecting systems and filtration plant (which should be generally known), but confines itself essentially to more recent findings and practical experience. 6 ref.

89 ECOLOGY IN HEAT TREATMENTS AND SURFACE TREATMENTS OF METALS: RECOVERY PROCESSES AND PURIFICATION TECHNIQUES

By Moretti C.

With restrictions growing on emissions and waste products from the heat and surface treatment of metals, the more common types of treatment plants are examined, as well as their relative emissions, various types of purification installations, and principal waste products. These installations utilize: chlorinated solvent degreasing, which produces only one toxic waste product, a mixed solvent oil, and uses modest amounts of solvent; alkaline degreasing; gaseous case-hardening furnaces and either oil or salt quenching; cyaniding; vacuum furnaces, the most ecologically-friendly of the plants; sandblasting; copper plating; rotational vibration; phosphating; and a dust exhaust with Venturi nebulizer. Experience suggests that

purification-recovery techniques are best factored in at the design phase of production plants, physical purification-recovery processes are superior in that they add no new elements to the process, but that chemical-physical purification processes are still necessary, and that ionic-exchange resin recycling systems are useful only for cleaning out the final traces of pollution.

90 DIOXIN POLLUTION PROBLEM FROM SCRAP PROCESSING

By Hong X. and Yang, T.J

Dioxins is a popular name of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF). This category of trace compounds emerges from steel scrap processing under certain temperature and catalytic conditions. Many years' studies of developed countries have confirmed that the dioxins endanger the health of mankind and harm the environment. The research development of this pollution problem is introduced and the countermeasures against dioxin pollution are put forward. Graphs. 6 ref.

91 GERMANY'S SECONDARY ALUMINUM INDUSTRY HAS DESIGNED ITS RECYCLING WITH THE ENVIRONMENT IN MIND

By Konzelmann G.

The economical challenges faced by the German secondary aluminum industry due to the increasing emphasis placed on maintaining an ecologically acceptable manufacturing environment and the unfavorable circumstances in the primary Al industry are discussed. The present cost structure of the German secondary Al industry is 53% fixed costs, 32% variable costs and 15% environmental costs. Production data for primary and secondary Al in Germany for 1970-1992 are presented. Primary Al production in Germany for 1993 is projected to be 550 000 tons, which is expected to be equaled by the secondary Al industry. Measures being taken by the German secondary Al industry to protect the environment, including improved processing of Al scrap, slag and dross handling and the use of regenerative burners are described. Graphs.

92 HIGH-TEMPERATURE SOLAR THERMO-CHEMISTRY: PRODUCTION OF IRON AND SYNTHESIS GAS BY FE_3O_4 - REDUCTION WITH METHANE

By Steinfeld A., Kuhn P. and Karni, J.

Criteria for selecting thermochemical processes that use concentrated solar radiation as the energy source of high-temperature process heat are reviewed. The system $Fe_3O_4 + CH_4$ is thermodynamically examined. At 1 atm and temperatures 1300K, the chemical equilibrium components consist of metallic Fe in the solid phase and a mixture of 66.7% H_2 and 33.3% carbon monoxide in the gaseous phase. The total energy required to effect this highly endothermic transformation is approx. 1000 kJ/mole of Fe_3O_4 reduced. Exploratory experimental studies were conducted in a solar furnace using a solar receiver (with internal infrared mirrors) containing a fluidized bed reactor. Directly irradiated iron oxide particles, fluidized in methane, acted simultaneously as radiant absorbers and chemical reactants, while freshly produced Fe particles acted as reaction catalysts. The proposed process offers simultaneous production of Fe from its ores and of syngas from natural gas, without discharging CO_2 and other pollutants to the environment. Graphs, Phase diagrams. 22 ref.

93 EXPERIENCE IN THE OPERATION OF A COMBINED SYSTEM FOR BURNING OF WASTE GASES AND THERMAL SAND REGENERATION IN A CUSTOMER ALUMINUM FOUNDRY

By Gruness, H. and Schroter, K.

The Mandl & Berger foundry in Linz, Germany, was challenged to reduce emissions of odorous gases, noise, and dust due to encroachment of residential buildings in the area of the foundry (annual output approx. 6000 t aluminum castings). A system to combine waste gas incineration and sand regeneration was designed and has operated successfully for a time. The system is described in some detail. Values of mandated maximum emissions vs. actual emissions achieved are also given for dust, organic carbon, carbon monoxide, and NO_x. Total organic carbon of 7 mg/m^3 was

measured, eliminating any odor from the system. Dust content of 5 mg/m^3 was achieved via fabric filters. Recovery of regenerated sand is given as 98%. Graphs, Photomicrographs.

94 THE NEW EFFICIENCIES OF ANTI-POLLUTANT FURNACES

By Ford E.

Wellman Furnaces is a leading European furnace design and manufacturing company that produces a full range of metallurgical heat treatment furnaces, low-temperature ovens, kilns, and rolling mill equipment. The equipment is designed for maximum energy efficiency, optimum production rates, and low pollutant emissions. The Supacase is an example of a state-of-the-art sealed quench furnace. It operates at an 80% thermal efficiency with a three-fold increase in temperature uniformity. This is a plus/minus 3 - C variation compared to a plus/minus 10 - C variation. A dual product improvement approach has been adopted that upgrades old furnace designs and development of new concepts. Use of convective heating is employed for rapid heating. Start-up from a cold state takes 10 min. Savings of 50% in gas consumption have been demonstrated in addition to improved product quality, productivity, and a cleaner plant environment. A pulse-fired non-modulating regenerative burner developed by Hotwork Development of Dewsbury have shown energy cost savings of $72 000/year, which is a payback of 1.7 years. Ferritic and martensitic stainless steels are annealed.

95 PROFITING FROM PRE-FINISHED METALS

By Hroncich E.F.

Increased awareness of environmental concerns, along with government-mandated pollution-control regulations, has prompted many metal formers to look more closely at possible changes in their operations. Such evaluation has fueled the trend toward the use of pre-plated and pre-polished metals, i.e. brass-plated steels. A decision to rely on pre-plated metals offers several advantages, which include: the metalformer need not invest in pollution-control equipment, time and cost savings benefits, production cycle is shortened, aesthetic merit, a variety of finishes including rigidized finishes, and existing tooling, in most cases, can be used on the pre-finished metals thus making the change without major capital expenditures.

96 THE ROLE OF EMERGING TECHNOLOGIES IN FLOWSHEET DEVELOPMENT

By Lakshmanan V.I.

The need for mining and metallurgical industries to be sustainable requires them to be innovative in their applications of existing technologies within the mining industry, and avail themselves of opportunities to apply proven applicable technologies from other industries or evaluate the role of emerging technologies in their process application. Increasing competition and environmental restrictions demand the process flowsheets to have efficient separation processes to obtain market advantage and be a good corporate citizen. The paper evaluates the need and opportunities of emerging technologies for mining and metallurgical industries. Opportunities for proven metallurgical separation processes in areas outside the metallurgical industries are identified. 11 ref.

97 MINERALS INDUSTRY FLOWSHEET DEVELOPMENT FOR THE NINETIES: A GREEN PERSPECTIVE

By Harris G.B.

Increasing concern over the environment in which we live, the air quality, water quality, dump sites, and even the aesthetic appearance of industrial processing plants, is having a significant effect upon the way in which flowsheets are now designed. The method of disposal of unwanted impurities is important, and in some cases is the most significant factor in the development of new processes, or the rehabilitation of older ones. The recent formation of the International Council for Metals and the Environment (ICME) and the number of conferences and workshops devoted to environmental issues point to this increased awareness in the minerals industry. This paper notes some of the more recent and proposed environmental-based legislation, and considers the consequences that have to be taken into account when designing modern flowsheets. As an illustration, the presence of arsenic in a refractory

gold ore is considered, and the implications its presence has in determining an economic, technically viable, and yet environmentally acceptable process for Au recovery 34 ref

98 COKE CONCERNS FUEL INTEREST IN PCI

By Kuebler G.G

Environmental regulations on coke production techniques have prompted many steel companies to adopt pulverized coal injection as a supplement for coke firing of blast furnaces Coal injection plants now cost half of an environmentally acceptable coke plant Accounts of experience with PCI at Armco, U.S. Steel's Gary Works, Inland Steel's Indiana Harbor Works are described USS/Kobe Steel is also embarking on a pulverized coal injection system addition and Bethlehem Steel will use granulated coal instead of pulverized coal Sources of PCI equipment and systems are also discussed

99 TOWARDS A CARBON-FREE STEEL PRODUCTION ROUTE?

By Birat J.P., Antoine M., Dubs A., Gaye H., Lassat Y., Nicolle R and Roth, J.L

The anthropogenic greenhouse effect raises the possibility of large climate modifications The steel industry, which in France emits 26 Mt of CO_2, has several countermeasures at its disposal energy savings, which have already been put into application to a large extent; recycling of steel, i e scrap melting; use of electrical energy, which in France happens to be essentially C-free; and, possibly in the long term, use of hydrogen as a reducing agent, in the form of natural has for example The stirring of Usinor Sacilor production routes towards electric arc steelmaking constitutes an adequate answer to the question of reducing CO_2 emissions Graphs 20 ref

100 NO-RINSE PRE-TREATMENTS: THE 'GREEN' SOLUTION

By Marsh C.

No-rinse pretreatment systems are of primary importance when trying to meet today's industrial needs and also those of tomorrow A number of chemical pre-treatments are available which include chromates, chromate phosphates, iron phosphates, and zinc phosphates All have the same objective converting metal surfaces into an adherent inert chemical complex which improves corrosion resistance and surface-adhesion characteristics The great advantage of no-rinse systems is that they can easily be incorporated into existing process plant with little or no system modification while substantially reducing costs Following application of chemical solution by immersion or spray, excess solution is removed from the component by natural drainage, squeegee roll, or air knives The use of no-rinse pretreatments are better suited to meet the environmental demands at lower costs.

101 EXTRACTION AND RECYCLING OF HEAVY AND PRECIOUS METALS

By Jeannerte G.

Industry is the principal reason for the presence of heavy metals in the aquatic environment, and the removal of these metals has bene the subject of a number of publications One method now in use is that of chelation, in which agents are added to modify the properties of the dissolved metals Both hydroxides and sulfides have been used for a number of years The sulfides are less soluble and easier to extract, but they have their own environmental safety problems Ten types of chelatants are described They work by the exchange of metallic ions between the solution and the chelatants with the speed of the exchange being very important, both for economic and productive reasons In one step the metals are recovered, purified and made ready for recycling Graphs 10 ref

102 COREX TECHNOLOGY, TODAY AND TOMORROW

By Flickenschild J., Lemperle M., Kepplinger W.L. and Helten F.

The high cost of cokemaking and the environmental problems involved as well as the high price of natural gas for DRI production in many areas of the world were the reasons for the development of the COREX process for the production of hot metal It has been demonstrated to be both technically and economically feasible on a large scale since 1989, using coal instead of gas of approx 7000 kJ/M^3

(STP) Due to its high degree of cleanliness and energy, this gas offers a tremendous potential for numerous applications as gas turbine based power generation, DRI-production, and chemical synthesis processes, i e for methanol The possible 100% lump ore input predicts COREX to be an economical completion to existing blast furnaces and future smelting processes on the basis of the fine ore. Due to the fact that cokemaking is no longer needed for the production of hot metal, the environmental impact from a COREX plant is in the range of up to 30% lower than hot metal from the blast furnace. High flexibility with respect to product quality and quantity, combined with environmental compatibility, shows substantial benefits for all mentioned applications
Graphs.

103 SO_2 REMOVAL FROM CONCENTRATED PROCESS GASES USING THE SULFRED PROCESS

By Roine, A., Talonen T. and Metsarinta, M.-L.

Outokumpu Oy has developed a new sulfur dioxide removal process which can be modified for concentrated process gases (SO_2 2-15%) as well as dilute flue gases (SO_2 0 1-2%) The main advantages of this Sulfred process are (1) the process is regenerable, (2) it produces valuable elemental sulfur, (3) SO_2 content and gas amount can fluctuate and (4) the process does not produce problematic waste gypsum The process can be divided into four main stages In the first absorption stage the gas is washed using OK-scrubbers The washing reagent, sodium sulfide, is added to the washing solution according to the pH control (pH 2.5-5) The solution contains mainly sodium thiosulphates, sulfates, polythionates and elemental S which all are formed in the absorption reactions A small bleed of the washing solution goes to the autoclave stage In this stage all thiosulphates and polythionates are decomposed to liquid S and sulfate solution This solution is then regenerated back to the sodium sulfide solution in the regeneration stage by adding enough barium sulfide to convert the sodium sulfate to sodium sulfide and to precipitate sulfates as barium sulfate The barium sulfate precipitate can then be filtrated from the sulfide solution and reduced back to barium sulfide by coal in the reduction stage The Sulfred process has been tested for concentrated and dilute SO_2 gases on a pilot scale (100- 10 000 Nm^3 /h) some of the main results are presented Graphs 4 ref

104 DEVELOPMENT OF ADVANCED MATERIALS IN AUTOMOTIVE INDUSTRIES - APPROACH TO TECHNOAMENITY. (RETROACTIVE COVERAGE)

By Taguchi, M.

A research director of a large Japanese auto manufacturer reflects upon the efforts to develop emission control technologies. As evidenced in the development of the company's ceramic rotors and metal catalytic converters, the role of auto manufacturers has been changing from a mere end user of new materials to a co-developer to meet new demands to maintain a healthy global environment. The role of Japanese industry is considered, which is still trying to gain respect as an original innovator in the worldwide effort to realize further reduction of emission, improved fuel efficiency, and effective recycling of plastics which would become important components of future automobiles. Photomicrographs, Graphs

105 DECREASED GAS CONSUMPTION OF A FLUIDIZED BED FURNACE

By Chen, Y.C.

The feasibility of utilizing a closed circulatory system to generate gases for a fluidized bed furnace was investigated with the primary concentrations of both economizing on the raw materials used for producing furnace atmospheres and decreasing the air pollution caused by exhaust gases. Air humidified with water vapor was first introduced into a charcoal furnace for causing a reaction with hot charcoal to form a carburizing atmosphere. This atmosphere was then introduced into a fluidized bed furnace to carburize steels The exhaust gases from the fluidized bed furnace were recycled by repassing them through the hot charcoal layer in the charcoal furnace with a gas pump The charcoal furnace and the fluidized bed furnace formed a closed circulatory system during the carburization of steels Experiments were performed with various parameters of this system, including content of water vapor in the humid air, temperature of the charcoal, rate of recirculation of the atmosphere, etc The

effect of each parameter on the carburizing behavior in the fluidized bed furnace was investigated on the basis of the rate of carburization and the carbon potential of the atmosphere. The feasibility of applying this system to a fluidized bed furnace was assessed from the aspects of the fluidization of Al_2O_3 powder, the result of carburizing steel or pure iron, and the rate of consumption of charcoal. The closed system employed in generating atmosphere was demonstrated by the experimental results of have enabled the fluidized bed furnace to operate normally and to have significantly decreased both the consumption rate of charcoal and the environmental pollution. Graphs. 6 ref.

106 MATERIALS FOR CARS OF THE 1990s

By Automotive Engineering, May 1992

A survey of a number of materials used in modern automobiles is presented. Some of these include a wood-fiber called Fibrit which is lightweight, dimensionally stable, resistant to temperature and humidity variations, and recyclable, a modified polyamide alloy with exceptionally low moisture absorption, increased impact strength, and improved heat resistance, and Arpro expanded polypropylene bead and Dylite expanded polystyrene resin, said to provide excellent energy absorption properties. Ashland Chemical has developed a new resin system, Arotran Q-6530, useful for automotive parts requiring high paint bake oven temperatures, and high gloss, weather-resistant bezels are being made from acrylonitrile/styrene/acrylate resin (grade S778T), with impact strength that remains high even at sub-freezing temperatures. Other products include a line of flexible vinyl composites which readily adhere to other vinyls using in-mold film transfer or overmolding, an advanced filter material providing superior performance in trap oxidizer systems to reduce particulate emissions from diesel trucks and buses. Steels and aluminum are also discussed.

107 MATERIALS AND RECYCLING. EXAMPLES FROM THE AUTOMOTIVE INDUSTRY

By Razim C.

The recycling of used automobiles concentrates on metals. The remainder, which includes plastics, lacquers, textiles, and rubber, constitutes approx 25% of the weight and mainly ends up in landfills. In Germany this amounts to 400 000 tons/year, but this is only a fraction of the total landfill receipts. Work continues to find a more environment-friendly method for recycling all the components of automobiles. Graphs.

108 WASTEWATER RECYCLING IN A EUROPEAN MANUFACTURING COMPANY

By Fabro M.

The wastewater regulations in Switzerland are moving toward the elimination, reduction, and recycling of waste compounds. For example, maximum levels of some contaminants are zinc 2 ppm, cyanide 1 ppm, nitrite 1 ppm, and COD 75 ppm. The approach of one plating company is shown to illustrate that these requirements can be met by recycling the waste water. New reclamation methods are available to actually make such operation profitable by reclaiming valuable metals from the drag out of the plating baths. Two examples of cost savings are $67 000 in a salt hardening line and $5350 in a plating line as a result of the reclamation of materials and reduced energy costs. The system has successfully addressed seven main concerns, meeting sewer limits for nitrite and cyanide discharge, zero salt discharge, 98% of hardening salts are recycled, more careful handling of valuable resources, elimination of hazardous chemicals, and total upgrade of an old plant previously scheduled for replacement.

109 HOT BRIQUETTING OF LD DUST IN THE STEEL PLANT OF VA LINZ

By Heiss J., Apfolterer R., Poferl G. and Binder H.

Thanks to the conversion from wet de-dusting with complete combustion of the LD process gases on the one hand, to dry de-dusting with converter-gas recovery on the other hand, and as a result of the erection of the hot briquetting plant, LD steelworks 3 at VA-Stahl Linz has progressed from dumping 100% of its LD dust in the form of sludge, to 100% recycling of all the primary and secondary dusts generated in the LD steelworks. In view of the environmental legislation prohibiting the dumping of this type of dust in the dumping grounds used

hitherto, and of the acute shortage of suitable dumping sites and the exorbitantly high - and rising - costs of dumping, this has developed into a factor of great economic significance. At the same time, one should not lose sight of the fact that this plant configuration and mode of plant operation was basically the only ecologically and economically viable way in which to comply with the ever more stringent environmental regulations. Graphs.

110 LD-PROCESS METALLURGY UNDER THE ASPECTS OF LD DUST RECYCLING

By Presslinger H., Antlinger K., Poferl G. and Maxl, E.

The recycling of dust briquettes back into the LD converter, as performed at the Linz steelworks for environmental reasons, has a number of metallurgical effects which are examined with particular reference to the slag metallurgy. In connection with this, ionic-theory-related inferences are described for slag formation and for the incorporation of individual elements into the slag. When briquettes are charged, there are very considerable effects on the oxidation behaviour and slag formation. The elements silicon, manganese, phosphorus, titanium, vanadium and chrome oxidize faster than is the case when no briquettes have been charged. This leads to low Mn and P contents in the second half of the blowing time. As retro-reduction is also less, low P and Mn values are achieved by the end of blowing. The converter slags, basically consisting of dicalcium silicate, wuestite and dicalcium ferrite incorporate the P in the dicalcium silicate. This is impaired by other anion complexes present in the slag. Sulphur is located in the lattice of dicalcium ferrite. Graphs, Photomicrographs. 17 ref.

111 ENVIRONMENTAL ASPECTS IN THE APPLICATION OF REFRACTORIES FOR CONVERTER LININGS IN GERMANY

By Klages, G., Solmecke R. and Thiemann, E.

A short overview of relevant legislation is followed by a characterization of the various binder systems used for shaped and unshaped basic converter lining materials, coal-tar pitch, bitumen, a new MCA binder and phenolic resins. Pitch is technically the best and also the least expensive binder in this respect. Resin, by comparison, reduces the durability by between 10-17%. This is the reason why nowadays, with a few exceptions, pitch-bonded linings are used in converters in Europe. The low porosity and high strength properties in the coked, i.e. service, condition, which in the case of resin are achievable only by means of antioxidants, explain this durability advantage. However all the binders mentioned also contain harmful substances which can be released on being taken into service. The pitch binder contains the highest concentration of polycyclic aromatics, some of which are carcinogenic, for example benzo(a)pyrene (BaP). The concentration of BaP, as well as of other polycyclic aromatics (PAHs) is - and this must be emphasized - largely reduced, however, as a result of thermal treatment and curing additives. Because of this it becomes possible to keep the workplace concentrations far below the technical guideline concentration (TRK). At present a new binder, which is practically BaP-free and comparable to pitch in quality, is also undergoing testsAnother important advantage of basic converter linings is their almost complete recyclability as a secondary raw material. This advantage is achievable, however, only in the case of linings that are free of dolomite and contain no antioxidants. Graphs. 7 ref.

112 AN ECOLOGICAL CONCEPT IS MATERIALIZING

By Kreulitsch, H. and Schroer U.

Linz is the major steel production center of Austria. The industry has agreed to effect a major improvement in environmental conditions by reducing dust and SO_2 emissions through the elimination of heating oil, reduction of H_2S in coke oven emissions, and SO_2 in acid sintering operations. Dust from sintering and blast furnace operations will be recaptured. Waste water will be purified. Graphs, Phase diagrams.

113 MODERNIZATION OF COKING PLANT AT LINZ WITH CONSIDERATION OF HIGH REQUIREMENTS ON ENVIRONMENTAL PROTECTION.

By Kandler W.

The Linz coking plant consists of two furnace

groups with a total of seven coking ovens The product feeds the Linz steel works and other steel plants, as well as the chemical industry, and home heating requirements The coking plant is being restructured to adapt to decreasing demand, introduce automation, improve working conditions, and protect the environment. This program has been ongoing for 10 years and aims in particular at reducing emissions of dust, SO_2 , NO_x , and polycyclic aromatic chemicals Significant progress has been achieved Graphs.

114 SOLUTION OF ENVIRONMENTAL PROBLEMS IN REFRACTORIES MANUFACTURING

By Siebenhofer M.

The manufacture of refractories requires a certain amount of sulfur, which oil heating supplied in quantity, but is less available since natural gas was substituted The sulfur is converted by absorption of SO_2 , followed by neutralization of sulfurous oxide with magnesium hydroxide and finaly oxidation of the of the sulfite salts Dust removal for enviromental protection is performed by equipment capable of filtering our particles in the 0 3 <F128P7W1>m<F255P255I>m range Graphs 9 ref

115 ACTUAL ENVIRONMENTAL PROTECTION SITUATION IN ELECTROPLATING AND SURFACE TREATMENT INDUSTRIES IN GERMANY

By Winkel P.

Three main constraints binding on surface treatment activities in Germany are defined as customer demand for quality, environmental laws, and business economics An encapsulated history of development of environmental protection measures in the industry starting from 1935 is given, for example, the 4-stage washing cascade with minimum water consumption is explained In 1970 the electrostatic powder-coating method evolved as solvent- emission- and waste-free method An example of the latest minimum-waste integrated galvanizing line is given
Spectra Graphs

116 WASTE DISPOSAL PROBLEM SPAN

By Winkel P.

A critical review is made of the progressively more stringent and comprehensive environmental regulations in Germany Some regulations are not economically friendly, e g dirty old oil in Berlin is reprocessed in a refinery while fresh new oil is burnt in heating furnaces Voluntary agreements on disposal of batteries and cooling fluids are discussed Problems of paper mountain including computer paper are touched upon

117 ENVIRONMENTAL PROTECTION INTERNATIONAL

By Winkel P

A comparison of the environmental protection procedures of Germany with those of the US, Thailand, and Singapore Air pollution, recycling, treatment of plating wastes, and traffic problems are some of the subjects discussed Each country has different standards based on its culture, and must differentiate between ideals and reality

118 NEW MATERIALS IN THE AUTOMOTIVE INDUSTRY

By Garcia-Zayas J

An objective of the search for new materials is the production of lighter, safer vehicles Environmental concerns are playing a growing role in the development of materials Graphs

119 INNOVATIVE METHODS FOR PRECIOUS METALS RECOVERY IN NORTH AMERICA

By Marsden J.O., Mansanti J.G. and Sass S A

Cyanide leaching and CIP will remain as the preferred route for the treatment of free-milling ores in the near future The development of ion exchange resins with suitable physical and chemical properties for in-pulp gold extraction is likely to occur over the next decade These may eventually replace carbon Heap leaching will be applied increasingly on a large scale as a low cost treatment for low grade

ores. Also, methods for heap leaching of ores with more complex mineralogy and in more difficult climates will be developed. Pressure oxidation has become the preferred, if not standard, treatment for nocarbonaceous refractory ores. Biological oxidation is likely to become an important alternative of some ores with potential cost advantages over pressure oxidation and environmental benefits over roasting. Roasting is likely to remain ass the preferred option for carbonaceous - sulfidic ores, but environmental pressures will continue to increase the costs of this process. Zinc is discussed.

120 THE EFFICIENT USE OF AQUEOUS CLEANING FOR PRECISION COMPONENTS

By Maltby P.

A cleaning system to replace CFCs and provide a higher level of cleanliness is described. Consideration of environmental concerns is covered as well as ease of maintenance and operation. An ultrasonic system is described which includes three steps: a wash, rinse, and dry. Recycling of hot air and water is included as well as a vacuum drying step. Tabular comparisons of various cleanliness parameters indicate the system described is superior to the replaced CFC system in all aspects evaluated. Graphs.

121 PICKLING WITH SULFURIC ACID WITHOUT WASTE WATER AND SLUDGE

By Winkel P.

The author discusses at length the technical and economic aspects of control or complete elimination, respectively, of wastewater and sludge residues that have accumulated in sulfuric acid pickling operations. In a historic review, a process scheme is presented in text and flow chart that was conventional as far back as 1965, whereby copper wire is pickled, the metal is precipitated, the wastewater is neutralized and the Cu is recovered electrolytically from the pickling solution dating back to the same year, a system then considered progressive dealt with a sludge-free wastewater processing scheme, as indicated in another flow diagram, the wastewater treatment is coupled with Cu recovery from the rinsewater through a combination of ion exchange and electrolysis. Finally, a recirculation scheme is discussed and diagrammatically projected that was perfected in 1967 for the purpose of largely eliminating all wastewater and sludge residue. The system provides a return of rinsewater, pickled metal, pickling acid and heat through use of a rinse cascade, a vaporizer and electrolysis. The author elaborates at length on the problems of unforseeable effects and presents insights into the practical experience gained with so-called "freedom from wastewater". He concludes with three observations. It is impossible to calculate exactly the cost of an introductory phase of such a system. An economically and technically safe operation is only possible under very specific conditions. No truly wastewater-free but merely wastewater-lean operating conditions can be attained whereby the fluid is shifted into a region of special residue accumulation.

122 ION-EXCHANGE AGENT AND USE THEREOF IN EXTRACTING HEAVY METALS FROM AQUEOUS SOLUTIONS

By Kuznicki S.M. and Whyte J.R.

A novel ion-exchange agent, an aluminum-enriched analogue to the zeolite chabazite, hereinafter "Al-Chab" is disclosed. The Al-Chab is used in processes for recovering precious metals from aqueous solutions or for removing toxic heavy metals from contaminated aqueous streams.

123 THE SX-EW SOLUTION TO PROCESSING LOW GRADE COPPER ORES

By Rosser M.

The solvent-extraction-electrowinning (SX-EW) process extracts copper from low grade (e.g. 0.4%) oxide ore formerly left as waste from sulphide ore extraction, at about half the operating cost of conventional processes. After light crushing, the oxide ore is sprayed with weak sulphuric acid on leach pads and converted to sulphate. The leachate is mixed with extractant bearing kerosene which extracts the Cu from and re-acidifies the aqueous phase - the barren raffinate. The raffinate separates in settling tanks and is pumped back to the

heap-leach pads while the Cu-rich kerosene is mixed with a highly acidic Cu-rich solution where the Cu is extracted by electrolysis The reasons given for low operating cost include no melting, fewer workers, no smelting, and less capital and maintenance Analysis of the two US companies coming into production concludes that they are good long-term investments

124 AN ENGINEERED CALCIUM CARBIDE DESULPHURIZER FOR LOWERING SLAG REACTIVITY

By Barker B.J.

Environmental concerns have recently been growing over the disposal of reactive desulphurizing slag Consequently, increased pressure has been placed on the foundry industry to reduce the reactivity of this slag To address this problem, Cyanamid has developed a new product which significantly reduces the calcium carbide content of the desulphurizing slag Testing equipment and procedures have also been developed to evaluate both the existing levels of carbide in the slag and the decreased levels which are achieved with this new material The development and use of this engineered carbide desulphurizer has made possible significant environmental and efficiency improvements in the field of calcium carbide desulphurizing Consequently, the lifespan of calcium carbide in ductile iron desulphurization has been increased, as have the benefits of its use in the foundry industry Graphs 10 ref

125 ENVIRONMENTAL MATTERS SURROUNDING DROSS AND ITS RECOVERY

By Ross I.B.

This paper gives a broad outline of the environmental matters related to dross and its recovery This serves as an introduction to other papers in these proceedings which will supply more detail on dross minimisation and dross processing The paper concludes that technologies are either available or are being developed to address the environmental concerns associated with dross and its recovery 2 ref

126 DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE ALUMINUM FORMING POINT SOURCE CATEGORY

By Gov. Res. Announc. Index

The purpose is to provide the supporting technical data regarding water use, pollutants and treatment technologies for any (BPT) best practical technology, (BAT) best available technology, (BCT) best conventional technology, (NSPS) new source performance standards or pretreatment standards for existing sources (PSES), and pretreatment standards for new sources (PSNS) which EPA may choose to issue for the Aluminum Forming Category, under Sections 301, 304, 306, 307 and 501 of the Clean Water Act

127 CHARACTERIZATION OF SURFACE CONTAMINATIONS ON METAL SURFACES

By Sommer J. and Gressmann K.

The results are reported of a surface examination of four cold-rolled steel strip samples conducted according to the German standard DIN 55 928, Part 4 Carbonaceous substances, such as oils, greases, waxes and graphitic carbon, as well as salt, chloride and sulfate contents were analyzed It was found that all samples were only minimally contaminated on their surfaces by water-soluble salts Relative to carbonaceous contaminants, single stage surface cleaning resulted in an 90% removal efficiency, which could be increased to 98% by mechanical means such as rushing or blasting In this connection, it is recommended that on the original steel strip carbonaceous protective coatings against corrosion are kept to the absolute minimum Finally, the removal of ferrous residues from metallurgical processing required further mechanical treatment It is concluded that the determination of the type of contaminants on the surface of the workpiece and a high degree of decontamination effectiveness assure a superior quality of the end product, as well as an optimizing of the process technology Moreover, an automated rinse bath control leads to a lowering of waste water pollution 9 ref

128 PAINTS: EVOLUTION AND TENDENCY

By Bianconi M

In 1990 Western Europe used 5 3 million tons of paint for metal protection and decoration Unfortunately, this was a principal source of pollution, since 70% of the painting was done by spraying, a method whose efficiency is only 40-60% In order to reduce pollution, changes have been made in both the paint and the methods of application The use of "high solid" paints cuts the solvent percentage for approx 50% in conventional paints to approx 25% This has created another problem in that these paints have a high viscosity and are more difficult to apply Standard water soluble paints offer an acceptable solvent, but have an automatic limit on final thickness Polymers forming an emulsion in water are now being used in the automobile industry Resins used as paint without a solvent and applied by electro-deposition are finding new uses and are now 5% of the market Polyvinyl chlorides do not have a solvent and are applied with UV and EB deposition All of these newer methods will result in much less pollution than their predecessors Graphs

129 HELP FOR HEAVY METAL REMOVAL

By Bonell W.

Because of tighter environmental regulations, the metal finishing industry is under increasing pressure to improve its methods of operation The Nalmet program developed by Nalco Unisolv Group overcomes problems in treating metal effluent by using a multiple component system consisting of a heavy metal precipitant, a coagulant and/or flocculant Strict control of pH is unnecessary

130 COIL COATINGS IN THE NINETIES: ECONOMIC AND ENVIRONMENTAL DIVIDENDS

By Cocuzzi D.A. and Pilcher G.R.

This paper deals with the historical development of coil coatings, the technology of the process, and the economic, environmental, and performance advantages of prepainted metal 6 ref

131 PRODUCTION EXPERIENCE WITH AUTOMOTIVE WATERBORNE COATINGS

By Fox C.

The need to reduce volatile organic emissions and thereby create more environmentally friendly coatings is completely altering the nature of coating process used by the automotive industry Waterborne basecoats allow application at low volume solids, thus producing optimum metallic effect while maintaining compliance with emission regulations In order to control rheology and thereby sag resistance and metal flake orientation, a novel aqueous microgel polymer has been developed Processing of these basecoats is similar to present solvent-borne finishes with the exception that stainless steel equipment must be used and water must be removed before application of clearcoat The production feasibility of waterborne basecoats was first established in a Canadian truck assembly plant and in the next two years several other production facilities are expected to convert to this new technology Graphs

132 EVOLUTION OF COATINGS

By Lopez A.

Improvement of performance and reduction of cost have always been the two principal factors in the evolution of procedures Quality (required by customers) and concern for the environment (required by legislation) have been added to them more recently The regulated materials in the coating industry are chromic acid, cyanide, complex materials, fluorides and heavy metals such as cadmium Substitute procedures including the use of trivalent chrome, passivation for chromic acid, degreasing using materials other than cyanide, and elimination of complex materials are all being tried as replacements Where the pollutants cannot be replaced immediately, much lower concentrations are used The search goes on

133 THE DEVELOPMENT OF ENVIRONMENTAL CONTROL TECHNOLOGIES IN JAPANESE NON-FERROUS SMELTERS

By Ueda K.

This paper describes the endeavor of the Japanese nonferrous smelters for the development of environmental contr-l technologies after the Second World War. In the 1950s, the smelters started to recover sulfuric acid from not only the roasting gas but the off-gas of smelting furnace. In the 1960s and 1970s, meeting the regulatory standards for pollution control, they developed suitable processes for the desulfurization process of fugitive gas, mercury removal from SO_2 gas and hydrometallurgical dust treatment process for the recovery of heavy metals. This paper finally shows how the smelters reduced CO_2 gas emission in four decades. Graphs. 22 ref.

134 CONDITIONS AND LIMITATIONS OF MATERIAL RECYCLING.

By Fleischer G.

Closing the circle with regard to recycling materials is quite often seen as a positive aspect. Therefore a great deal of faith is being put into saving resources, reducing the environmental burden and consideration toward new deposit areas. Recycling is only one of the possibilities for getting rid of waste, a process which also requires the use of resources and creates waste and emissions. The condition required, to take recycling as the most ecologically efficient method to get rid of waste in an ecologically sensible manner, is that the difference of the necessary primary resources for recycling and manufacture of secondary raw materials must be lower than the primary resources required for alternative waste disposal methods. Bearing this in mind, the sensible limitations for recycling are automatically set. Not in every case is the recycling of materials ecologically orientated. Conditions and limitations stipulate each other. The ecological limits are given a lot of consideration where recycling is concerned. Graphs. 7 ref.

135 THE POSSIBILITIES AND LIMITS OF THE SHREADING TECHNOLOGY WHEN RECYCLING CONSUMER MATERIALS

By Schmieg F.

Shreading means reducing goods in size so that all scrap pieces comprised of one material can be fed to a separate recycling process. The shreading technology today is of a high standard and well developed. Efficient scrap preparation for the steel industry is necessary due to the increasing number of old cars and used consumer items. Various handling methods in the shreader enable almost 100% separation efficiency. Man-made fibres, rubber items, and glass can only be recycled to a certain extent. In this case they are sorted manually. In this way many metals, fibres polyester materials, and glass can be recycled many times and will not be a burden to nature. Our resources will be spared, energy saved, and the environment relieved. Graphs.

136 VARIOUS METHODS OF METALLURGICAL RECYCLING

By Paul E.

Ever increasing criticism is being made toward the practiced recycling methods for scrap. This is why the metallurgical recycling systems are losing out on acceptance and attractiveness. Scrap recycling of consumer items is becoming very critical in Germany. Taking the automobile as an example, changes in the scrap recycle system have been gathered and analysed. These analyses make up the basis for alternatives in recycling. These alternatives eliminate the rightfully criticised points occurring in practiced recycle methods. The presented methods of metallurgical recycling are more acceptable and attractive. These methods are: the "thermal cleaning in a fluidised bed". It enables scrap pretreatment of smaller parts. This method is applicable for recycling and cleaning of removable parts. It is also possible to supply casting shops with high quality and environmentally friendly scrap. Oily and zinc-plated scrap can be processed in an environmentally friendly way in Kupol furnace. In this way, casting shops can recycle their own scrap in metal working groups. Total recycling in the automobile industry requires coordination with the raw material industry. The material cycle can only be closed at the suppliers, not at the manufacturers. Graphs. 11 ref.

137 "TOTAL RECYCLING OF SCRAP CARS". CONCEPT OF THE STUDY COMMITTEE FOR THE DISPOSAL OF SCRAP CARS (EVA)

By Nieder W.

The combination of development measures,

dismantling concepts, utilization of components and downstream metallurgical recycling allows for an applicable continuous future-oriented concept for the disposal of scrap cars. In this overall process an optimum combination of metallurgical values with lowest possible energy consumption is achieved by an ecologically and economically oriented sequence of procedures. The utilization of the chemically bound energy content of the organic substances in the scrap bale will reduce the amount of required primary energy. The use of natural gas as melting energy (i.e. secondary energy source) instead of electrical energy also contributes considerably to minimize CO_2 emissions. This process sequence ensures an environment-friendly disposal of scrap cars with saleable by-products and lowest emissions. Graphs. 4 ref.

138 IRON CONTROL IN NITRATE HYDROMETALLURGY BY (AUTO) DECOMPOSITION OF IRON (II) NITRATE

By Weert G. and Shang, Y.

Iron removal from hydrometallurgical sulphate or chloride systems has not, to date, provided a low-cost route to a saleable Fe product. Regeneration of the Fe^{3+} ion as an oxidant still relies on slow gas/liquid transfer. Thee present work evaluates the possibilities in the nitrate system. Iron (III) nitrate leaching of metallic Fe or reactive iron sulphides would yield iron (II) nitrate, which in this work was found to decompose spontaneously into iron (III) nitrate and iron (III) oxides in the temperature range 63-103 - C , depending on the excess of nitric acid (HNO_3) present. An increase in nitric acid lowers the decomposition temperature. Stirring may have the opposite effect. (Auto) decomposition of $Fe(NO_3)_3$ involves reduction of nitrate and the gaseous end product was found to contain at least 95% nobelium in the absence of nitric acid. The iron (III) nitric oxide formed 120 - C gave good filterable iron oxides. Hydrolysis at 160 or 180 - C gave a remarkable increase in particle size. In the more concentrated solutions, hematite spheroids of approx 25 <F128P7W1>m<F255P255D>m were produced. When sufficient nitric acid is present, only iron (III) nitrate is formed in the (auto) decomposition. A process possibility is proposed where iron (II) nitrate is first (auto) decomposed to iron (III) nitrate, from which a bleed stream is hydrolyzed to Fe_2O_3 and HNO_3. The bulk of the iron (III) nitrate is directly returned to the leaching operation. Air is used for oxidation of the NO evolved during (auto) decomposition o iron (II) nitrate. Graphs. Photomicrographs. 17 ref.

139 MULTI-DISCIPLINARY APPROACHES FOR ENVIRONMENTALLY SAFE PROCESSING OF MATERIALS FOR PROPERTIES

By Torma A.E.

In the last decade, the application of biotechnological principles in the processing of low-grade mineral materials, which are economically not amenable for metal production by the conventional technology, is gaining considerable industrial importance. This tendency is especially motivated by the fact that biotechnological processes are simple to operate, less capital and energy intensive than the conventional technologies. Furthermore, these processes are environment friendly since they do not result in any air, soil or aquifer pollution. As a rule of thumb, for example, a pound of copper can be produced from mining wastes for about one-third to one-half of the costs of Cu production by the conventional smelting process from high-grade sulfide concentrate. Currently, approx 25% of the total Cu produced in the US is imputable to bacterial activity in heap, dump and in situ leaching operations. In Canada, an important segment of the uranium production is achieved by bio-assisted leach technologies. Other industrial application of biotechnological processing is related to gold production from refractory pyrite and arsenopyrite materials. When submicron-size native Au particles are finely disseminated within the above refractory ore materials, then the conventional cyanidation technology becomes economically marginal for the Au production. However, if these materials are subjected to pre-oxidation by the bacteria, pores will be created in the mineral matrices and the follow-up cyanidation can successfully extract Au. This integrated biopreoxidation and cyanidation process is industrially practiced in South Africa, Brazil and Australia. Further establishments of industrial plants are in progress in Ghana. Diverse bioremediation processes are under development for the removal of trace concentrations of heavy metals and radionuclides from very large volumes of industrial effluents and contaminated soils. It is well known

that the conventional physical and chemical technologies are economically handicapped for dealing with these situations. The application of biotechnology to complex mineral materials treatment opened up new opportunities for the mineral and metallurgical industries for research and application. There are various possibilities for environmentally safe bio-processing of materials and remediation of contaminated sites. Examples of industrial applications are presented and where appropriate, new opportunites for application are discussed. 29 ref.

140 SIROSMELT FOR SOLVING ENVIRONMENTAL PROBLEMS OF LEAD - ZINC PRODUCTION

By Floyd J., Robilliard K.R., Guorgi G.A., Wu S.K., King P.J. and Floyd J.M.

The salient features and operation of the Sirosmelt furnace system based on top submerged lance technology are described which provides a pollution-free, economic process for treating residues and waste minerals from the lead and zinc industry and certain steel plant operations. The plant design and economics of the systems for smelting steel plant dust or Pb concentrate are highlighted. Examples of Pb - Zn processing via smelting of wastes are presented using Zn leach residues, slag dumps, steel plant dusts, and vertical retort residues. 4 ref.

141 ENVIRONMENTAL AND SAFETY ATTRIBUTES OF WATERJET CUTTING

By Burnham C. and Sepe R.

The inherent characteristics of ultrahigh-pressure waterjet technology resolve many of today's concerns over both environmental and operator safety in the work place. Advances in waterjet cleaning provide an alternative solution to today's environmental processing problems. This paper examines the environmental and safety attributes of waterjet cutting as an alternate to other conventional and non-conventional methods. The conventional methods of cutting materials such as paper or GFRP can create an inordinante amount of airborne dust. Cutoff saws used to de-gate metal castings can create a dense fog of airborne particulate. Cutting these materials as well as an endless list of others with waterjet or abrasive waterjet (AWJ) virtually eliminates this hazard. The waterjet stream traveling at three times the speed of sound pulls the potential airbound kerf material into itself and safely deposits it in a catcher. Plasma arc and lasers burn materials which can create heat-affected zones and emit toxic fumes. The abrasive waterjet can cut heat-sensitive materials such as aluminum, steel, titanium, and nickel alloys without risking heat damage. Fume extractors are not required on waterjet or AWJ systems. Potentially hazardous chemical coolants and lubricants required with conventional cutting tools are not needed with waterjet processing. The latest ultrahigh-pressure waterjet systems utilize closed-loop water recirculation systems minimizing water consumption, noise-abatement techniques keeping sound levels 75 dB, and waste disposal systems that separate the kerf material from the water simplifying the disposal process.

142 THE GREEN ANODIZING LINE

By Potter H.

Slijppol Aluminium in Amsterdam, Holland, has built a brand new, completely automatic anodizing line. During the preparing of the lay-out, they discovered important energy-saving features.
The speaker would like to tell in which way an anodizing line in Holland has to be built to reach the heavy requirements of present and especially future environmental regulations. The Dutch Anodiser's Association has requested the Environmental Studies Department of Amsterdam University, to investigate possibilities of preventing of waste and emissions in anodizing companies. A list of approx 40 prevention measurements has been compiled. Some of them are known and easy to execute in every anodizing plant but some of them, while logical, had not yet been used. Slijppol has used the recommendations for its new plant and on that basis the company has now built the first environmetally friendly "green anodizing line" in Holland and probably also in Europe.

143 A NEW CONCEPT IN SURFACE FINISHING TREATMENT ON ALUMINIUM

By Amigo J.

A tougher legislation on classified wastes of

hydroxide sludge has made the aluminium coaters companies assume responsibility for the application of some procedures concerning a technology called "clean" In fact, if the effluents by hydroxide precipitation treatments are still being often used, the difficulties that appear when using this method are several. Therefore, we propose a "clean technology" for the near future, which is mainly devoted to the product, additives and equipment development and grants Al protection by anodising and/or lacquering with the recycling solution, approaching the optimum "zero reject". Pickling, etching, colouring, sealing and lacquering products permits the application with recovery equipment based on ultrafiltration, reverse osmosis, ion exchange, evaporation, etc. making possible Al protection with "clean technologies" and "zero reject". Graphs. 6 ref.

144 IRON POWDER METHOD FOR WASTE WATER TREATMENT

By Saito T., Tanaka A. and Murakami M.

Dowa Mining Co., Ltd. has developed a method for simultaneously removing a large number of heavy metals from waste water by using iron powder. Dowa's study of environmental technology as a leader in the resource industry has enabled such a unique technology to develop. The special characteristics of the Fe powder method are introduced: simultaneous removal of a large number of harmful heavy metals and substances, e.g. high toxicity elements arsenic, Cr^{6+}, and mercury; removal of heavy metals by forming ammonium complexes; removal of heavy metals by forming chelate complexes; removal of ferrocyanides and ferricyanides; removal of fluorine; and easy condensation, filtration, and separation of the precipitates generated after reaction in the Fe powder method. Graphs.

145 FUTURE OF IRON AND STEEL-MAKING

By Nilles P.

This double volumes gives a retrospective and an outlook for the future of steelmaking processes (the future evolution of the steel industry, the trends in steel consumption, the steel production, and its geographical repartition, raw materials). Energy sources are reviewed in view of the necessity to reduce CO_2 emission and to comply with stricter ecological constraints. The literature closing date was the end of 1990. English and German subject indexes are provided.

146 CURRENT ENVIRONMENTAL ISSUES FACING THE LEAD, ZINC AND CADMIUM INDUSTRIES

By Cole J.F.

Challenges to the continued production and use of Pb and Cd have increased during the past several years. These challenges have been on charges that the production and use of these metals result in illness in both occuptationally exposed workers and the general population. Prominence has been given to some studies suggesting subtle, but perhaps adverse health effects on workers and the general population. Both Pb and Cd are toxic and both have produced well-documented cases of illness. Lead attacks primarily the nervous system, the hematopoeitic or blood forming system, and the kidney. There have been suggestions that low level Pb exposure can result in lowered intelligence in children and may impair a variety of biochemical processes in the body. Based on animal evidence, Pb is regarded as a possible human carcinogen. Cadmium attacks primarily the kidney and, according to some studies, may produce lung cancer. As a result of concerns about toxicity, there have been numerous governmental and intergovernmental initiatives proposing or enacting stringent standards for emissions in the air and water. Concerns have also been expressed about the levels of Pb and Cd in soil and dust from prior uses and industrial activity. Additional concerns have been expressed regarding disposal of Pb and Cd containing products in landfills and municipal waste incinerators. Programs encouraging substitution of Pb and Cd in products with other materials have been suggested and outright bans on certain uses have been either suggested or, in limited cases, enacted. While Zn is not regarded as being a toxicant in the same category as Pb and Cd, there have, nonetheless, been concerns expressed about Zn as a toxicant to fish and other aquatic organisms. Zinc runoff from galvanized structures, which also can contain Pb and Cd, is a subject of ongoing study. 12 ref.

147 THE QSL-REACTOR AT THE BERZELIUS SMELTER IN STOLBERG

By Hohn R.W. and Deininger L.E.

A QSL-plant at Metallgesellschaft AG's Stolberg facility avoids emission of dust because a closed reactor is used as a single-step unit. Flue dust produced is precipitated in an electrostatic precipitator and returned to the mixture over a short way using a closed dragchain conveyor. Produced SO_2 gas is converted into sulfuric acid at a high efficiency (99.5%) because of the continuous production of this gas. Heat of the chemical reaction can be converted into electrical energy and cadmium and arsenic can be separated in a pure form. A flowsheet of the QSL-process is shown and described.

148 THE TRADITIONAL SMELTING PROCESS: ADAPTING IT TO THE FUTURE NEEDS OF THE ENVIRONMENT

By Ferquel S.

Traditionally, the majority of the primary lead consumed by the world has been produced from galena by roasting the ore followed by reduction in a shaft furnace. In recent years, pyrometallurgical processes (QSL, Kovcet, Outokumpo, Isasmelt) have emerged. In other research in the hydrometallurgical field, methods using the chloride route have resulted. Production of SO_2 and dust during lead extraction and economics of Pb extraction processes are described briefly.

149 DEEP SEWAGE TREATMENT AT CRYOLITE AND ALUMINIUM SMELTERIES

By Morozova V.A. and Kirillova G.I.

A method for removing fluoride from waste waters is proposed which involves a combined treatment by lime and carbon dioxide. Fluoride ions in the waste waters are adsorbed by the surface of the freshly precipitated calcium carbonate crystals. The method has been tested on weakly mineralized waste waters of cryolite and aluminum plants with initial fluoride concentrations of 3 and 12 mg/dm^3. The fluoride content is reduced to the maximum acceptable concentration (0.75 mg/dm^3) by adding 1-1.5 g of calcium oxide/1 mg of fluoride, with a carbonation time of 90 min. Graphs.

150 NONFERROUS PRODUCTION - ZINC, LEAD, AND TRACE METALS

By Maczek H.

Production/consumption of zinc and lead in the world, W-Europe, Asia, Germany, South Korea, and Peru are tabulated for 1980-1989. Conventional production and recycling methods are mentioned. New developments and environmental questions are briefly related.

151 PRESENT STATUS OF LD STEELMAKING AT KWANG-YANG WORKS OF POSCO

By Balk D.H.

The total production capacity of the Pohang Iron and Steel Company is reported to have reached 10.4 million tons/year by October 1992, as against 1 million tons in 1974. Eight design concepts which were instrumental in achieving this enormous growth, are listed, including anti-pollution control systems. Extensive operational results of their LDS system are given. Other topics are minimizing slag carry-over and prolonging lining life. Graphs.

152 IRON AND STEEL PRODUCTION

By Bogdandy L.

Today's developments in iron and steel industry are mainly ecological, i.e. smelter emission decrease. Problems posed by SO_2 in Eastern Europe, CO_2 and industrial waste worldwide. The low-pollution COREX process developed by Voest-Alpine is described. Graphs. 2 ref.

153 PROCESS TECHNOLOGY AND PLANT CONSTRUCTION

By Puhringer O.

The COREX process for blast-furnace-quality iron production is taken as an example for discussing various aspects of metallurgical process equipment. Emission characteristics of different processes are compared. Use of expert systems and automation for integrating process industry is represented on block diagrams. Graphs.

154 EQUIPMENT FOR THE ADDITIVE TREATMENT OF CAST IRON

By Dmitriev S.P., Eryshkanov E.A., Alabin A.L. and Karpenko, V.I.

Previously abstracted from original as item 9210-51-1421. A technology which makes reduction in smoke emission and better modifier use possible was developed. An intermediate cast iron modification in a reactor allowed a higher usage of magnesium, reduction of sulfur content, elimination of smoke emission, and improved mechanical characteristics of parts cast from VCh50 cast iron. The technique can be used in small series, mass, and one piece casting production. Graphs.

155 IN PLANT AIR POLLUTION CONTROL SYSTEMS FOR DIE-CASTING MACHINES WITH WATER SOLUBLE DIE LUBE

By Schneider D.

In 1983, Aerology was challenged with the task of developing an efficient air pollution control system for aluminum die casting machines using water-soluble die lubricants. The main design goal was to develop a system that eliminated the problems associated with large, higher-cost, ducted systems and could effectively control the contaminants generated in these operations. This paper outlines the design problems and their solutions, with additional discussion of system maintenance considerations.

156 COOLANTS AND LUBRICANTS: THE TRUTH

By Bienkowski K.

The principal types and functions of metalworking fluids are examined, with attention given to mineral and synthetic oils, water- based fluids, and major additives. The discussion covers the main advantages and disadvantages of various fluid formulations, efficiency ranges of lubricating additives, selecting the right combination of additives and chemical blends, and principal types of laboratory tests. Workers health considerations and environmental concerns are also discussed. Graphs.

157 HOW TO SOLVE THE SOLVENT REDUCTION/INDUSTRIAL CLEANING PROBLEM

By Murphy R.

The principal questions that have to be addressed by the US stamping industry to successfully change over from the vapor- degreaser solvents that are soon to be banned by the EPA to a less regulated or unregulated cleaning method are examined. Solvents to be phased out by 1995 include CFC-113 (Freon) and 1,1,1-trichloroethane (methy chloroform), as well as halons and carbon tetrachloride. In particular, attention is given to the following five areas: overall use of vapor degreasers, production information, information on new equipment, environmental information, and economic information.

158 LATEST DESIGN TECHNOLOGY FOR COAL-FIRED LARGE-CAPACITY ADVANCED STEAM CONDITION SUPERCRITICAL SLIDING PRESSURE BOILERS

By Hisatome M., Maruta, T., Soda M., Hashimoto T. and Sato, S.

Nowadays Japanese utilities are pursuing thermally high efficient power generation in order to save fuel and protect the global environment by adopting advanced steam conditions for coal-fired units. Coal-fired units have been designed with the following features in addition in Japan (1) large capacity, (2) capability for burning various kinds of coal, (3) excellent capability for DSS, (4) fast start-up and shut-down capabilities and (5) minimum air pollution including NO_x. The needs for higher steam conditions have resulted in the development of various unique technologies for coal-fired boilers. These advanced technologies developed by Mitsubishi Heavy Industries, Ltd (MHI) for coal-fired advanced steam condition supercritical sliding pressure boilers are introduced, referring to the design of 1000 MW boiler. The applications of Cr - Mo steels and austenitic stainless steels in boilers are discussed. Graphs.

159 COREX PLANT IN POSCO

By Shin Y.M.

In the early 2000s, a part of ironmaking facilities of POSCO such as blast furnaces, coking ovens and sinter plants operated since 1973 and 1976 are expected to be replaced (30 years life expectancy) Replacement by the conventional blast furnace process with acceptable pollution control requires high investment capital cost, but nevertheless the lack of production flexibility and the restriction of raw material conditions are still remaining problems Therefore it was decided that the Corex process, the only commercialized smelting reduction process in the world until now, will be introduced to POSCO with the scale-up to 600 000 metric tonnes/year production capacity. In parallel, the R & D program to develop a new ironmaking process utilizing fine raw materials is being carried out on the basis of Corex technology. POSCO, which accomplished 21 million tonnes of annual steel production in a quarter of a century's construction work until October 1992, will contribute to the development of iron and steel making technology by the introduction of Corex Plant and the performance of the R & D program

160 CFB REDUCTION OF FINE ORES WITH COAL - THE LURGI CONCEPT

By Hirsch M., Bresser W. and Schlebusch D.

The crude steel output in 1990 was in the order of 770 million t worldwide. More than 60% of this output was obtained via the blast furnace/converter route and the balance principally via the scrap/EAF route In the face of the current stagnation of total consumption, steel producers are increasingly exposed to economic and ecological pressure The concept proposed by Lurgi, to reduce fine ores with coal in the circulating fluidized bed, meets the demands made on a process of the future Using low-cost raw materials and primary energy that are available world wide, high-grade direct reduced iron is produced which as highly metallized HBI briquette helps compensate for the contaminants introduced by scrap as feed material in electric arc furnaces, as a mixture of fine-grained DRI and char injected into the blast furnace allows one to enhance the capacity of existing blast furnaces, or together with the char produced constitutes a self-fluxing intermediate in an alternative smelting reduction process Compared with other direct reduction processes, the operating costs and capital outlay for this process method are low and its ecological impact is minimal thanks to the closed, energy-balanced concept Graphs 4 ref

161 PROCESS EXHAUST GAS PURIFICATION IS PAYING OFF FOR ALUMINIUM MANUFACTURERS

By Keul E.

Environmental protection was for Al producers an ecological challenge. The problem is, however, solved now The solution is a dry exhaust gas purification plant with fluoride gas recuperation A Norwegian company has developed the know-how over a period of 40 years 1 ref

162 REDUCTION OF EMISSION OF NITRIC OXIDES IN THE IRON AND STEEL INDUSTRY

By Griffay G. and Dicque B.

Approximately 30 000 t of nitric oxides per annum are discharged into the atmosphere by the French iron and steel industry EEC member countries aim, as a priority, to reduce these emissions. The main nitric oxide emissions (50%) occur during sintering in the coking plant, in heating furnaces and to a lesser extent, during nitic acid pickling After a description of the formation of these oxides, the possible means of reducing these emissions are discussed These are, selection of coals with a low nitrogenous compound content, treatment of the coals (the coking process can be considered as a coal treatment) and treatment of the emitted siderurgical gases 7 ref

163 ENVIRONMENTAL MEASURES IN EUROPEAN SINTER PLANTS AND BLAST FURNACES. (MIT FE 28952)

By Lungen H.B. and Theobald W.

Previously abstracted from original as item 9206-45-0702 102 5 million t hot metal have been produced in the member countries of the European Blast Furnace Committee in 1990 At present, there are still differences in terms of pollution control requirements in the individual member countries, which lead to competitive distortions in terms of the costs incurred for the construction and operation of environmental protection facilities Standards in this respect have been set by the Technical Directive

"Clean Air" adopted in Germany in 1986 which has been followed in part also by several other European countries This report, which is based on an inquiry, outlines some measures for the protection of the environment in European sinter plants and blast furnaces Plant data of different production units from Belgium, Germany, Finland, Great Britian, Holland, Italy, Luxembourg, Austria and Sweden have been used for the preparation of the documents for evaluation purposes These are complemented by examples of plant and process technologies applied for the protection of the environment
Graphs

164 APPARATUS FOR TREATMENT AND PURIFICATION OF WASTE GASES FROM A SECONDARY ALUMINUM MELTING PLANT

By Sommer H.W. and Schloderer R. and Neubacher F.P

A process and apparatus for purifying waste gases from a secondary aluminum melting plant are provided, by which the individual waste gas flows are collected and thermally post-combusted, wherein the generation of the energy necessary for post-combustion is provided by waste substances of high caloric value.

165 ECOLOGICAL ASPECT OF MOLD PRODUCTION FOR TITANIUM ALLOY CASTINGS

By Atashov V.G., Trunov A.I. and Chernikov V.A.

Previously abstracted from original as item 9302-51-0302 More than 80% of Ti alloy castings are produced using graphite molds The graphite dust presents a significant health and ecological hazard The resin binders used in the molds evolve significant amounts of CO_2 and carbon monoxide. Analysis of the options available for making the process more ecologically safe leads to the conclusion that molds must be replaced with ceramic preheated molds which do not react with Ti, e.g. yttria

166 HEALTH EVALUATION OF THE REFINING OF ALUMINUM ALLOY MELTS

By Ermolenko A.E., Grinberg A.A., Savichev S.A. and Rabinovich A.M.

Previously abstracted from original as item 9302-51-0301 A new ecologically safe flux was developed The flux has a reduced amount of toxic substance evolution The fluxes were evaluated during their use in melting of Al alloys AK12 The flux was recommended as a cleaner alternative in Al alloy refining A detailed analysis of the evolved substances was carried out

167 ENHANCING THE EFFECTIVENESS OF ALUMINUM ALLOY DEGASSING BY INERT GAS INJECTION

By Palachev V.A., Inkin S.V., Belov V.D. and Kurdyumov A.V.

Previously abstracted from original as item 9302-51-0293 An ecologically pure technique for Al alloys degassing was developed The technique reduces the amount of hexachloroethane released into the atmosphere Optimal conditions for the processing of hypereutectic Al - Si alloy KS740 were established The effect of various additions on the hexachloroethane produced was established
Graphs

168 ADVANCEMENT IN THE RECLAMATION OF PHENOLIC ESTER BINDERS

By Higgins R. and Stevenson M.

The development of the Alphaset process by Borden (UK) in 1981 introduced to the UK foundry industry a unique binder system for the manufacture of moulds and cores. The phenolic ester system was developed against a background of increasing problems with the emission of sulfur dioxide from the furane resin systems which were currently being used Since the mid-1970s, furane resins hardened by sulfonic and sulfuric containing catalysts were increasingly being used for the production of boxless moulds on a jobbing and semi-mechanized basis Experience with the problems created by the emission of SO_2 fumes at casting led directly to the development and introduction of the phenolic ester system known as Alphaset An investigation into the possibility of re-using Alphaset reclaim sand was

made, in conjunction with Baker Perkins Ltd Among the factors which were to be examined was an assessment of the level of reclaimed sand which could be satisfactorily used without problem, and also an examination of the environmental features of the system when it was reclaimed From the very beginning, the benefits of low fume at mixing and casting were established as a major benefit of the phenolic ester system, and it was necessary to assure that these advantages would be retained in a system which used reclaimed sand (in casting aluminum or copper) Graphs 4 ref

169 SILICA SAND: THE OTHER SIDE OF THE EQUATION

By Curtis M.

Increased demands are being placed upon the foundry industry as a result of the current economic and environmental situations This paper describes the efforts made by one major supplier to address the problem by considering sands and binders together as a complete system rather than in isolation, and thus offer the maximum benefits to the foundryman An attempt was made to illustrate the factors that should be considered when selecting a suitable base sand The correct choice, remembering that price is not necessarily the only consideration, can open up other possibilities if a compatible binder system is also selected Judicious choice, to achieve a higher strength system, may well lead to lower addition rates, lower cost resins, reduced mix sand costs, increased reclamation and improved environment Graphs, Photomicrographs 3 ref

170 THE DISPOSAL CRISIS - CURSE OR BLESSING IN DISGUISE?

By Leidel D.S.

From the discussion presented the following conclusions can be drawn Waste reduction is an absolute must Waste minimization by way of improved process control, process change, etc will have highest priority, specifically since this will nearly always be associated with quality and/or productivity improvements Unavoidable wastes must be used constructively as much as possible While external constructive use has many favorable aspects connected with it, the legal risks resulting therefrom may in many cases shift the interest towards internal constructive use, i e reclamation Every effort must be made to use thermal processing only where it is absolutely unavoidable because thermal reclamation will in all cases force one to consider complicated emission legislation If thermal processing is unavoidable the lowest possible degree of thermal processing must be applied The latest European research suggests that process temperatures of 300 - C should not be exceeded when reclaiming green sand for re-use with resin binders 14 ref

171 HORIZONTAL CASTING AT ARDAL FOR FOUNDRY ALLOYS

By Sunnana D. and Alluminio e Leghe

New computer-controlled horizontal casting equipment at Hydro Aluminum's smelter in Ardal, Norway, allows for continuous casting and contains a flying shear linked to the casting process The system consists of two casting furnaces, an in-line degassing filter, a casting machine, and shear It is totally computer-controlled and requires highly skilled operators Continuous casting provides the benefit of an even surface, which is of ingot quality but in the form of rods, and which reduces the risk of condensation The in-line degassing filter ensures the cleanest metal possible before casting Foundry alloys are continuously cast and cooled, then automatically fed to the shear where it is cut into pieces weighing 6 5 or 7 5 kg The largest customer base for aluminum foundry alloys is the automotive industry, particularly for use in wheels Regarding pollution, the Ardal foundry has cut fluoride emissions by 50%, without large investments in new pollution abatement equipment

172 A GLANCE ON THE FUTURE: PHYSICAL PROCESSES AS PRE-TREATMENTS TO PAINTING?

By Pozzoli S.A. and Mura G.

Environment friendly processes are becoming more and more necessary physical processes might be the right answer After having made some investigation about them, some testing was performed (using 3003 Al) After a short survey of the characteristics of PVD processes, the results of the tests are presented along with some practical considerations

173 ADVANCED POWDER COIL COATING: NEW POWDER PRODUCTS AND NEW HIGH-SPEED LINE

By Biancotti E., Rota R. and Sacchi F

Hunter Engineering, a member of the Fata group of companies, is a world leader in coil coating lines for steel and aluminium. Hunter is constantly developing its range of products and machinery in order to meet the need for new products and technologies. Presently, the major problems are pollution control and the need for high-performance, thick and flexible coatings. The answer is powder coil coating (PCC). Hunter is now collaborating with an "industrial-pilot" powder coil coating line in Italy (Otefal Sud), which is currently coating approx 4000 t/year of Al coils per shift, and is ready to build an improved line, running at much higher speeds. Experience with the present line has shown that architectural panels are an immediate market, home appliances are an around-the-corner market, and a possible "avalanche market" may be in store for the future, when solvent pollution may cause problems to liquid painting lines. Characteristics of PCC architectural Al sheet are described, and examples are given of practical working and applications.

174 COLD SEALING OF ANODIZED ALUMINIUM WITH COMPLETE RECOVERY AND RECYCLING SYSTEM

By Burbidge A. and Pieve A.

Cold sealing (or impregnation) of anodized aluminium has long been part of the industrial anodizing practise, but new regulations in many countries are limiting the use of nickel ions in the waste waters and sludges coming from the water treatment waters. To face this problem, a special system for the recovery of the Ni ion and the fluoride ion from the rinsing waters has been set up. The procedure proposed insures the observance of the strictest law parameters. At the same time a new system for the dosing of chemical products for cold sealing has been developed.

175 CREATIVE DESTRUCTION OF EXISTING SOLUTIONS IN FAVOUR OF ECOLOGICALLY BETTER ALTERNATIVES. (RETROACTIVE COVERAGE)

By Bald L.

In the past few months, there has been a change over in the material used for bottle neck labelling from Al to paper on the basis of "ecological requirements". EPH-Tochter haendler und Natermann in Hannover, Germany comments on eco-marketing in the brewing industry with the example of Al bottle neck labelling. It is plainly absurd to talk of a "poisonous" or "noxious" material. Aluminium has on the basis of its attractive qualities, a large share of the packaging market. The questions "How shall we explain to the consumer that we gave up such an ecologically-irreproachable material as Al in favour of paper? Shall we, in another few years, give up paper also?" were posed.

176 ECOLOGY - MAXIM FOR THE 1990S - A CHOICE BETWEEN ORDER AND CHAOS IN REFUSE. (RETROACTIVE COVERAGE)

By Bald L.

Ecological and economic aspects of energy and recycling are considered, both in general terms and in the specific case of aluminium. Fundamental to this is a knowledge of thermodynamics. An overall energy balance (manufacturing, usage and recycling) is required from an ecological and economic point of view and Al, like no other material, has an excellent chance of becoming the material of the future. It fulfills outstandingly the requirements of a cyclical system and both manufacturer and user of Al products have long made use of its recyclability. The high value of Al used products enable collection and processing systems to be introduced without the need for subsidies.

177 GLOBAL CONSIDERATIONS OF ALUMINIUM ELECTROLYSIS ON ENERGY AND THE ENVIRONMENT

By Huglen R. and Kvande H.

Aluminium production requires resources in the form of energy and minerals, and the by-products of the process have an impact on the environment. Important tasks for the Al producers are to use the energy and the raw-materials more efficiently, and to reduce the amounts of various harmful gaseous and particulate emissions and their negative effects on the surroundings. The ways that the Al producers can contribute to lower the total energy consumption and reduce the emissions are reviewed and discussed. Graphs. 12 ref.

178 STRATEGIES FOR DECREASING THE UNIT ENERGY AND ENVIRONMENTAL IMPACT OF HALL HEROULT CELLS

By Richards N.E.

The electrolytic production of Al in a molten cryolite bath depends upon, as major raw materials, alumina, electrical energy, coke, pitch, and aluminum fluoride. From both economic and environmental aspects, conservation of these inputs, decreasing the energy in or operating voltage across cells, raising production, controlling and minimizing emissions from reduction plants are extremely important to every primary Al producer. Due to the complex and interactive nature of the parameters, fixed and variable, fundamental to the electrolytic process, there is a hierarchy of choices possible for addressing and improving, for instance, components of cell voltage, heat balance and conservation, variability among and stability within pots, consistency of high current efficiency, life of the cells, management of anode effects, etc. The impacts that operational procedures and work practices have on key parameters, their relationship to the inventory of basic knowledge about the Hall Heroult process and the expectations for relative improvements are identified and quantified to the extent possible. Additionally, with recent increased concern for global warming and environmental effects of carbon monoxide and CF_4, enlarging the industry's continuing concern and responsibility for the immediate surroundings of a plant, aspects for characterizing and decreasing fluorocarbons are discussed. 4 ref.

179 REVIEW OF THE RETROFIT PROGRAM FOR THE PREBAKE POTLINES OF HYDRO ALUMINIUM A.S

By Moen T., Vee K.O., Gjorven S., Solbu A. and Jordal P.

Hydro Aluminium a.s. has continuously improved and retrofitted its old prebake potlines. The most common structural changes made in cell retrofitting are introduction of point feeding of alumina, improved cathode design and materials, use of larger anodes, and rearrangement of the current busbar system in order to improve the magnetic conditions in the cell. Technical results are presented together with a discussion on how continuously improved technical results, productivity and finally outcome is possible through increased knowledge about the organizational processes, and how these processes are influenced to take the desired directions for successful operations. Graphs. 1 ref.

180 RECENT DEVELOPMENTS IN THE LEAD INDUSTRY: SOME ASPECTS OF SMELTING, REFIRING AND ENVIRONMENTAL ISSUES

By Temple D.A.

Considerable progress in the development of the new direct smelting processes for Pb has been made although not all the problems have been solved. QSL, Kivcet and Isasmelt, together with increased contribution from the ISF, amount to a shift of 18% away from the sinter/blast furnace route in a period of seven to eight years. They offer lower production costs and reduced capital costs and demonstrate the possibility of greater efficiency in controlling emissions of Pb, SO_2 and other toxic dusts. As Pb's image problem is rectified, new applications such as the development of advanced Pb - acid batteries for electric vehicles will proliferate. 9 ref.

181 THE KIVCET PROCESS: 12 YEARS' EXPERIENCE AT PORTO VESME (1981-1993)

By Ibba R.

The KSS Pb plant of Portovesme (KSS Kivcet Samim Snamprogetti) is the largest Pb smelter in

the world based on a new technology of direct smelting. It is located at Portovesme, Sardinia (Italy), under the ownership of Nuova Samim S.p.A. The KSS plant started up in February 1987 and two years after the start-up the results obtained from the process, with respect to production cost and ecological factors, were better than expected. Since June 1990 capacity of the KSS plant has been increased to 800 t/day of charge and the KSS furnace has been treating a wide range of Pb concentrates, Zn leaching residues, and secondary Pb bearing materials, with a 96% continuous running. As far as the environmental hygiene and the protection of workers is concerned, the experimental data detected by monitors, either in the working area and on the ground outside the complex, are widely below the stricter new limits recommended by the EEC (Economic European Community) rules and by Italian law. For the time being the KSS plant of Portovesme is the biggest Pb running plant in the world based on a new technology and it represents a milestone in the Pb and Zn industry.

182 RECENT DEVELOPMENTS IN IRON ORE SINTERING. IV. THE SINTERING PROCESS

By Dawson P.R.

The major developments around the sinter strand are in four areas (i) energy consumption, (ii) productivity, (iii) process control, and (iv) environmental control. Significant reductions in energy requirements have already been achieved as a result of installing heat reacovery systems, improved ignition, decreasing air leakage, improved raw materials characteristics, and improved fan control. Increased productivity is achieved by maximising the yield of sinter product. This is influenced by factors such as uniformity of sintering both horizontally and vertically in the bed, sinter bonding strength, crushing of the sinter product, and slection of screen aperture for return fines. Other factors such as bed depth, size distribution of coke breeze, ignition, plant availability, and oxygen enrichment may also have an effect on productivity. The latest plant control systems are based on artificial intelligence and their use is spreading. The main emissions from sinter plants are dust, sulphur oxides and nitrogen oxides. Many plants have installed electrostatic precipitators to control particulate emissions and can achieve levels 50 mg/Nm^3. Desulfurization equipment has been installed at about one-half of the operating plants in Japan but at only one plant in Europe. Graphs 6) ref.

183 PRECIOUS METAL REFINING; MEETING THE CHALLENGE OF THE 1990'S

By Castilleja D.

The 1990s pose many daunting obstacles for refiners in general and precious metal refiners in particular. The stringent environmental laws have required many operations to undergo very expensive process control improvements to greatly limit or totally eliminate emission of certain effluents into the air or water. Tighter requirements are also in the products that each customer may require. For example, in the semiconductor industry, spent sputtering targets are refined and upgraded not only to meet a simple minimum metal content such as 99.999% minimum gold, but also to meet specifications limiting alkali metals on the order of 1-2 ppm. This impacts both the refining techniques employed and the analytical processes to test with absolute confidence in the result. The focus of this paper is to address these topics in detail and provide an outlook as to the direction of the industry. 4 ref.

184 THE KENNECOTT - OUTOKUMPU FLASH CONVERTING PROCESS

By Hanniala P., Kojo I.V. and Kyto M.

The Kennecott - Outokumpu flash smelting process was developed to commercial stage during the 1980s. The first flash converting process in full industrial scale will be put into operation in Kennecott Corporation's Salt Lake City Plant in June, 1995. However, because the new process still raises many basic questions and there exist some misunderstandings regarding the process concept and its benefits, the most essential facts and most misleading fictions are discussed. The requirements of today for a modern converting operation include economical, metallurgical and environmental issues. The flash converting process fulfills all of these criteria. Graphs 8 ref.

185 INCREASE OF CONVERTER AISLE PRODUCTIVITY AT RONNSKAR

By Nystrom L. and Lundstrom J.

The productivity of the Ronnskar smelter is heavily dependent on a high converter aisle operation. The output has steadily increased and the quality of the anodes has improved substantially. This has been achieved through scheduling converter operation, improved maintenance and quality teamwork. New measurement technologies have helped to understand the metallurgical process and hence allow for better process control and lower unit cost. The improved availability resulted in lower number of hot units needed. This led to lower energy consumption and reduction in manpower. The improvements are also demonstrated by improved environmental performance of the smelter. Graphs.

186 ILSERV PROCESS FOR THE TREATMENT OF EAF AND AOD

By Bruno F., Hunt J.J. and Repetto E.

The largest plasma arc furnace for the treatment of EAF (electric arc furnace) and AOD (argon oxygen decarburization converter) dusts has recently come on stream in the Terni, Italy, area. The plant has a Multiserv Plasminox Furnace with the capacity to treat 20,000 t/year of dusts having a high chromium and nickel content, arising from the steelmaking plants of ILVA Terni Works. The furnace is tapped at regular intervals, with approx. 4 t of liquid ferroalloy and at the same time approx. 1.5 t of slag. The ferroalloy (typically 12% Cr, 2.5% Ni) is reintroduced into the production cycle of the EAF, whereas the volatile metals (Zn, palladium and cadmium) are recovered from the furnace as dry dust of their oxides and collected in the dust filtration plant. They are then traded thanks to their very high zinc oxide content. Slag, which mainly contains SiO_2, CaO, MgO and Al_2O_3 and is by now non-toxic, is sent for dumping.

187 INVESTIGATION OF DUST AND GAS EMISSIONS IN THE HEATING OF INGOTS OF KILLED STEEL BY DIFFERENT HEAT-INSULATING PACKINGS

By Tsymbal V.P., Ibragev I.K. and Varenik V.I.

Previously abstracted from original as item 9310-51-1585. Dust and gas emissions from fill materials used for the thermal insulation of killed steel ingots are a major source of air pollution at metallurgical plants. Here, various fill insulations are examined from the environmental standpoint in order to select the most ecologically clean materials. It is shown that particularly low levels of emissions of dust and gases are observed for fill insulation consisting of aluminum cuttings.

188 A NEW GENERATION OF FLUXING IN ALUMINUM MELTING AND HOLDING FURNACES

By Guttery J.R. and Evans W.

The surface of the holder bath shimmers orange with little evidence of dross. Twenty three gently rolling elevations break the surface as the flux cycle nears its end. There are no wands, no hoses, no thermiting, no smoke and no splashing of molten Al. Observed is an advanced level of hydrogen removal in furnaces. There is unparalleled emissions control at bath level. A new generation of fluxing technology in the aluminum industry is described. 1 ref.

189 AUTOMOTIVE ALUMINUM RECYCLING CHANGES AHEAD

By Linden J.H.L.

The high intrinsic value of Al has been an inhibiting factor for its wide-spread use, and a stimulating factor when its favorable properties can be augmented with its recyclability. The can recycling success story in the US delivers a convincing testimony to that effect. In the car industry, Al has played a modest role until recently. However, the public's growing concerns about resources and the protection of the environment, and the car manufactures' increased realization of the favorable properties and recyclability of Al, are positioning the metal well for a predominant role as the automotive construction material of choice. The use of many alloys to meet the requirements for the different applications poses a challenge to the existing recycling infrastructure. The lessons from the can recycling efforts are discussed in light of applicability to automotive recycling.

Graphs 12 ref

190 FRICTION WELDING: A PROVEN JOINTING METHOD

By Horn H. and Grunauer H.

Friction welding is an ecologically precise technique giving reproducible energy-saving rapid automated and mechanized butt jointing of comopents It is described and illustrated on bonding of ceramics, hard metal or brass to steel, of duplex steel 1 4462 to steel C35, of GGG40Fe to St37 or St52, of brass to X20Cr13, X20Cr13 or brass, and of 422CrMo4 to 42CrMo4 Graphs, Photomicrographs 2 ref

191 ADHESION: AQUEOUS CLEANERS FOR PRETREATMENT

By Dorn L. and Salem N.

Water based cleaners have been under test as alternative solvents to industrially and environmentally hazardous organic compounds, such as 1,1,1,trichlorethane, used to decontaminate steel plate before the application of an adhesive Steel plate was used as delivered, cleaned with one of the chosen solvents or cleaners in conjunction with ultrasonic action, and/or subjected to abrasion by a jet of carborundum particles The aqueous cleaners each contained a surface active compound, a sequestering agent, and was neutral or made alkaline or acidic by the addition of a caustic hydroxide or phosphoric acid, respectively The cleaners tested were NA 09 (organic), 1,1,1,trichlorethane, Cleaner GC (neutral), Ultrasonic Alkaline HD, and Descaler 2 (acidic) The strength of adhesion of appropriately cured 0 2 mm layers of an epoxide or polyurethane based adhesive was measured by a peeling test DIN 53 282 Although the use of aqueous cleaners resulted, in part, in some improvement in resistance to peeling, further investigation was considered necessary before advising their use as replacements for solvents in current use Graphs, 9 ref

192 ENVIRONMENT FRIENDLY PROCESS FOR STAINLESS STEEL PICKLING

By Fortunati S., Novaro E., Pedrazzini C. and Pollastrelli A.

The traditional methods for pickling stainless steels may now be regarded as being surpassed as it is possible to substitute the most toxic compound, HNO_3, with less toxic substrates An environment friendly process has been developed for pickling ferritic and austenitic grades Pickling mechanisms are centered on the concept of potentiostatic pickling of stainless steels developed by CSM during the 197 's for sulfuric acid solutions The potentiostatic elements are substituted by suitable proprietary mixtures named Cleanox 352 consisting mainly of HF together with inhibitors and wetting agents, properly stabilized H_2O_2 and H_2SO_4 The pickling process is operated within the metal/solution potential range where the anodic dissolution of the chromium-depleted layer under mill scale is kinetically favoured over that of the base alloy, which remains passive Process management limits reagent consumption and relevant operating costs without impairing the productivity of the production line or the surface quality of products due to problems of under or over-pickling Graphs 10 ref

193 RECOVERY VALUES OF NEUTRALISATION SLUDGES IN METALLURGICAL PLANTS

By Wallis E.

As well as identifying selected metallurgical plants for recovery of sludges from neutralised metal salts derived from electroplating operations Tables are shown, listing the maximum permissible values of other substances present Most such plants are based on the pyrometallurgical route However, certain special cases are treated separately These include sludges from zinc coating plants, effluents from ferro-alloy processes based on plasma technology and those from copper-based processes The ideal situation for producing recoverable sludges can only be reached by separating the various effluent streams On-site electrolytic metal recovery is an attractive option Precipitation using sodium hydroxide rather than lime is recommended, since in the latter case there will be greater concentrations of precipitant and the sludge will be less easily treated

194 STAINLESS STEEL AND THE ENVIRONMENT: GLOBAL GROWTH OPPORTUNITIES

By Rutherford R.W.

The environment is defined as the aggregate of external circumstances, conditions, and influences that affect the existence and development of an individual, organism, or group This discussion considers three of these influencing factors, air, water, and soil Humans can exert very little control over natural forces affecting the environment However, control can be exerted over man made threats to the environment that will affect future development and existence These controls must stand the test of availability, durability, ease of use, longevity, and cost Perhaps a better and more concise term is life cycle costing Stainless producers have a strong case to make that stainless steel is an ideal material of choice for environmental equipment, balancing life, longevity and cost

195 ENVIRONMENTAL BENEFITS OF STAINLESS STEEL PROVIDE NEW MARKET OPPORTUNITIES

By Pauly T.

The compatibility of a material with the environment is a key factor of market success Investors and private consumers increasingly orient their buying decisions toward ecological criteria Stainless steel perfectly complies with this trend In fact, it is beneficial to the environment in four ways clean production processes, ecologically desirable use properties durability, integrated corrosion resistance, minimum maintenance requirements, perfect recyclability, and key material in environmental technology Examples are shown of how stainless steel contributes to securing one of mankind's most precious resources, water It is shown how the unique combination of technical properties, aesthetic appeal and environmental benefits of stainless steel is used in marketing Actual campaigns run by companies and industry organizations are described 2 ref

196 AOX DETERMINATION IN PROCESSING SOLUTIONS

By Schatzlein-Maierl P., Jungnickel F. and Held K

German effluent discharge legislation (Appendix 40) lays down administrative procedures for management procedures in the metal-finishing and metal-working industries, describing a straightforward means of AOX determination Modifications in the procedures for sampling, storage of samples, their concentration and analytical methods are described Especially in cases of high DOC contents, these measures call for a significant increase in the analytical effort required 8 ref

197 EVALUATION OF ENVIRONMENTALLY ACCEPTABLE MULTI-LAYER COATING SYSTEMS AS DIRECT SUBSTITUTES FOR CADMIUM PLATING ON THREADED FASTENERS

By Ingle M.W., Handsy I.C. and Schorr B.S.

Cadmium has been identified by the US Army's Tank and Automotive Command as a threat to worker health and the environment Based on already completed Cd substitute testing, an evaluation program was conducted to quantify the performance of environmentally acceptable, multi-layer coatings that could be directly substituted for Cd on threaded fasteners The performance issues investigated included coating system lubricity and corrosion control performance Data were generated from both natural marine atmosphere exposure tests and laboratory evaluations Test specimens were prepared by applying sacrificial plating layers and lubricous topcoat materials to commercially available 1/2-20 UNC Fine, Grade 5 fasteners Experimental analyses included realistic torque-tension curve development, marine atmosphere exposure testing, and ASTM B 117 salt fog evaluations Program findings indicate that ASTM B 633 zinc coatings (without the Type II or III chromate passivation treatment) exhibited torque tension behavior that was directly comparable to that of the Cd experimental controls Corrosion control performance test results indicated that regardless of underlying plating chemistry, systems topcoated with Everlube 6108 performed as well as the Cd experimental controls Graphs 7 ref

198 ROUTES TO THE DEVELOPMENTS OF LOW TOXICITY CORROSION INHIBITORS

By Kalman E

Because of the toxic and carcinogenic nature of chromate containing corrosion inhibitors, considerable efforts are made by researchers to

develop environmentally acceptable compounds. A review of such corrosion inhibitors for mild steel in neutral aqueous solution is given. The mechanism of corrosion inhibition is discussed and correlations between the structure and inhibitive efficiency of organic molecules are studied. The concept of a computer design of corrosion inhibitors, i.e. 'tailor-made inhibitors', is given. The role of synergism is presented. Relationships between scaling and corrosion are discussed. Graphs 65 ref.

199 AMALGAMATION IN SMALL GOLD OPERATIONS: ALTERNATIVES AND TREATMENT OF MERCURY-CONTAMINATED SOILS AND EFFLUENTS

By Lins F.F., Monte M.M., Hamelmann C.R. and Middea A.

There is a large use of Hg in Brazil by the Au miners in the so-called garimpos (non-registered mining operations), where it is usual to recover the Au contained in the gravity concentrates by amalgamation, which is highly deleterious to environment if not conducted properly. Unfortunately, this is a common practice there. After presenting in brief the modus operandi generally practiced in the garimpos and the environmental problems, this work reviews some of the research conducted in CETEM according to two approaches: replace amalgamation by other processes and develop technology to treat magnisium-contaminated soils and effluents. Conventional processes like froth flotation to recover Au from gravity concentrates, and centrifuges were considered. Also as alternatives to amalgamation, innovative process like the recovery of Au by coal-oil agglomerates and a technology that is currently under development in the laboratory, called Au-paraffin process, are described in brief, some results presented and their potential use is assessed. To reclaim sites already polluted, a technology was developed to float Hg selectively from contaminated soils. The potential use of centrifuges to pre-concentrate the Hg is also discussed. The scope for applying the last techniques is to concentrate the pollutants in a small volume of mass which would be suitable for recycling or isolation from the environment. A prospective technology to treat contaminated soils, or Hg concentrates, is the immobilization of Hg by adding inorganics. Concerning the ionic Hg which may be present in effluents, precipitation of the ions and flotation of the precipitates are being studied. Graphs. 49 ref.

200 IMPROVING COPPER SMELTING PROCESS, CAPACITY AND COSTS - THE ANSWER IS OUTOKUMPU FLASH SMELTING

By Jortikka M., Helle L. and Hanniala P.

The smelting process of the old reverberatory furnace including its capacity has been improved over the years in different ways, e.g. with oxy-fuel burners, parallel reactors with the reverb or with various modifications of the reverb furnace itself. The future reverb modifications with old concepts are difficult or impossible as the increased copper losses in slag call for separate slag treatment and particularly the process modifications do not solve the environmental issues but instead mean unavoidable high capital and operating costs in gas cleaning and sulphur recovery. This paper discusses the possibilities for future process improvements of the existing flash smelters, taking into account the process concepts, equipment modifications and capital aspects, not forgetting the environmental issues. The revamping of the PASAR smelter in Philippines is introduced as an example of a recent success story. Graphs.

201 SURFACE-LUBRICATED STEEL SHEET

By Hoboh Y., Yauchi A., Oshima K. and Kajiyama E.

In a process of producing electric appliances, most zinc coated steel sheets are degreased after press forming to eliminate press lubricant oils and other contaminants, then assembled as end products. Organic solvents such as CFCs (chlorofluoro carbons), 1,1,1-trichloroethane have been widely employed as cleaning solutions. However, these solvents will not be available, since they are recognized as ozone-depleting materials and are scheduled to be phased out by the end of 1995. Therefore, recent research has focused on alternative techniques of degreasing. development is still under way. A surface-lubricated steel sheet with a special lubrication is one of the solutions. This steel sheet enables both oiling and degreasing out of

processing, thus shortening the process and cutting cost. This is one of the steel sheets which are very gentle on the environment. This report introduces some properties and performance of the surface-lubricated steel sheets developed by Sumitomo Metals. Graphs, Photomicrographs. 5 ref.

202 ENERGY SAVING AND ENVIRONMENTAL PROTECTION BY CONTINUOUS CASTING

By Schwaha K.L., Granitz F., Ortner A. and Felbermayr E.

The introduction of continuous casting has been a major factor in energy saving and environmental protection for steel production. Comparative data with ingot casting are discussed. Innovation in plant and process technology leads to further reductions in energy consumption and environmental pollution. As an example, the features of the modern slab caster concept are illustrated by the new slab caster at Egyptian Iron and Steel Works Hadisolb, which was supplied and installed by VAI. Graphs. 15 ref.

203 OPERATION START-UP OF CONTINUOUS CASTING

By Ahmed M.T., Ayoub A.M. and Farrag, S.H.

This paper explains the experience and techniques of ANSDK for smooth operation since start-up, including the improvement procedures to the optimum operation condition based on good training programs for staff, keeping work and operation standards, and techniques of minimizing operational troubles of continuous casting machines. The goal is to maximize the time utilization of continuous casting machines, increase productivity while keeping cost down, and improve the product quality. Graphs. 5 ref.

204 NON-CHROMATE TALC CONVERSION COATINGS FOR ALUMINUM

By Buchheit R.G., Drewien C.A., Finch J.L. and Stoner G.E.

A method has been developed for applying an inorganic conversion coating on aluminum that is procedurally similar to chromate conversion coating methods. This new method, however, does not use or produce hazardous or toxic chemicals. The coating forms by a precipitation mechanism involving Al^{3+}, Li^{+}, OH^{-}, CO_3^{2-}, and possibly other anions present in the bath as impurities. This polycrystalline coating is continuous, conformal and persistent in aggressive environments. Coating thicknesses range from several tenths to ten micrometers depending on the substrate alloy composition and the coating process conditions. The outer portions of the coating are porous, but pores do not penetrate to the coating-substrate interface. These coatings, as currently fabricated, do not match the levels of performance offered by commercially available chromate conversion coatings, but are capable of meeting many of the corrosion resistance, electrical resistivity, and paint adhesion requirements established in MIL-C-5541E Chemical Conversion Coatings on Aluminum and Aluminum Alloys. Methods for producing the talc coating on Al alloys 1100 and 6061-T6 are described and compared to traditional chromate conversion coating methods. The resulting coating structure and composition are described. Additionally, performance data for the talc coatings in MIL-C-5541E required tests are presented along with comparative data from samples prepared using commercial chromate-based coating processes. Graphs, Photomicrographs. 15 ref.

205 IRONMAKING BY SMELTING REDUCTION: AN ANALYSIS UNDER INDIAN CONTEXT

By Ray A.K., Prasad K.K., Chaudhury P.K. and Aeron S.M.

Smelting reduction of Fe ore has started receiving attention as a viable alternate route for ironmaking. The smelting reduction processes can be classified into three categories - single, two and three stage processes. Single stage process is carried out in a single well stirred vessel in which cold Fe ore, coal and oxygen are reacted. The gases evolved from the molten bath is post-combusted to a very high degree (approx 70%) and the post-combustion heat is sent back to the bath. ELPR is an example of this process. Two stage process is characterised by moderate degree of post-combustion of the smelter off gas (approx 50%). The post-combusted gas having lean reduction potential is used to pre-heat and pre-reduce iron oxide up to FeO stage. The pre-heated and pre-reduced iron oxide is fed into the smelter. Hi-smelt, HSC and NKK processes fall in

this category. In the three-stage process, the hot smelter of gas is enriched by reacting with coal before being sent to the pre-heating and reduction unit. COREX is an example of this type of process. The efficiency of these processes increase with a rise in complications necessitated by addition of steps. The quality requirement of raw materials also become more stringent with increase in number of stages. Indian coals are characterised by high ash and high VM content. Graphs.

206 DIRECT IRON ORE SMELTING REDUCTION, NEXT GENERATION MAKING PROCESS

By Minerals and Metals Review

A direct iron ore smelting reduction (DIOS) pilot plant under construction by the Japan Iron and Steel Federation (JISF) at NKK's Keihin Works has been completed. Billed as a next-generation ironmaking process, DIOS is expected to replace the current blast furnace process, allowing the use of cheaper non-coking coal with greater operational flexibility and lower production costs. The DIOS project was launched in 1988, by JISF jointly with the Centre for Coal Utilisation Japan (CCUJ), an affiliate of MITI, which partly funded the project. NKK and seven other integrated steelmakers participated in the study of elementary technologies, jointly dividing the work.

207 NEW GROSS ENERGY-REQUIREMENT FIGURES FOR MATERIALS PRODUCTION.

By Heijningen R.J.J., Castro J.F.M., Hazewinkel J.H.O., Worrell E., Beer J.G., Faaij. A.P.C. and Vringer K.

New gross energy requirements (GER) have been calculated for 40 materials for the reference year 1988. The materials comprise metals (steels, aluminum, and copper) plsties, paper, ceramics and non-metallic minerals, wood and fertilizrs. GERs are given both for the final (distinguished with respect to energy carriers) and primary energy consumption. Most of the GERs hold for Western Europe but some only apply to the Netherlands. 81 ref.

208 PRODUCTION OF HIGH QUALITY SINTER FROM ALL REVERT BURDENS AT INLAND STEEL

By Horst C.A.

Changes in Inland's No. 3 sintering plant to machine, materials, and practices successfully eliminated Inland's reliance on foreign suppliers for sintering materials and increased the amount of waste oxides and fluxes recycled at the Indiana Harbor Works. Two key process changes were responsible for eliminating most of the purchased materials: a mill scale deoiling facility was constructed to enable the sintering plant to use large quantities of mill scale; high iron content fines from magnetically separated BOF slag were screened out for use in the sinter burden. Raw material costs per mg of sinter were reduced 51% in the fourth quarter of 1991 compared to the second quarter of 1989. Prior to the start of the program, reverts made up approx. 46% of the sintered burden. Now, revert materials make up approx. 93% of the sinter burden. Though sinter production is currently 24% less than in 1989, revert consumption is up 27% over previous levels. Graphs. 2 ref.

209 EOS - EMISSION OPTIMIZED SINTERING: A NEW PROCESS FOR ENHANCED POLLUTION CONTROL IN IRON-ORE SINTERING

By Cappel F. and Weisel H.

Iron ore sintering entails substantial off-gas volumes, the treatment of which causes considerable cost to meet increasingly stringent environmental protection standards. The EOS process is geared to reducing the off-gas volume by 60-80% while conserving or even improving the sinter characteristics. This process opens up completely new opportunities of off-gas cleaning and leads to appreciable savings for environmental control measures. Lurgi has applied for industrial property rights to cover all process features. Graphs. 1 ref.

210 REDUCTION OF SINTER PLANT EMISSIONS AT HOOGOVENS IJMUIDEN

By Keddeman E. and Oosterhuis E.

At Hoogovens Ijmuiden, Netherlands, three sinter-machines with specific suction areas of 1 x 90 m^2 and 2 x 132 m^2 produce 4 million tons of sinter/year. The burden composition of the blast furnaces is 50% sinter and 50% pellets. The pellet plant on site produces approx 4 million tons/year as well. These productions are sufficient for a pig iron production of 4 million tons. Pellets are only MgO-fluxed thus sinter basicity is relatively high (CaO/SiO_2 is approx 2.30). All plant reverts, i.e. mill scales, steel plant dusts, steel plant slags, screen offs, etc. are recirculated through the sinter plant if chemistry permits. A typical composition of the blend for the sinter plant and the chemistry of the sinter are presented. A review is given of present Dutch Government regulations and some government intentions as well as the results and conclusions of studies and tests by or on behalf of Hoogovens as a result of the environmental pressure to reduce emissions.

211 ENVIRONMENTAL PROTECTION IN THE SINTERING PLANT OF STEEL WORKS

By Hattori M., Iino B., Kimura K. and Matsunaga, Y.

A desulfurization plant (brought into operation in October 1976) and a denitrification plant (June 1979) having a capacity of 1 230 000 Nm^3/h were installed in the sintering plant site of the Keihin Works after various fundamental tests and industrialization tests on pilot plants. These large-capacity facilities have been in operation with no serious trouble since the startup. High desulfurization and denitrification rates are constantly kept, and the reduction of quantities of produced SO_x and NO_x is believed to be making a great contribution to environmental protection. Graphs.

212 THE INTRODUCTION OF $MG(OH)_2$ TYPE DESULFURIZER IN THE SINTER WASTE GAS LINE AND OPERATION RESULTS

By Kubo S., Iida T., Sakuragi J., Inokunchi and K. Kodama I.

The $Mg(OH)_2$ type desulfurizer developed by Nippon Steel was introduced in the sinter waste gas line at the Tobata No 3 Dwight-Lloyd type sintering machine in 1988. This desulfurizer is relatively small and about one-third the cost of the conventional $Ca(OH)_2$ type. At the same time, completely unattended operation of the desulfurizer has been made possible due to the lack of scaling trouble and the fully automatic operation system. Graphs 1 ref.

213 PROSPECTS FOR FUTURE IRON- AND STEELMAKING

By Fuwa T.

Three serious issues which the steel industry needs to solve and the prospects for iron- and steelmaking in the future are discussed. The first difficulty has arisen because of the dependence of the steel industry on the use of fossil fuels and their deleterious effect on the environment. There is also a problem because the technical requirements for some steel products are becoming more stringent, with increasing demands for much lower concentrations of carbon, phosphorus and sulfur. A third major problem is that it is not economically feasible to produce high quality steel from steel scrap because of the difficulty of removing tramp metals from the scrap. Predictions are made with regard to future steelmaking technology and pollution abatement. Graphs 12 ref.

214 CONSTEEL PROCESS SUCCESSFUL IN USA - A 120 MT/HOUR UNIT STARTED UP IN JAPAN

By Vallomy J.A., Fuse T. and Nakamura S.

The Consteel process is a technological leap in electric steelmaking which features energy efficiency, increased productivity in the meltshop and rolling mill, improved working conditions in the meltshop, dramatic decrease in dust and gaseous emissions, and steam or energy cogeneration. The patented process consists in continuously feeding-preheating-melting and refining ferrous scrap or direct reduced iron, using the chemical and sensible heat of the furnace off-gas to preheat the scrap. Thermal incineration of the flue gas reduces harmful emissions to the level required by current worldwide regulations on environmental protection. Flue gas dust is approx 60% that in conventional electric steelmaking. The tap to tap time is set to match the cycle of the caster. A Consteel prototype

was tested at the Nucor Steel plant in Darlington, South Carolina, USA. A 54 tonne/h commercial plant is in its third year of operation at Florida Steel Corporation, Charlotte, North Carolina, USA, proving the economic viability of the process. A 120 metric tonne/h plant went into operation in early October 1992 at the Nagoya works of Kyoei Steel in Japan.

215 LME METALESCAUT: DIRECT CURRENT CONTINUOUS CHARGING DC3

By Lebrun C. and Thebault J.M.

The tri-electrodes arc furnace of LME Metalescaut was the first big industrial DC furnace in the world. In such system, a convergence of the arc occurs and a possible consequence is a hot spot at the center of the roof. This disadvantage was turned to account by installing a continuous feeding system of half of the scrap charge through a hole at the center of the roof. Besides the reduction of solidifications to the roof, some important production savings were confirmed: energy saving by reduction of thermal losses, time saving in relation with these losses reductions and the cancellation of half of traditional charging operations, saving of dust emissions while charging. Now, this equipment is able to produce charges of 80 tons of goods billets with a tap to tap time of 45 min. Graphs.

216 THE SHEERNESS SHAFT FURNACE

By Clayton J., Ehle J., Twiselton J. and Knapp H.

The new and unique solution of an arc furnace with integrated scrap preheating at Sheerness Steel, the so-called Ruchs Shaft-Furnace, is introduced. In a conventional arc furnace 20% of the overall energy requirement is carried away with the off-gases. The shaft-furnace has proven that approx. 60% of this energy is returned into the scrap, thus reducing the melting energy requirements, therefore reducing the heat cycle and increasing the productivity by almost 20%. This contributes to an overall efficiency of the steel works and reduces environmental burden. The return of investment could be proven in some cases to be less than three years. Graphs.

217 ADVANCED ENVIRONMENTAL TECHNOLOGIES - THE BSW CONCEPT FOR ENVIRONMENTAL PROTECTION

By Klein K.-H., Koster V., Paul G. and Haas J.

BSW = Badische Stahlwerke AG, Kehl, Germany, is trying new ways to cope with the demands of environmental protection regarding noise, water treatment and exhaust gas cleaning. To reduce the noise of falling scrap at the scrap yard, a special noise protection wall was installed two years ago. The existing steelplant outside wall was coated with a new type of noise absorbing material. Regarding water supply, BSW uses, as far as possible, circuits with progressive filtration technologies, without application of any chemical additions. In January 1991, BSW started, at both 80 t EAFs, a new type exhaust gas system. The new system is based on an after-combustion and following fast cooling-down of the exhaust gas. Substantial advantages of this system are the extensive avoidance of formation of dioxines in furnaces, reduction of dust settling in the tube system to a minimum as well as reduction of carbon monoxide content in the off-gas. Measurements of dioxine in the off-gas showed values with only one-tenth of the values measured before with conventional systems. With the installation of the new exhaust gas system, the existing baghouse could be reused without capacity increase of the filter area. Graphs.

218 A NEW SCRAP VARIETY: SHREDDED SCRAPS FROM INCINERATED DOMESTIC WASTE

By Gros B.

The action undertaken since the early 1980s, by French tinplate producers, to maintain and strengthen the position of steel as a "green" packaging material, allows for the marketing of a new type of scraps, the quality/price ratio of which places them in a favourable competitive position in relation to existing scrap materials. Potential deposit, through incinerated French annual household refuse, is approx. 300 kt. The specifications defined, taking account of the performances made possible with a specially developed shredder mill, are as follows: magnetically separated from ashes after waste incineration, Fe % 90, density 0.9, residual content

1%, and scrap dimensions all between 10-200 mm. Today, the conditions to extend the recycling mechanism, nationwide, in compliance with the defined standards, have all been met. French territory has been divided up into six zones, whose selection criteria are based on the importance of the deposits, the proximity of potential users, and the motivation of local decision makers and contractors. East, North and Paris areas are operating well, with one specific shredding plant each. South-East and West will join the recycling movement in 1993, then South-West in 1995. Nearly 200 kt of good scraps have been collected from incineration plants by magnetic separation to the shredder in 1991, representing 100 kt of good scraps to be consumed in steel furnaces, either EAF or BOF. All French, even all European, steel plants are concerned, but the more experienced at that step are: Dunkirk and Florange Sollac's BOF steel plants, Valenciennes, Thionville, Neuvs-Maisons and Montreau Unimetal EAF steel plants, and Schifflange Arbed's EAF steel plant. Graphs.

219 HYDROCYCLONE TREATMENT OF ELECTRIC ARC FURNACE FLUE DUST (EAF AND EAF/AOD)

By Sainz E., Lopez F.A. and Formoso A.

This report presents the preliminary results obtained in the hydrocyclone treatment of electric arc furnace flue dust, designed to give a substance with higher zinc and lead contents which, after hydrometallurgical processing, can then be recovered. The first step was to determine the ideal cyclone geometry by testing internal diameters of 10, 25 and 50 mm and different sizes of apex and vortex finders. This geometrical study was initially carried out using dust from carbon-steel furnaces which can be considered as representative of Spanish flue dust with a high Zn content. After establishing the optimum cyclone geometry and operating conditions (pressure and concentration of solids in fed slurry), a number of samples from different Spanish steelmaking facilities were studied (carbon, high-alloy and stainless steel plants). The results show that it is possible to increase Zn and Pb contents in the cyclone's overflow in comparison to the original metal contents of the initial dry flue dust, to give a level of non-ferrous metals of 70-80%. To reach this level, a hydrocyclone with a 50 mm internal diameter is required, with a 3.2 mm vortex finder and an 8 mm apex finder, operating at a pressure of 3.2 kg/cm^2 and using a fed slurry with a dry solid content equal to 34 g/l. The field of application for this process is preferably in the treatment of steelmaking flue dust with a Zn content of 20 wt%. Graphs. 7 ref.

220 A PYRO-HYDROMETALLURGICAL ALTERNATIVE FOR THE TREATMENT OF THE ELECTRIC ARC FURNACE DUST

By Godinez J.A.

This paper presents an alternative for the need to convert thousands of tons of electric arc furnace dust (EAFD) into an environmentally safe or economically recyclable product. Since the content of Zn in the EAFD is low and variable, though important, this work also attempts the reclamation of Zn from this waste material. The EAFD is first subjected to a double kiln process in a rotatory reactor. The calcination product shows a high and fairly constant Zn concentration and its main components are zinc oxide (ZnO), iron oxide (Fe_3O_4) and zinc-iron oxide ($ZnFe_2O_4$). Sulfuric acid leaching experiments were performed to search for and establish the effects of ultrasound, air bubbling rate, temperature, acid concentration and weight of calcine to acid solution volume ratio on the Zn and Fe recovery in solution and on the An - Fe selectivity index. These results led to using sulfuric acid instead of other acids for further leaching testing. Zinc sulfate solutions were cemented with Zn dust and electrolized showing a current efficiency as high as 92%. Nonetheless, the presence of halogen elements in the electrolyte induced the Zn deposit to stick to the substrate. Thus, it was proven that it is possible to reclaim Zn from the electric arc furnace dust by means of a pyro-hydrometallurgical process. Graphs. 19 ref.

221 AN ENVIRONMENTALLY SAFER AND PROFITABLE SOLUTION TO THE ELECTRIC ARC FURNACE DUST (EAFD)

By Diaz G., Martin D. and Lombera C.

The modified Zincex process, a Spanish process, is the best solution for the secondary residue treatment regarding technical, economical and ecological areas. It is a hydrometallurgical process with atmospherical

leaching, solvent extraction and electrowinning, with low capital and operating costs, and it is able to produce SHG zinc (99.99%), with high overall Zn recovery. Nevertheless, this possibility is a good solution to companies with residues such as hot galvanizing ashes, Waelz oxides, brass and bronzes residues and others. It is also a profitable solution and reliable process to the EAFD treatment. The modified Zincex process has advantages over other pyrometallurgical and conventional methods of treatment in the following aspects: higher Zn recovery, better plant flexibility, better Zn quality, better ratio gains/investment costs, no problems regarding fluorine, chlorine and magnesium and environmentally safer. Experimental tests from more than ten EAFD samples of European industrial companies, and more than six weeks of pilot plant running with several EAFD sources show a high global Zn recovery with nil ecological risks.

222 CARBON DIOXIDE AND THE STEEL INDUSTRY

By Publisher: International Iron and Steel Institute

The main issues related to the use of CO_2 in the steel industry (levels of consumption, measures to reduce CO_2 emissions, alternatives to a carbon tax) are summarized. A quantitative analysis of carbon consumption data provided by a small sample of integrated and EAF producers is included. The data provide an interesting global overview and focus for discussion. 6 ref.

223 A HIGHLY CONCENTRATED COAL-WATER SLURRY BURNER

By Wang H., Wang S.J. and Zhao L.

Based on simple introduction to the mechanical and burning properties of highly concentrated coal-water slurry (CWS) the construction and operation behavior of a newly-developed CWS burner are described in detail. In addition, the practical working performances of this kind of burner, such as combustion stability, start-up, turn down ratio, CWS nozzle durability, effect on reheating process of steels, and pollutant emission are also evaluated. The results of application show that his series CWS burners can be widely used in ordinary industrial furnaces.

224 DESIGN OF HIGH TEMPERATURE HIGH PRESSURE LARGE CAPACITY BOILER FOR HIGH RELIABILITY

By Hisatome M., Hishida M., Iwanaga A., Sada T. and Soda M.

Not only economical power generation but also the saving of fuel and for minimization of CO_2 emissions which is considered to be concerned with global warming, the improvement of the thermal efficiency of power plants is increasing in importance. Coal-fired power generation will increase its share in power generation in the future and, at the same time, the unit capacity will be increased because of the limited availability of plant sites. From the view point of operation, the plants will be fired with a wide range of coal imported from various regions of the world, satisfying the very stringent air pollution limitations, and operated in middle load mode. To meet these requirements, Mitsubishi Heavy Industries, Ltd. (MHI) has established design technology for large capacity high temperature supercritical pressure once-through boiler, developing new materials with high strength at high temperature and established technologies for application. SUS 347 HTB, SUS 310 HTB, STPA 24, STPA 28, HCM 12A, NF 616, SUS 316 HTP, STBA 28 are discussed. Graphs.

225 COMPETITION BETWEEN STEEL AND ALUMINIUM FOR THE PASSENGER CAR

By International Iron and Steel Institute

A comprehensive comparison of the relative merits of steels (e.g. EDDQ, DDQ, SPC35, SPC 40, BH 300, BH 365, BH400) and Al alloys (e.g. 6009, 6010, 6011, 6016, 2036, 2038, 2008, 5052, 5182, G4B, GZ45, KS5030, GC45, TG19, TG25, KS6183, TM17, TM02, AU2G, CV15) as materials for use in passenger cars is presented. Following an overview of the automobile industry and its markets, an investigation of required metal properties and vehicle performance is presented. Materials properties and fabrication issues addressed include formability, weldability/joinability, paintability, repairability, and recyclability primarily of sheet materials. Economic and safety considerations are also covered along

with legislative requirements that influence the final selection of materials for automotive applications (especially weight reduction, emissions and fuel consumption standards). It is concluded that Al is an important competitor for steel in automotive applications, especially in the production of small series passenger cars. Graphs.

226 WHY MELT CUPOLA

By Kaiser F.T.

The primary driving forces leading to a shift to electric melting were environmental concerns, differential escalation of coke vs electric energy costs and technological improvements in electric furnaces equipment and refractories. Concurrent with the shift of some tonnage to electric melting, cupola technology also improved tremendously and this type of furnace still remains the major tonnage melter in iron foundries. Recent studies predict that during 1994 cupola melted Fe will account for 63-64% of all castings produced in US Fe foundries. Today, environmental compliance needs are catching up with electric melting processes and the Clean Air Act amendment of 1990 is substantially affecting the complexity and cost for installing and operating environmental control systems for this substantially batch type melter. Conversely, during the last 30+ years, environmental controls for cupolas have been substantially improved. Further, the continuous melting nature of the cupola makes it easier to comply with the Clean Air Act needs. Today, the cupola is the more environmentally responsible type of Fe melter for both implant conditions and emissions to atmosphere and its tolerance for so-called less-than-clean scrap substantially increases its competitiveness with electric melting. Cupola energy costs have been, and are now, more than competitive due to efficiency improvements and escalated electric energy costs.

227 CUPOLA DESIGN CONSIDERATIONS

By Rubin R.

Continual tightening of the environmental standards has affected the design of the cupola. Charge door openings have been reduced in size, to reduce the degree of infiltered air, therefore reducing the amount of gases to be handled by the emission system. Stock height has also been increased to burn the gases properly. Tuyere placement and size, to achieve optimum combustion throughout the cupola, has received much attention during this period. The advent of the protruding, water cooled tuyere provided the opportunity to explore and test different approaches. The more efficient long campaign cupolas have resulted in reducing the cupola size required to provide a specific melt rate. The 100 ton/h cupola is now in production. The advent of OSHA, and the current legal atmosphere, has dictated that safety and working conditions be improved in the melting area.

228 A SCANDINAVIAN VIEW OF (COATED) SCRAP AND THE ENVIRONMENT

By Lindblad B.

A lot of different actions can be taken to solve the problem of smelting of coated scrap. In the Scandinavian steel industry, scrap sorting and scrap pre-treatment are important before melting. Pre-treatment in shredders can have a great impact on the environment at EAF shops because the organic load in scrap is important. During melting, post-combustion and injection of absorbants are important. A high oxidation degree in the furnace is important but post-combustion in separate channels/chambers seems to be an expensive way of solving these environmental problems. Injection of absorbants before the filter can perhaps solve the problem with the dioxin emission and of metals like mercury. Graphs. 4 ref.

229 SIDOR'S ENVIRONMENTAL QUALITY NETWORK

By Castro F.

The pollution potential of the steel industry demands the systematic measurement of the air, water and waste disposal to assist in the development of control strategies, verify their efficiency and provide for the timely responses to any contingencies or new legal requirements. The design of SIDOR's environmental quality monitoring network and the sampling data obtained during the period from July 1990-April 1993 are discussed. The results of the program show an overall improvement of the environmental quality in the areas covered by the network and indicate the need of an improved and tighter control in the areas of raw material handling.

dust generating production processes, oil, chrome and acidic waste leakage and spills and sewage treatment. The industrial landfill will also require improved operating, maintenance and operational control procedures.

230 EAF-DUST TREATMENT BY DC-ARC FURNACE WITH HOLLOW ELECTRODE AND NEW CONCEPT OF DUST RECYCLING

By Ban B.C. and Lim B.M.

EAF dust generated on the steel production is classified as hazardous wastes by environmental protection acts. Several dust treatment processes are being applied to fulfill both the environmental aspect and recovery of valuable metals such as iron, zinc, lead, chromium and nickel. Thus, focus was given on the comparison of main pyrometallurgical processes which can treat dust without any pretreatment. And new concept of DC technolgies and dust recycling for other applications were given and explained. Graphs.

231 NEW INORGANIC NOBAKE BINDER SYSTEM

By Adamovits M. and Barnett K.W.

The introduction of a new phosphate-based binder system affords the foundry industry a viable alternative to conventional inorganic nobake processes for the production of ferrous castings. This two-part binder system offers considerable advantages over organic binder systems in terms of smoke and emissions at pouring and shakeout. Thermal breakdown of molds and cores prepared using this technology is considerably more facile than for conventional systems at typical binder levels. This advantage is most dramatic in comparison to silicate binder technology. Conventional mixing and molding techniques have been used to produce molds and cores of up to approx. 5000 lb. Strength development of the phosphate binder technology is somewhat slower than with organic binders, necessitating attention to proper foundry practice. All understanding of this technology's potential applications is obtained through an overview of recent foundry trial applications. Graphs. 6 ref.

232 REPLACING OZONE-DEPLETING CHEMICALS IN CORE AND MOLDMAKING OPERATIONS

By Swartzlander M.W. and Martin R.A.

Chlorofluorocarbons (CFCs) commonly used in the core and moldmaking operation as carriers or solvents for release agents, metal cleaners and refractory coatings are being outlawed. These products, such as methylene chloride, 1,1,1-trichloroethane and freon, deplete earth's ozone and have been targeted by all countries for elimination by the year 2000, as set forth by the Montreal Protocol. The US, as part of the revised Clean Air Act, set the end of 1995 as the deadline for ending the production of these chemicals. Meanwhile, the use of CFCs is becoming extremely expensive due to increases in ozone-depletion taxes and mandatory phase-out of production. The increased costs of CFCs and their ultimate unavailability are causing foundry suppliers and foundries to evaluate alternative products. Fortunately, not only do alternatives exist, but in many cases these alternatives can save the foundry money if properly implemented. This paper reviews the challenges posed by eliminating CFCs from foundry operation and discusses the solutions.

233 BENCHMARKING THE NOBAKE BINDER SYSTEMS

By Archibald J.J.

The coldbox binder systems were benchmarked at the 56th World Congress in Dusseldorf, Germany. The wide variety of nobake processes available and the limited foundry experience with some of the recently introduced systems have left the metalcaster with a very difficult selection process. The objective of this paper is to benchmark the general characteristics of eight nobake processes when selecting a nobake system. The eight nobake binder systems compared in this technical offering have unique production features and environmental considerations (of gray iron and steel). Production needs, quality demands, cost and environmental considerations must be carefully studied to assure that metalcasters remain competitive. The nobake binder systems available to the metalcasting industry offer many opportunities for improvements;the challenge is in the selection process. Graphs. 22 ref.

234 AIR EMISSIONS FROM FOUNDRIES: A CURRENT SURVEY OF LITERATURE, SUPPLIERS AND FOUNDRYMEN

By McKinley M.D., Jefcoat I.A., Herz W.J. and Frederick C.

Research on emission control and waste disposal is the number one priority within AFS. In an industry survey conducted by AFS, ten top areas of concern were outlined, headed by sand system waste and emissions from molding, pouring, melting and shakeout in iron and steel green sand foundries. The objective of the present program is to define the foundry waste streams and emissions, establish where the streams originate and their make-up. Currently available technology is identified to minimize, treat, dispose, or reuse the waste. Information obtained is summarized into a manual for use by foundry operators. Additional research and development needed to respond to environmental regulations is identified. A primary driving force for this work is the Clean Air Act Amendments of 1990, which will set new regulations for air emissions from foundries for 189 hazardous air pollutants (HAP) by 1997. This report covers the first year's research on the nature of the foundry waste streams in the form of air emissions from processes of coremaking, molding, pouring and shakeout, and establishes where they originate and their makeup. Binder chemicals are a major potential contributor to emissions from coremaking and subsequent processes. Remaining objectives will be accomplished in a further development of the program. Graphs: 26 ref.

235 SCRAP PROCESSING TECHNOLOGIES TODAY AND IN THE FUTURE

By Jensen A.

In many cases, foundries spend more money for iron and steel scrap than any other purchased commodity. Because of this fact, current scrap processing techniques must be reviewed continually between the scrap processor and foundry consumer to determine if there is a way to improve quality and reduce costs to the consumer. Continuous improvements are a way of life at foundries today. This same commitment must be made by scrap processors to insure that they are supplying the best possible charge materials to the foundry industry.

236 ADHESIVE BONDING IN ALUMINIUM VEHICLE CONSTRUCTION

By Diggelmann K.

The case for regarding the adhesive bonding process as "ecologically sound" is presented. The basic properties of adhesives are analysed and ways in which they are used in practice to make best use of their damping and crevice corrosion prevention properties illustrated. The need for improvements in knowledge of the materials in the workplace and in the colleges and the lack of certain calculation fundamentals are highlighted. Appropriate procedures for the non-destructive testing are given. Illustrations showing the performance of joints in shear, torsion, compression, tension and peel and good and bad joint design, are presented. The long-term performance of adhesive bonds is shown to depend on the use of the appropriate pretreatment for the particular material being bonded. Improvements in shear strength and high temperature performance can be achieved through combining adhesive bonding with mechanical fastening. Graphs: 9 ref.

237 POLLUTION-PREVENTION ANALYSIS AND THE QUENCHING OF STEELS

By Michels W.H.

With the goal of improving process efficiency and reducing risk, a pollution-prevention analysis technique that can be applied to most secondary steel heat-treating operations involving quenching is described. Costs, risk assessments, and pollution-prevention options are discussed, as are the effects of quenching on two subsequent processes - parts cleaning and tempering. In contrast to many process comparisons, the issues of worker exposure, material safety and toxicity, liability, waste reduction, reclamation, and disposal are emphasized.

238 POSSIBILITIES FOR THE REDUCTION OF ENVIRONMENT POLLUTION OF SURFACE TREATMENT METHODS

By Utas-Novak Z.

The most difficult problems of environment pollution caused by surface treatment processs are the treatment of sewage water and heavy metal containing sludge. Reviewing the possibilities of formation of dangerous materials in the course of electrodeposition, the author has described the dangerous wastages. Specific wastage, use and loss of metal and metal hydroxides formed annually are listed for electroplating shops. Possibilities for the reduction of pollution are outlined in detail. 17 ref.

239 CONTROL OF SECONDARY EMISSIONS IN PYROMETALLURGICAL SMELTERS

By Davis J.A. and Taylor J.C.

Existing environmental, health and safety regulations have forced pyrometallurgical facilities worldwide to drastically change some of their traditional methods of operation. In extreme cases, a number of facilities have been closed due to their inability to conform to these existing regulations. Tougher future legislation and government policy will lead to more stringent regulations and enforcement policies. The efficient control of smelter secondary emissions will, therefore, become critical to successful smelter operation. Much attention has been paid to the smelter primary process off-gas systems, including the development of new process designs. Some of the potential secondary emissions encountered in many of the present process technolgies are discussed. A few of the emission sources presented are only periodic in nature, such as those caused by maintenance procedures, but which have the capability of forcing smelter shut-down because of their direct impact on worker health and safety. A variety of topics relating to the efficient control, maintenance and monitoring of secondary emissions in Cu, Ni, Al, Mg, and Pb smelters, as well as in Fe foundries and steel making facilities are dealt with. Examples of the typical problems encountered in each of the above process operations are presented, including fume control at furnace tapping and slagging locations, metal transfer stations, tapping launders and ladle transfer operations. The parameters for the most efficient design of fume capture systems, problems encountered with the handling and clean-up of certain collected emissions, and examples of successful solutions in particular operations are discussed. 16 ref.