Abstracts of papers—Symposium on Utilization of Metallurgical Wastes

1

The Rational Utilization of Fine Ores from the Lorraine Iron Ore Deposits

J. ASTIER, M. BOUCRAUT, F. CHAPOTOT and P. FOLIE
IRSID, Maizieres-les-Metz Station, France.

MECHANIZATION of iron ore mines leads to a higher production of fines which have to be agglomerated before they can be charged into blast furnaces. In this paper the authors have examined the possibilities offered by the sintering and pelletizing processes towards a rational utilization of the Lorraine iron ore deposits. Sintering of fines from the low grade self-fluxing sedimentary Lorraine ores calls for better heat efficiency which has been discussed in detail both from theoretical and practical angles in relation to the main controlling parameters such as adjustment of bed depth; double layer charging and use of preheated air or additional burners; and selection of a suitable solid fuel. Industrial development of sinter in France and its use in the Lorraine blast furnaces have been fully described and illustrated. Investigations were also carried out recently on pelletizing of Lorraine iron ores, and the test data obtained from the IRSID Pelletizing pilot plant at Maizieres-les-Metz have shown that the pellets obtained possess good mechanical strength and chemical composition. A comparison between sinters and pellets is also given on basis of laboratory tests. In concluding, the authors stress that performances of blast furnaces with high sinter burden especially 100% self-fluxing sinter, are technically the best and can often suggest an economical scheme for crushing and grinding all the ore and as far as pelletizing is concerned it is pointed out that it might become necessary in the future to carefully compare it with sintering before making a final choice of process for agglomerating iron ores.

2

Utilization of Important Mining and Metallurgical Wastes Employing Mineral Beneficiation Techniques

M. S. CHOPRA, G. P. MATHUR and P. I. A. NARAYANAN
National Metallurgical Laboratory, Jamshedpur.

THE application of beneficiation techniques for upgrading of low grade minerals and metallurgical by-products, has assumed importance not only because of the simplicity of the operation involved and the technical advancements in this field but also because of the economic advantages over most other methods. Though the amenability of the low grade ores to beneficiation has been established in most cases, studies on some of the metallurgical wastes have also proved equally successful.

During the past few years, exhaustive research investigation has been in progress at the National Metallurgical Laboratory for beneficiation of low grade manganese, chrome, iron ores, non-metallic minerals, etc. from various parts of India. Laboratory scale researches in some cases were sufficiently encouraging to justify large scale pilot plant studies at N.M.L. The results of these activities are briefly reviewed in the paper. Due to the expansion of the iron and steel industry in the country, it has become essential that iron ore fines amounting to 45% of the run-of-mine ore, and also large reserves of blue dust produced during mining operations should be efficiently utilized. Results of beneficiation of these fines have been very encouraging and the methods of their utilization after suitable agglomeration by sintering and pelletizing studies have been worked out.

Typical examples of recovery of metallics from drosses and slags and beneficiation of foundry sands, flue dust, rejects from beneficiation plants as well as from mines, are also presented. Wherever possible, the methods of beneficiation adopted and the important results obtained during laboratory and pilot plant studies have been presented. The use of beneficiation techniques is recommended for utilization of the mining and metallurgical wastes and consequent conservation of these resources wherever physical separation of the valuables is found feasible.

3

Utilization of Fine Grained Raw Materials by Briquetting for Smelting of Ferro-manganese

A. B. CHATTERJEA, S. R. GHOSH and J. GOSWAMI
National Metallurgical Laboratory, Jamshedpur

FOR the utilization of large amounts of fine grained raw materials obtained during the smelting of ferro-manganese, investigations were conducted at the National Metallurgical Laboratory on making self-fluxing briquettes suitable for electro-thermal smelting employing various inorganic and organic binders. The physical characteristics such as shatter index, crushing strength and underload tests at elevated temperatures were conducted to assess the physical characteristics and furnace stability of the briquettes. Inorganic binders, such as bentonite and burnt lime proved to be unsatisfactory. Organic binders, such as molasses and sulphite lye conferred satisfactory physical properties particularly after heat hardening the briquettes at 200°C, but strength at elevated temperatures was inadequate for smelting purpose. As high temperature strength cannot be developed through the use of these binders, effects of addition of coking coal of various particle sizes were studied. The addition of 5 to 10% coking coal assured desired high temperature stability. The variation of grain size of coking coal did not cause any outstanding benefit. Briquettes containing 10% coking coal (−2·41 to 0·5 mm in size) with 4% sulphite lye revealed satisfactory characteristics for electro-thermal smelting.

4

Utilization of Metallurgical Wastes in Ferro-manganese Industry

C. R. COIL and A. SANGAMESWARA RAO
Ferro Alloys Corporation Ltd., Shreeramnagar, Andhra Pradesh.

THERE are three main by-products, so far considered as wastes, from the ferro-manganese industry: slags containing 14–16% Mn, flue dust with 28–30% Mn and furnace gas containing 68–70% carbon monoxide.

About 150 000 tons of ferro-manganese is being produced in this country and it has been estimated that the manganese lost in the slag and flue dust would be sufficient, if recovered, to produce about 60 00 000 tons of steel. In view of the growing importance of manganese in ferrous and non-ferrous metallurgy, various possibilities of its conservation and recovery from such wastes are to be explored. Manganese can be conserved by (1) producing ferro-manganese by suitably adapted methods and (2) producing elecrolytic manganese.

Large quantities of gas amounting to about 750 to 850 Nm^3 per ton of alloy are now discharged into the atmosphere. These gases being rich in carbon monoxide and of high calorific value—2 200 K. Cals/m^3 or 250 B.T.U/ft^3—can be utilized as reducing agent, heating agent and for synthesis of methanol and chemicals.

5

Research and Development Work on the Utilization of Metallurgical Wastes at the National Metallurgical Laboratory

B. R. NIJHAWAN
Director, National Metallurgical Laboratory.

THE science of metallurgy is based on extraction of metals from their ores on an economic basis. Whilst the metallic ores gradually become leaner, the requirements of different metals and their alloys on the other hand progressively become more specialised in terms of rigid service requirements in the background of rapidly expanding horizon of engineering technology.

The resulting spiralling production costs in their wake require the metallurgical 'back room' boys not only to improve the intrinsic economics of metal extraction and processing but also to devise economic means and develop technical 'know-how' for the recovery and utilization of most of the resulting by-products and metallurgical wastes. In these fields of turning metallurgical wastes into useful assets, metallurgical research ingenuity and engineering technology to-day present a broad spectrum as vast as it is challenging in the past background of general apathy and 'back-yard' treatment in making the best use of metallurgical by-products and wastes. Such a general situation is particularly pronounced and equally significant in India since optimum metallurgical techniques for recovery and utilisation of metallurgical wastes have to be basically indigenous in character and execution. In view thereof, metallurgical research and development work on this vitally important subject have to be well planned and systematically pursued. The National Metallurgical Laboratory realising the importance of the subject, started systematic studies on the recovery and utilisation of metallurgical wastes. In this paper, a review has been given of the research and development work undertaken in the National Metallurgical Laboratory on diverse phases of the subject whilst outlining fresh fields for work in these directions. References have been made in this paper to work done at the National Metallurgical Laboratory on the recovery of mine wastes in the form of low-grade ore discards such as that of the fines and their beneficiation and subsequent agglomeration through various means for optimum uses. Details have been furnished of extensive work undertaken on the treatments of different types of slags produced in the iron and steel industry, treatment of drosses, swarfs, skimmings and residues by pyro-, hydro- and electro-metallurgical techniques particularly in the case of non-ferrous metallic residues and by-products met with. Reference has been made to the rather unconventional approaches on the subject, such as the utilisation of granulated ground blast furnace slag for coal mine stowing in view of scanty reserves of silica sand for the purpose. Fundamental work on the subject, such as by hot stage microscopy relating to phase studies, has formed an important link of such investigations at the National Metallurgical Laboratory. Further plan of work in the background of current thinking on the subject has been referred to ; the scope for future work is vast indeed offering high premium to metallurgical research ingenuity both in planning and execution and in which the National Metallurgical Laboratory is to-day actively engaged upon.

6

Recovery of Unburnt Gases from Oxygen Blown Converters

H. MALCOR

Chairman, Cie. des Forges et Acieries de la Marine, General Manager, Cie. des Ateliers et Forges de la Loire and Hony. Chairman, IRSID, France.

CHARACTERISTICS of the unburnt gases from oxygen blown converters have been examined, discussed and compared to show that their recovery is highly advantageous. Some difficulties are encountered in connecting the converter mouth to the recovery device. The tight connection system patented by the Cie. des Ateliers et Forges de la Loire (France) and the open connection method patented by the Institut de Recherches de la Siderurgie Francaise (France) have been described in detail and their performances discussed. On the basis of the experience gained and data collected from plant trials the author concludes that unburnt gases from oxygen blown converters can be safely recovered and cleaned and that recuperation of their latent heat will substantially increase the thermal efficiency of the steel process.

7

Energy Recovery from LD Converters—A Descriptive and Thermodynamic Comparison

B. S. HOLMES, E. M. WOOLLEY and P. A. YOUNG
Research and Development Division, Head Wrightson & Co. Ltd., England.

THE general problem of the utilization of waste gases from oxygen steelmaking processes is considered, and detailed descriptions are given of waste heat boilers and gas recovery plants for LD converters. The problem is then analysed in terms of both the first and second laws of thermodynamics.

8

The Recovery and Utilization of Waste Gases in Iron- and Steelmaking

J. L. HARRISON
Manager, Iron and Steel Processes, British Oxygen Co. Ltd., England.

CLOSE economic and practical study of the recovery possibilities is essential to make the best use of the chemical and sensible heats arising from steelmaking processes. Though satisfactory means do exist to convert the energy to steam or to collect the gas and store it for a number of uses, it seems desirable that alternative methods be developed.

Suggestions have been put forward for using the energy to preheat scrap or to reduce fine ores. It may be possible to handle, in the pre-reducing cycle, the fine dust from the fume cleaning system. If processes are developed they should be capable of providing an end product comparable in price with alternative coolants for the LD process. The prices of such materials would vary according to availability. Therefore comparison cannot be made on a general basis, but must be individually investigated in a given locality.

9

Recovery of Waste Gas from Oxygen Converter by the O. G. Process

M. YUKAWA, M. ICHINOE and J. IMAI
Yawata Iron and Steel Co. Ltd., Japan.

EXTENSIVE studies carried out on the recovery of CO rich oxygen converter gas in the unburnt state and tests conducted over a period of about eighteen months, covering 220 heats, have shown that the oxygen converter gas recovery process can be safely adopted on an industrial scale and that the gas recovered will contain 70–90% CO. The Tobata No. 2 LD plant was fitted with O.G. process equipment and started operation in March, 1962. The present report gives an account of the tests, the compositions of the gas recovered and characteristics of the dust collected.

10

Utilization of Waste Heat and Gas in Small Integrated Iron- and Steelmaking Unit

B. L. SEN and P. K. BOSE
Indian Oxygen Ltd, Calcutta.

THE economics of a small scale iron- and steelmaking unit comprising low shaft furnaces and top or side blown oxygen steelmaking converters largely depend on the effective utilization of the waste heat gases. This paper examines the availability of waste gas from low shaft furnaces, LD converters, etc. and discusses its subsequent utilization.

If low shaft furnaces are to be set up in different regions of the country where non-coking coal, iron ore and limestone are abundantly available for steelmaking purposes, the economics of such units combined with oxygen steelmaking process cannot be satisfactorily balanced without a very effective use of waste heat and gas including their applications in other ancillary industries e.g. cement, fertilizer and chemicals based on steel plant by-products.

The availability of low cost oxygen and nitrogen from tonnage oxygen plant will play a significant role in the economics of such integrated projects.

11

Nickel Recovery from Low Nickel-Copper Ores

S. C. SIRCAR and YA. YA. MIKHIN
Indian Institute of Technology, Kharagpur.

THE possibility of nickel extraction from copper matte containing small amounts of nickel has been examined. It is shown that nickel can be extracted into slag phase by addition of flux at a predetermined time. By proper adjustment of the nickel rich slag addition and of the converter blow, a nickel rich copper matte

can be obtained, which can be treated in the conventional way to give nickel metal. Also, the circulation of nickel between converter and reverberatory can be eliminated, thus achieving smoother operation of the reverberatory furnace.

12

Chloride Volatilization by Salt Roasting

D. V. JACKSON, T. J. N. GRAINGER-ALLEN and R. G. WHITEMORE

Warren Spring Laboratory, Department of Scientific and Industrial Research, Stevenage, Herts, England.

A STUDY of past work on chloride roasting and volatilization for recovery of non-ferrous metals suggests that attempts have been made to develop processes without first obtaining a full understanding of the reactions occurring and, in consequence, no volatilization process has had lasting economic success. This paper describes some preliminary experimental work designed to provide further information on the reaction processes. Results of chloride volatilization experiments using pure metal oxides, synthetic mixtures, pyrites cinders and samples of tin ore are given. The possibility suggested of treating pyrites cinders by firing pellets containing $CaCl_2$ on a sinter strand is considered and some results obtained on a small sinter pot are given. The collection of volatile chlorides is discussed.

13

SL Direct Reduction Process and its Application for Indian High and Low Grade Ores Utilizing Non-coking Coals

W. JANKE and L. R. CHOUDHARY

Lurgi Gesellschaft fur Chemie und Huttenwesen mbH Frankfurt, W. Germany.

STEEL works in India are at present concentrated around the deposits of rich ore and coking coal. With the projected development of steel and other industries, steel plants will have to be set up throughout the country including areas possessing only non-coking coals and inferior ores. Direct reduction processes would be of great interest in such cases. This paper describes the development of the SL direct reduction process and reports test results from a 1 ton/day unit and a semi-commercial plant of 100 ton/day capacity. The authors have discussed the flexibility of the process to suit the raw materials and end product requirements. Conversion of the reduced product into pig iron or steel has also been described together with the economic aspects of production.

14

Utilization of Coke-breeze for Production of Pig Iron on Small Scale

A. B. CHATTERJEA, J. GOSWAMI, S. K. BISWAS, R. SANTOK SINGH, and J. S. PADAN

THE paper presents the results of research investigation on the utilization of coke breeze available from the integrated iron and steel plants for the production of pig iron on a small scale. Investigations were conducted on making self-fluxing briquettes containing iron ore fines, coke-breeze and limestone dust employing bentonite as a binder and smelting of the briquettes in a small blast furnace designed and fabricated at the National Metallurgical Laboratory. The effect of various binders on briquetting was studied ; bentonite was preferred in view of its low cost. The physical properties and high temperature stability of the briquettes were comprehensively studied. Smelting performance of the briquettes has been discussed on the basis of operational results obtained with the objective of utililizing abundance of coke-breeze currently surplus at the steel plants.

15

The New Stora Process for Ironmaking

A. N. WHITING and A. G. RAPER

Davy and United Engineering Company Limited, Sheffield, England.

THE new Stora ironmaking process is described and compared with other ironmaking processes; the process has several distinct advantages where, for example, there is a supply of high grade ore and a shortage of metallurgical coke.

A liquid product of controlled composition and temperature is produced. This provides an ideal feed material for oxygen steelmaking processes or foundry application.

Low phosphorus pig iron can be produced from high phosphorus ore when basic linings are used and little

or no preparation of the fuel and ore is required prior to reduction.

Low grade carbonaceous fuels, such as coke-breeze and certain types of coal can be used, and the total fuel consumption is low.

Early indications are that for small scale operations, for example up to 150 000 tons of pig iron a year, the process is cheaper both in capital and operating costs than other ironmaking processes.

16

Possible Economies which could be effected in the recovery of metallics from Steel Mill Wastes

WILLIAM T. HOGAN

Professor of Economics and Director of Research, Fordham University, New York, USA.

... ...

17

Utilization of Metallurgical Waste on the Indian Railways—Ferrous Metals

K. C. CHOUDHURI and P. K. MUNSHI

Research Design and Standards Organisation, Ministry of Railways, Chittaranjan.

THE authors have examined the situation of ferrous scrap in India and particularly with the Indian Railways. Different methods of use of ferrous scrap on Indian Railways have been reviewed with special emphasis on the utilization of cast iron swarfs by melting in cupola based on (*i*) Crofts method (*ii*) Briquetting of cast iron swarfs and (*iii*) Direct charging by Sandwich technique.

18

Production of Cement from Blast Furnace Slags and Utilization of Fly Ashes by the Sintering Process

H. KLIER, L. R. CHOUDHARY and F. SCHOEN

Lurgi Gesellschaft fur Chemie und Huttenwesen mbH, Frankfurt, W. Germany.

USE of blast furnace slags for the production of hydraulic binding agents is very common in European countries particularly in the Federal Republic of Germany. The paper discusses the chemical compositions of Indian blast furnace slags and their suitability for the production of binding agents. Manufacture of Portland cement clinker from blast furnace slags through sintering process and its further processing into Portland blast furnace cements and other Portland cements are described. The advantages of the sinter process have been explained on the background of a slag cement plant operating on this process since 1953. Fly ash from power plants can also be utilized after sintering, the fly ash clinker being used as raw material for the manufacture of various construction materials. Details of a plant engaged on such work since 1958 have been included in the paper.

19

Investigations on Granulated Low Shaft Furnace Slag for the Production of Slag Cements

B. N. SINGH, P. C. DEBNATH, B. C. KAR and B. R. NIJHAWAN

National Metallurgical Laboratory, Jamshedpur.

LATEST technical developments in diverse utilization of granulated blast furnace slag for the production of Portland slag cement have been reviewed in this paper including references to appropriate standard specifications in vogue in different countries including India. The chemical and physical requirements for the production of slag cement from blast furnace slag have been discussed in relation to the low shaft furnace slag produced in the pilot plant of the National Metallurgical Laboratory. The suitability of low shaft furnace slag for the production of slag cement has been discussed on the basis of experimental investigations and composite trials

based on different admixtures of the ground granulated slag with Portland cement, etc. The investigation results have established that the low shaft furnace slag cement used with Portland cement as activators satisfies the requirements of A.S.T.M., B.S. Specifications and Indian Standards Specifications in relation to the requirements of chemical composition, compressive strength, tensile strength, setting time, soundness, sulphate resistance of the slag cement, etc. The hydraulicity of the ground slag was evaluated on the basis of its chemical composition in relation to different established formulae and relationships.

In the Pilot Low Shaft Furnace operating at the National Metallurgical Laboratory, the results presented on the utilization of low shaft furnace slag will no doubt find eventual industrial scale application when the growth of small foundry iron production plants in India projected during the Third and Fourth Five Year Plans is stepped up. Meanwhile, results of the low shaft furnace slag whilst conforming to the standard pattern of quality and accepted uses of blast furnace slag, are specifically those presented, it is believed, perhaps for the first time in technical literature.

20

TISCO Blast Furnace By-Products

B. P. SINGH and PARVEZ M. MEHTA
The Tata Iron and Steel Co. Ltd., Jamshedpur.

THE article discusses the optimum utilization of blast furnace by-products with particular reference to local conditions. The major by-products from the blast furnace are gas, slag and flue dust. Their utilization at the Jamshedpur works is described and suggestions are made for further development.

At Tisco, up to 97 per cent of the blast furnace gas is utilized and flue dust has been used in the sinter mix. About three hundred tonnes of slag are being granulated per day for the cement plant at Jhinkpani, and production of granulated slag can be stepped up if required. Indian blast furnace slag has a high alumina content and could be used in glass manufacture, as road ballast and as an aggregate for concrete while foamed slag may be suitable for making sound proof wall bricks. Flue dust and sludge which are not utilized in Tisco at present may be used with sinter mix in the future.

21

Scope for Utilization of Slags and Related Wastes from Indian Iron and Steel Plants

NARINDER SINGH, R. M. KRISHNAN, K. N. SRIVASTAVA and B. R. NIJHAWAN
National Metallurgical Laboratory, Jamshedpur.

RECOVERY and utilization of slags and related by-products in modern iron and steel industry present a vast scope and are challenging ingenuity in evolving applications other than those hitherto conventionally established—amongst the latter are the use of blast furnace slags for concrete aggregate, bituminous road aggregate, rail ballast, soil conditioners, slag wool, etc. Foamed blast furnace slag provides suitable aggregate for light weight concrete building material, possessing adequate thermal and accoustic insulation properties. Granulated blast furnace slag finds the well-established application of blast furnace slag cement and special mortar. Use of the basic steel slags for fertilizers finds a world-wide application—the subject of basic steel slag has been discussed in this paper in relation to Indian steel slags in the context of potential indigenous applications. Recovery of metallic values from basic steel slag recycling in steel melting furnaces is today well established both in India and abroad. Soviet developments in this field include the treatment of molten steel slag with mineral additives for recovery of metallic values and conventional uses.

The paper also refers to the utilization of other by-products met with in mechanized iron ore mining, such as the blue dust, the ore fines in relation to potential uses in production of pure iron powder and agglomerated products such as pellets, sinter and briquettes for iron smelting. Various aspects of the subject have been critically reviewed in the background of introducing potential recovery cycles within the indigenous iron and steel industry on the basis of research and development work at the National Metallurgical Laboratory in close co-ordination with the Indian steel plants.

22

Utilization of Low Shaft Furnace Slag as Light Weight Aggregate for Insulation Concrete

NARINDER SINGH, K. N. SRIVASTAVA, R. M. KRISHNAN and B. R. NIJHAWAN
National Metallurgical Laboratory, Jamshedpur.

MOLTEN blast furnace slags containing low MnO and FeO and high sulphur contents when foamed whilst at high temperature with a limited quantity of water yield a porous, light and strong product which after crushing and grading, is suitable as coarse and fine aggregate for light weight concrete.

The authors have critically reviewed latest developments in the foaming processes whilst presenting their research results on the production of light weight insulation concrete from slags produced at the low shaft furnace pilot plant of the National Metallurgical Laboratory. The physical properities of the slag aggregate conformed to ASTM Specifications. Concrete mixes investigated on volume as well as on weight basis gave satisfactory unit weight, compressive strength and thermal conductivity values. Concrete with less or 'no fine' aggregate gave lower thermal conductivity value, low unit weight and low compressive strength whilst mixes with more fines possessed superior thermal conductivity, greater unit weight and higher compressive strength. In all cases, thermal conductivity value was below 2·0 Btu/(hr) (sq ft) (F°) (in.). The light weight concrete was about 60% lighter than gravel-sand concrete. Thermal conductivity values obtained at different temperatures by Blakeley and Cobb apparatus showed a steep rise with increase of the mean temperature.

On the basis of the research results, extensive use of slag in foamed form as aggregate for light weight concrete has been advocated.

23

Utilization of the Indian Blast Furnace Slag

S. K. CHOPRA and C. A. TANEJA
Central Building Research Institute, Roorkee.

THIS paper deals with the current researches and some of the long term studies on the use of blast furnace slag in the building industry. The mineralogy of the air-cooled slag from the Tisco, Durgapur, Bhilai, Rourkela and Bhadravati steel plants has been reported. The more common minerals are melilite, oldhamite and pseudo-wollastonite while spinel or a combination of wollastonite and diopside has also been observed. No dicalcium silicate was observed. Glass was present in varying amounts. Hydraulicity and activation of the Indian slags which are characterised by relatively low lime and high alumina contents have been discussed. Optimum compositions for the manufacture of different types of slag cements have been reported and current studies on the utilization of Rourkela slag (2 to 4% Mn_2O_3 content) in the manufacture of Portland blast furnace cement have been described. Long term studies now in progress on the hydration, stability and durability of different types of slag cements are briefly reported and some problems in the field of slag utilization have also been mentioned.

24

Utilization of Blast Furnace Slag in the Manufacture of Slagwool and its Products

R. P. PUNJ
Punj Sons Private Ltd., Jamshedpur.

THE total demand of slag wool in India is estimated at 12 000 tons per annum by end of 1964 to meet the requirements of slagwool for insulation and other purposes. The paper describes the salient features of the processes employed for the manufacture of slagwool, namely, high pressure steam or air blown through the molten stream with the help of a single nozzle; high pressure steam or air blown through equally divided streams with the help of a multiple nozzle unit; single disc centrifugal process; 3, 4 and 5 wheel centrifugal process; 'Super Tel' process in which the combination of spinning and blowing with high pressure hot gases is used. The properities of various types of slagwool manufactured have been compared and the quality control techniques employed during production have also been dealt with. The future requirements of slagwool in India for Fourth Five Year Plan have also been estimated.

25

Utilization of Metallurgical Wastes on the Indian Railways—Non-ferrous Metals

K. C. CHOUDHURI and P. K. MUNSHI
Research Designs and Standards Orgn., Ministry of Railways, Chittaranjan.

THE paper is devoted to non-ferrous scrap and the scope for its utilization. The annual requirement of different non-ferrous virgin metals on Indian Railways and the types of scrap available have been reviewed and various methods of reclamation outlined, particularly the (i) Sigma Oil Method (ii) Bradley Process and (iii) Differential Melting Process for separation of bronze borings mixed with white metal and reclamation of scrap lead battery plates.

26

Utilization of Red Mud

C. SANKARAN and P. P. BHATNAGAR
National Metallurgical Laboratory, Jamshedpur.

LARGE quantities of red mud are currently dumped to waste at aluminium production plants in India; in some of the aluminium plants, 0·25 to 0·3 ton of red mud is produced per ton of bauxite treated. The recovery of aluminium, titanium, iron and vanadium oxides as by-products from this easily friable, finely divided red mud would greatly improve the overall economics of aluminium production. A review has been given in the paper of various processes for recovering the iron, aluminium, titanium and vanadium oxides from the red mud in the background of researches carried out at the National Metallurgical Laboratory on the recovery of alumina. The results of investigations on the recovery of alumina values from a red mud sample containing 21·4% Al_2O_3, 48% SiO_2, 20·8% Fe_2O_3, 28·8% TiO_2 and 1·8% CaO by soda ash and limestone roasting, have been reported. Various operating factors investigated included the effect of soda ash and lime on alumina recovery, temperature and time of roasting, leaching temperature and time, etc. The possibilities of utilizing the residue to produce pig iron and titania-rich slag or the ferro-titanium have been discussed.

27

Production of Secondary Aluminium—A Review

M. C. SEN and T. BANERJEE
National Metallurgical Laboratory, Jamshedpur.

IN this paper, the importance and feasibility of production of secondary aluminium and its alloys in India have been outlined. In the paper different kinds of scraps and wastes are enumerated of aluminium and its alloys and their quality and character. Various modes of utilization and methods of treatment, depending on the nature and composition of scraps, for the production of secondary aluminium and its alloys have been discussed at length.

28

Metallurgical Wastes from Aluminium Smelters

K. K. CHERIAN
Indian Aluminium Co. Ltd , Alupuram, Kerala.

THIS paper gives an account of the loss of aluminium metal in the dross, skimmings and sawings of casting units and loss of electrolyte materials in the reduction cell linings and exhaust gases of aluminium smelters. Methods adopted for recovery of the same are also dealt with briefly.

29

Bayer Plant Liquors—A Source for Vanadium

N. VENKATARAMAN and M. S. THAKAR
Indian Aluminium Co. Ltd, Chotamuri, Ranchi.

VANADIUM is widely used in the production of various alloy steels and its compounds are employed in increasing quantities in different industrial oxidation processes. The authors have examined the possibilities of isolating vanadium salts from the Bayer Plant liquors where they find their way as an undesirable impurity while processing bauxite for the production of alumina. Chemical composition of the vanadium salts which can thus be separated has been studied and pilot plant data relating to the optimum operational conditions have been presented. A process is also described for the recovery of soda from this salt and elimination of a vanadium rich sludge. As vanadium is not so far industrially produced in the country, its tonnage requirement and available resources have been examined. A brief discussion is presented on Bayer Plant 'red mud' as a potential source of vanadium.

30

Short Rotary Furnace and its Application in the Treatment of Battery Scrap

W. SCHWARTZ and W. HAASE
Lurgi Gesellschaft fur Chemie und Huttenwesen mbH. Frankfurt, W. Germany.

TREATMENT of battery scrap will gain more and more importance with advances in automation and increase in transport facilities. The short rotary furnace is eminently suited to the treatment of battery scrap by its capacity to quickly heat the charge at a low fuel consumption. It can easily convert battery scrap into antimonial lead producing a slag of low lead content. Coal being used as the reductant, soda ash, pyrite cinder or iron ore are suitable for fluxing. High smelting capacities and antimonial lead recovery are achieved under low flux consumptions.

31

Recovery of Lead from Scrap

K. ROYCHOWDHURY
Works Manager, The Eyre Smelting (P) Ltd., Calcutta

REVIEWING the current lead production, consumption and import figures, the author has shown the importance of recovery of lead and its alloys from scrap. The various sources of lead scrap and its forms have been discussed. Methods of recovery are outlined and utilization of the recovered metal described.

32

Recovery of Metallic Zinc from Galvanisers' Dross

M. N. PARTHASARATHI and B. C. AGRAWAL
Indian Lead/Zinc Information Centre, Calcutta.

A CERTAIN amount of dross is inevitable even with the best galvanizing practice. The paper discusses the various sources of dross and the methods by which it can be kept to a minimum. The authors have also critically reviewed the well known processes of recovery of zinc from dross and discussed their economics with particular reference to Indian conditions.

33

Recovery of Zinc from Scraps and Wastes

B. C. MUKHERJEE, S. C. AUSH, M. C. SEN and T. BANERJEE
National Metallurgical Laboratory, Jamshedpur.

THIS paper consists of two parts. In the first part different types of scrap and wastes have been enumerated and their modes of production, composition, etc. have been discussed. Various methods of treatment of the scraps and wastes for the recovery of zinc and/or zinc compounds (especially oxide) have been reviewed. In the second part, results of some investigations carried out at the National Metallurgical Laboratory for the recovery of zinc and zinc oxide from a sample of treated zinc ash, have been presented.

34

Pickle Liquor Regeneration by Vacuum Crystallization

H. WELLING

Lurgi Gesellschaft fur Warmetechnik mbH Frankfurt, W. Germany.

PICKLE liquor treatment involves the separation from the spent liquor of the ferrous sulphate formed during the pickling operation and the regeneration of the liquor by addition of concentrated sulpuric acid.

The liquor may be subjected to either concentration at high temperature so that ferrous sulphate precipitates in the form of mono-hydrate, or low temperature cooling whereby ferrous sulphate crystallizes out in the form of hepta hydrate. Advantages and disadvantages of different treatments have been examined in the paper.

The LURGI process based on low temperature cooling under vacuum has so far proved the most efficient. The process is continuous; it lends itself to both very small and very large pickling capacities and even permits treatment of bath liquor of low iron content. For an iron content of 60–70 grammes per litre of spent liquor, that of the treated liquor is as low as 20–30 gm, per litre with H_2SO_4 up to 28%. During the entire pickling process an almost constant Fe concentration is maintained in the pickle liquor, with maximum H_2SO_4 content which results in a higher pickling rate, and uniform surface quality of the pickled material. The author finally suggests uses for the hepta hydrate and gives the complete description of a process for decomposition of ferrous sulphate in the turbulent layer furnace together with a study of the economics of the process.

35

New Method for Treatment of Waste Pickling Acid

KIHEIJI TAMAKI

Hirohata Works, Fuji Iron & Steel Co., Tokyo, Japan.

ABOUT 55 000 tons of cold rolled steel sheet are produced every month at the Hirohata Works of Fuji Iron & Steel Co. Before cold rolling the hot-rolled coils are subjected to sulphuric acid pickling entailing 4 500 to 6 000 m³ of waste pickling acid per month. In an attempt to utilize the sulphuric acid contained in the waste pickling acid, a new process of manufacturing iron oxide and ammonium sulphide has been developed, based on the Ishihara Oxidation Method, wherein ferrous sulphide in the waste acid is combined with ammonia and air to produce magnetite with slight absorption of water. This magnetite is precipitated and filtered and its ammonium sulphite is thus recovered. Our process is a modification of the above and is characterised by the following distinct features: the waste acid is neutralized with ammonia contained in the coke oven gas; the ammonium sulphide produced has equally good size distribution and colour as synthetic ammonium sulphide and iron oxide is also recovered.

36

Method for Regeneration of Waste Pickle Liquors

V. KRAMARSIC. F. STROJIN and Professor Ing. C. REKAR

Metallurgical Institute, Ljubljana, Yugoslavia

THE Metallurgical Institute in Ljubljana has developed a method for regeneration of ferrous sulphate pickle liquor. In this process a cavitation stirrer is used, which by oxidizing ferro-hydroxide makes possible the production of mineral pigments of various shades or of magnetite. It is possible to reduce this magnetite and use it very successfully in the powder metallurgy.

If the ferrous sulphate is neutralized and precipitated by means of the sodium brine, the sodium sulphate obtained can be dissolved by the electrolysis developed particularly for this purpose by Messrs E. Merck to recover a 50 per cent solution of sodium hydroxide which can be used again. The anode solution contains the sulphuric acid and the sodium sulphate yet undissolved. By under-cooling this solution a crystalline sodium sulphate decahydrate can be recovered to be returned into the electrolysis. The sulphuric acid solution combined with sulphuric acid being a residue after the

ferrous sulphate has been precipitated forms a sulphuric acid solution of suitable concentration to be used again for pickling.

This process is represented in a diagram, divided into nine phases and calculated for pickling 1 250 tons of hot rolled strips in 24 hours. By pickling, the surfaces of these strips are to be freed from 8·75 tons of scale considered mainly to be FeO. A material balance has been worked out for each of these phases, as well as for the complete regenerating process.

The method has been experimented on a semi-industrial plant, in its individual phases and as a whole. The capacity of the plant has been determined according to the prototype electrolysis of the sodium sulphate having a capacity of 1 500 amperes.

The authors finally give an estimation of costs per ton of pickled hot rolled strips, which shows that this regeneration method, though expensive—Rs 1·6 or more per ton of pickled strips—can be profitable under special circumstances.

37

Treatment and Recovery of By-Products from Pickling Liquor Wastes

G. K. SETH and Y. S. MURTY

Central Public Health Engineering Research Institute—Hyderabad Zonal Centre, Hyderabad.

THE paper discusses the process of pickling in the steel industry and gives the composition of the liquid wastes coming out of the pickling baths. The pollutional effects of these wastes when discharged on land or water environment and their toxicity to fish and other organisms have been mentioned. Methods of treatment and recovery of useful by-products from these wastes have been discussed with reference to :

(1) Dilution and disposal in the sewer or nearby stream provided the wastes get amply diluted.
(2) Neutralization with lime and recovery of ferrous sulphate and sulphuric acid or sulphonic acid and hydrated ferrous sulphate. Utilization of waste materials from other industries especially lime sludge from acetylene manufacture and water softening plants for neutralization purpose has also been indicated.
(3) Crystallization by evaporation and recovery of ferrous sulphate and sulphuric acid.
(4) Production of 'Ferron'—a constructional material.
(5) Recovery of electrolytic iron and regeneration of sulphuric acid by electrolysis.

The economics of neutralization with lime and recovery of ferrous sulphate and sulphuric acid which appears to be most suitable under Indian conditions have been detailed.