POSTER SESSION

Room: Imperial Ballroom 5,7,9
Chairman: D. MITLIN, University of Alberta, Canada

POSTER 1

PHISICO-CHEMICAL INVESTIGATION OF PROCESS OF OBTAINING LEAD AND SILVER BY HIDROMETALLURGY METHOD.

Z.H. GAIBULLAEVA, M.M. SAIDOV, G.T. NASIMOV and B.M. MIRZOEV, Tajik Technical University, Dushanbe, Tajikistan

For independent Tajikistan and its transition to market economy elaboration of non-waste technological process requires widening of fundamental research, in technological direction and rise of their role in founding new technologies. For Tajikistan, the most important is the complex work out and rational exploitation of mineral row-material and industrial wastes.

Lead and silver are mostly found in sulfide form in heavy non-ferrous ores. That ores arc exploited on basis of widely used and well investigated oxidizing process. At the same time, the whole of contemporary problems of non - ferrous metallurgy, such us widening row material base, providing non-waste row material exploitation and ecological aspects of production dictates necessity for search of new ways to exploit sulfide ores.

As the initial material, the lead silver concentrate enriched in Adrasman ore-enriched factory was used. The concentrate has the following composition %: Pb- 36-38, Zn- 1.8-3.6, Cu- 0.60-0.67, Fe- 14-20, Bi- 0.4-0.05, Co- 0.05-0.06, Ba- 0.7-0.8, SiO_2-10-15, CaO- 1.0-1.4, MgO- 1.0-1.2, $A1_2O_3$- 2.5-3.0, Ag- 0.22-0.3.

Preparation of lead silver concentrate for reduction in aquatic solution of basic metals (I A group) was conducted firstly by baking it in presence of sodium chloride under the temperatures of 650°C, 700°C, 750°C, 800°C, 850°C. The resulting kinetic-curves of bake in presence of NaCl are given in figure. As it is seen the process starts with maximum speed and its developments are almost linear. In further, the decrease of speed is observed than theoretically calculated speed of lead sulfide interaction with sodium chloride. So far us noticeable evaporation of lead starts at much higher temperature than the formation temperature of PbCl2, the reason of mass lose must be the evaporation of initial lead sulfide, which starts in inert atmosphere at 785^{o}C.

POSTER 2

EFFECT OF CHROMIUM, BORON AND MANGANESE ADDITIONS ON THE RECRYSTALLIZATION TEXTURES OF WARM ROLLED LOW CARBON STEELS

M.R. TOROGHINEJAD, Isfahan University of Technology, Isfahan, Iran
A.O. HUMPHREYS and J. JONAS, McGill University, Canada

The effect on the warm rolling behavior of solute carbon content, as well as of chromium, boron and manganese addition was investigated. The recrystallized microstructures and textures were assessed after rolling at temperatures between 440 and 780C. The strength of the LC steel recrystallization texture decreased with increasing temperature. The addition of chromium to the low manganese steel strengthened the {111} component of the annealing texture at higher rolling temperatures. However, a higher manganese level was found to be detrimental to the development of the ND fibre components and boron addition resulted in a retained rolling component.

POSTER 3

SLOW STRAIN RATE TESTING OF HIGH-STRENGTH COMMERCIAL AL-MG-SI BASED ALLOYS

M. SENOH and M. KANNO, The University of Tokyo, Tokyo, Japan

An Al-Mg-Si based alloy with excess silicon has been reported to show environmental embrittlement. Therefore, it is necessary to clarify whether environmental embrittlement occurs in high strength commercial Al-Mg-Si based alloys. Environmental embrittlement was evaluated by comparing ductilities of peak-aged specimens of A6066, A6070, A6013 and A6061 aluminum alloys tensile-tested at an initial strain rate of $1.7x10^{-7}$/s and $1.7x10^{-4}$/s. No environmental embrittlement appeared in all specimens though three kinds of the alloys contain excess silicon. SEM observation revealed that no grain boundary fracture surface was present. Discussion will be made why environmental embrittlement disappeared in these alloys.

POSTER 4

DEVELOPMENT OF AUSTEMPERED DUCTILE IRON FOR AUTOMOTIVE CONNECTING RODS

M. HASSAN

Austempered Ductile Iron (ADI) is known to exhibit better strength, wear resistance and ductility than conventional grades of ductile iron and steel. This applied research project aimed at using these improved mechanical properties to achieve the best trade-off in terms of cost, weight, manufacturability and end use properties for automotive connecting rods. The goal was to replace forged steel by a grade of ADI specifically designed for this

application. Optimizing the austempering process (particularly the heating and cooling profiles) resulted in ADI grades with:

- Higher elongation: ADI elongation was 10%, compared with 6% for forged steel
- Higher tensile strength
- Lower cost to weight ratio: The cost to weight ratio of ADI was 20% lower than the cost to weight ratio of forged steel
- Longer service life: The service life of the automotive connecting rods made with ADI was on average 30% longer the service life of rods made with forged steel.

This presentation describes the approach and process used to achieve these improved properties.

POSTER 5

SURGICAL INSTRUMENTS – CRACK AND HAIRLINE FRACTURE DURING THE MANUFACTURING

M. HASSAN

This applied research project aimed at reducing the 8 to 10% rejection rate experienced by a manufacturer of stainless steel surgical instruments. Through the application of mechanical testing, optical and scanning electron microscopy, a detailed study of the various steps involved in the manufacturing process of these instruments (forging, heating, cooling, cleaning and hardening) demonstrated that the key process variables impacting the formation of cracks in the finished instruments was the heat treatment temperature profile. This study showed that controlling the heating and cooling rate to within 2% and controlling the temperature of the quenching media to within 5% decreased the rejection rate from 8-10% down to less than 0.1%.

POSTER 6

DEVELOPMENT AND PRODUCTION OF ALUMINIUM-SILICON PISTON FOR A 100 C.C. MOTORCYCLE

M. HASSAN

This research project was designed and implemented to overcome the environmental problems experienced by Pakistani motorcycle piston manufacturers when dealing with scrap generated during the production of pistons and with used pistons. Attempts at recycling scrap yielded very poor results: The average life of pistons made from scrap typically ranged from 8 to 12 months, well below the average life expectancy of pistons made from virgin material.

Micrographical analyses (optical and scanning electron microstructure, chemical analysis by EDS technique, and macrostructure) performed on pistons cast from 100% scrap showed that these pistons contain shrinkage cavities, blow holes, non metallic inclusions and a dull surface appearance. This research project showed that mixing scrap metal with virgin material in 1-to-1 ratio and optimizing the scrap selection, preparation, melting, casting and heat treatment steps yields virtually defect-free pistons, as demonstrated by subsequent tests such as hardness, micro structural analysis by optical and scanning electron microscopy and EDS analysis. Durability tests indicated an increase in piston life span from 12 months to 20 months.

POSTER 7

UNDERSTANDING BRAZING OF STAINLESS STEEL THROUGH COMPUTATIONAL THERMODYNAMICS

M. MEDRAJ, M. ASHRAF-UL-ARAFIN, Concordia University, Canada and
P. BOCHER, École de Technologie Supérieure, Canada

Computational thermodynamics is applied to the brazing of stainless steels to understand the evolution of microstructures, phase stability, solidification behavior, micro-segregation effects, inclusion formation and phase transformation behavior. Using solidification simulation and thermodynamic modeling of multi-component phase equilibria, the effect of alloying elements resulting in brittle phases will be presented. This in turn would lead to the appropriate selection of the filler metal and the development of new filler alloys. Range of vulnerability limit for solidification cracking ($0.7<fs<0.98$) in terms of temperature range can be found and thus the combination of base metals and filler metals that are more susceptible to solidification cracking will be discussed.

POSTER 8

THE MICROSTRUCTURAL CHARACTERISTICS OF AL-ALLOYED DUCTILE IRONS AUSTEMPERED AT 350°C FOR 100 MIN.

A.-R. KIANI-RASHID, University of Sistan & Baluchestan, Zahedan, Iran and
D.V. EDMONDS, University of Leeds, United Kingdom

Al-alloyed Ductile irons have been made by green sand casting and gravity die casting of appropriate design to provide the experimental materials. Austenitising was carried out at 920°C and holding time for 90 min to achieve sufficient homogeneity for further isothermal heat treatment. The microstructure of ductile irons have been investigate after austempering at 350°C for different time up to 100 min. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) were used to study the changes during austempering. Isothermal heat treatment at 350°C for 100 min resulted in microstructures consisting of carbide-free bainitic ferrite with considerable amounts of high carbon retained austenite. In the present investigation an attempt has been made to extend the published work dealing with the microstructure and characteristics of ductile iron for a range of aluminium alloying element additions.

POSTER 9

THE SIGMA PHASE PRECIPITATION INDUCED AUSTENITIC-FERRITIC COMPOSITES DAMAGES DURING ACCUMULATIVE ROLLING BONDING PROCESS

H.-C. HSIEH, M.-C. CHEN, W. WU, National Chung Hsing University, Taiwan and
D.-Y. LIN, I-Shou University, Taiwan

The purpose of this study is to investigate the effect of sigma phase under various hot rolling ratios during ARB process in austenitic-ferritic composites. The sigma phase, brittle phase, was able to affect workability, corrosion resistance, and mechanical properties of stainless steels. Sigma phase was formed as a result of an eutectoid decomposition, $\delta \rightarrow \sigma + \gamma 2$. Optical microscopy with image analysis, Feritscope, X-ray diffraction, SEM, EPMA and were used to determine the sigma phase and to estimate the amount. Experimental results showed that a higher hot rolling ratio suppressed sigma phase precipitation.

POSTER 10

HATCH ELECTRODE COLUMN – "SET IT AND FORGET IT"

M. DARINI, N. VOERMANN, F. MCCAFFREY and B. EMERY, Hatch, Canada

Electrode Columns are commonly used in electric furnaces to deliver current and regulate furnace power during the smelting process. Hatch has developed an innovative patent-pending system for lowering ("slipping") and/or raising ("back slipping") the electrodes through an electrode column, without requiring the release of any clamping devices. All clamping forces are applied by springs. Unlike systems employing hydraulically applied clamping forces, (e.g., water bladders) the spring system is failsafe. Its inherent simplicity virtually eliminates the need for maintenance.

The Hatch system comprises two axially movable slipping clamps and a stationary power clamp, each of which apply a distributed, radial clamping force to the electrode. The magnitudes of the slipping sleeves' clamping forces and sequencing of their axial movements are selected such that the slipping clamps, in conjunction with the weight of the electrode, provide slipping or back slipping without release of any clamping force.

POSTER 11

MICROSTRUCTURES AND MECHANICAL PROPERTIES EVOLUTION DURING ACCUMULATIVE ROLL BONDING OF AL/MG COMPOSITE.

M.-C. CHEN, H.-C. HSIEH and W. WU, National Chung Hsing University, Taiwan

Accumulative roll bonding (ARB) is a kind of severe plastic deformation process which can produce high strength metals with ultra-fine grained microstructure. Mechanical properties will be increased owing to ultra-fine grain. In this study, the ARB process is used, the snap-stack working to reduplicate Al (ASM-1100) / Mg (AZ31) alloy is chosen and then thinner and longer by rolling and repeating the processes. The multilayer compound between Al/Mg layers with an excellent bonding is produced and the fine microstructure is obtained in ARB process. The microstructure morphologies were observed with a Transmission Electron Microscope (TEM). The Mechanical properties were carried out using tensile test.

POSTER 12

CARBON CONTAINING, STEEL FIBER REINFORCED, ADVANCED MONOLITHICS WITH IMPROVED THERMOMECHANICAL PROPERTIES.

K. BALAMURUGAN, K. SANKARANARAYANANE, E. PARANSKY and M. RIGAUD, CIREP, Ecole Polytechnique, Canada

After due consideration of their rheological behaviour, the present study evaluates the thermomechnical behaviour of alumina-magnesia based castables containing 6 wt% of graphite pellets reinforced with steel fibres from 2 to 6 wt%, in the temperature range of 900 to 1100ºC. The hot strength of castables have been measured at various temperature upto 1100ºC as well as work of fracture, at 1100ºC, using wedge-splitting technique under inert atmosphere. Interfacial study and fracture surface observations have been carried out using optical and scanning electron microscopy. The observed results confirm the effect of fibre length on the thermo mechanical behaviour of the castable for both carbon steel and stainless steel fibres.

POSTER 13

EFFECTS OF ALLOY COMPOSITION AND HEAT TREATMENT ON ENVIRONMENTAL EMBRITTLEMENT OF AL-MG-SI ALLOYS.

M. ANDOH, K. ASAKURA and M. KANNO The University of Tokyo, Tokyo, Japan

Environmental embrittlement was studied by use of round tensile specimens of three kinds of alloys: Al-1.12%Mg2Si-0.35%Si (S-alloy), Al-1.12%Mg2Si-0.35%Si -0.34%Cu (SC-alloy) and Al-1.47%Mg2Si-0.34%Cu (BC-alloy). After heat treating, they were tensile tested at a strain rate of 10^-4/s or 10^-7/s in a laboratory air. Peak aged S and SC alloys showed embrittlement at the lower strain rate, and the embrittlement was most apparent on over-aged

alloys. No embrittlement appeared in the BC-alloy irrespective of aging condition. Thus, the embrittlement is thought to be stimulated by the Si-rich precipitates which are increased with the progress of aging.

POSTER 14

HIGH PERFORMANCE HYDROGEN FUEL CELLS BASED ON DOPED PROTON CONDUCTING PEROVSKITE-TYPE ELECTROLYTE

J. MELNIK, S. WANG, Y. FENG, J.L. LUO, K.T. CHUANG and A.R. SANGER, University of Alberta, Canada

A number of rare-earth-doped perovskites ($BaCeO_3$; $BaZrO_3$; $SrCeO_3$; etc.) exhibit high proton conductivities, and thus have potential utility as electrolytes in intermediate-temperature fuel cells. In our work we focused on barium cerates doped with Me^{3+} and Me^{4+} oxides. Such doping provides improved chemical stability and enables high performance of intermediate temperature (600 – 750°C) hydrogen SOFC. The performance and electro conductivity achieved are higher than values for other systems reported in the recent literature.

POSTER 15

AN OVERVIEW OF SOUTHERN AFRICAN PGM SMELTING.

R.T. JONES, Mintek, South Africa

The two largest known PGM deposits in the world are the Bushveld Complex in South Africa and the Great Dyke in Zimbabwe. It is therefore not surprising that the majority (about 4.7 million ounces or 145 metric tons per annum) of the world's platinum is produced in Southern Africa. Primary smelting of ore concentrates is carried out in that region by five companies, namely Anglo Platinum, Impala Platinum, Lonmin Platinum, Northam Platinum, all of South Africa, and Makwiro Platinum in Zimbabwe. The only other primary smelter of platinum group metals (PGMs) is Stillwater Mining of Montana, USA, although very significant quantities of PGMs are produced as co-products by Norilsk Nickel of Russia. Smaller (but still significant) quantities of PGMs are produced by Falconbridge and Inco of Canada, also as co-products from nickel sulphide smelting. There are many similarities between PGM smelting and nickel sulphide smelting, and the range of technologies in use includes six-in-line rectangular electric furnaces, three-electrode circular AC furnaces, Peirce-Smith converters, and Anglo's ACP (based on Ausmelt technology). PGMs are also recovered from waste materials using DC arc furnace technology.

POSTER 16

FLUID FLOW WATER MODELLING OF SABA THIN SLAB CONTINUOUS CASTER.

M. MERATIAN, Isfahan University of Technology, Isfahan, Iran and
M.H. JOULAZADEH, Isfahan Steel Complex, Isfahan, Iran

Thin slab continuous casting of steel is a complex process of slab production. Due to its complexities such as high speed of production, and contiuity of the production line, the least technical problem my occure the whole line to stop, and the production efficiency to reduce remarkably. One of the most important reasons that may cause the production line to stop includes unsuitable flow pattern in the casters' mold. Because of very high teperatures and being the molten steel opaque, it is impossible to study the flow pattern in the real system. Instead, a water model could be easily utilized for visualization and some measurments for the real system(prototype).

In present work, a full scale water model for Saba Steel Complex thin slab continuous caster was established, and effects of some important variables such as casting speed, and submergance depth of Submerged Entry Nozzle(SEN) were studied. It was the first time a water model successfully used for studying fluid flow in continuous casting in Iran.

POSTER 17

MINERALOGY OF OIL SANDS TAILINGS

H. KAMINSKY, T. ETSELL, D. IVEY, University of Alberta, Canada and
O. OMOTOSO, CANMET Energy Technology Centre, Canada

The mineralogy of Alberta's oil sands is very complex, as evidenced by the shear number of possible minerals identified by researchers in the area. To date over 90 mineral species have been documented as present in either the oil sand deposits or as products of hydrothermal alteration of the oil sands. This paper discusses the mineralogy of the oil sands, as determined by X-ray diffraction (XRD) and electron microscopy. Special focus will be placed on the mineralogy of oil sands tailings, and in particular the clays and heavy minerals.

POSTER 18

THE ESTIMATING BIOHYDROMETALLURGICAL OPERATION OF COPPER-PORPHYRY ORE

T. AYUSH, Erdenet Mining Corporation, Mongolia

Although the mineral bioleaching is compound and depends on diverse factors, it could be possibly to give estimation at the result of determination of relevance major parameters. Whereupon we investigated the bioleaching kinetics of copper-porphyry ore, it was based on variuos particle size, copper grade ore, ambient temperature, duration time and distribution of mineral type such as hypogene, supergene. It used acidy solution including microorganzsms

and ideal samples which are prepared by method "MIXATION-2" from copper-porphyry ore at Erdenet Mining Corporation as experiment objects.

All the tests took place under adequate aeration and we determined optimal variation between those 4 paramemetrs and had done program "Cu-" to estimate copper recovery above type ore at any condition and at temperature range 15-35°C.

POSTER 19

EFFECT OF CU & SN ON THE FATIGUE PROPERTY OF PEARLITIC DUCTILE IRO

M. TADAYONSAIDI, Azad University, Iran
N. VARAHRAM, Sharif University, Iran and
N. BAGHERSAIEE, Ministry of Jihad Agriculture, Iran

Ductile iron castings are used for many industrial applications, particularly in the automotive industry. For those applications such as crankshafts, pearlitic ductile iron grades are the usual choice. These are produced by alloying the iron with pearlite promoting elements by either Cu or Sn. However, secondary effects on the structure of the castings limited the use of these elements. A comparative study of the effects of Cu and Sn on the microstructure and fatigue behavior of pearlitic ductile irons was carried out. In this case, samples whit deferent percent of Cu and Sn was supplied. The following conclusions were obtained. In spite of pearlitic ductile iron alloying with Sn has higher tensile strength, but fatigue strength in the pearlitic ductile iron alloying with Cu in the all of applying stresses is higher than that.

POSTER 20

VISUALIZATION OF A RAPIDLY SOLIDIFIED AL – 0.6 WT% FE PARTICLE USING MICRO-TOMOGRAPHY

C. WATT and H. HENEIN, University of Alberta, Canada

The iron content in recycled aluminum alloys can lead to damage during the rolling and forming operations of sheet for automotive applications. These occur due to the formation of aluminum-iron intermetallics, which first form during the solidification of the alloy and are not affected by subsequent heat treatment operations. Thus, it is important to characterize the aluminum-iron intermetallics, which are formed during solidification under cooling rates similar to those encountered in strip casting. Thus, one of the objectives of this study was to visualize the solidified structure of an Al-0.6 wt% Fe alloy as part of a study to understand the formation of the aluminum rich intermetallic phase in the eutectic. Al-0.6wt%Fe alloy was atomized using the Impulse Atomization technique under different atomizing conditions simulating strip casting. In this work a 550 micron particle that was atomized in a nitrogen atmosphere was studied using micro-tomography at the ESRF – ID19 with 0.3 micron resolution. The visualization of the solidified microstructure of this particle will be presented in terms of the point of nucleation, initial growth of dendrites, and porosity and eutectic distribution.

POSTER 21

QUANTITATIVE MICROSTRUCTURAL ASPECTS OF IMPACT TOUGHNESS IN PIPELINE STEELS

D. BAJWA, P. PORUKS, I. YAKUBTSOV and J.D. BOYD, Queen's University, Canada

The development of high-strength, high-toughness pipeline steels has resulted in highly refined steel microstructures. Such microstructures have very small features and lack clearly visible boundaries, making quantitative metallography difficult. In the present work, orientation mapping (OM) by electron backscattered diffraction (EBSD) was carried out to quantify the microstructure of 3 advanced pipeline steels having a range of yield strengths, impact toughnesses and processing parameters. The size of each OM microstructural element (domain) was then compared to the prior austenite grain structure, the cleavage facet size, and the impact toughness.

POSTER 22

AQUEOUS-BASED PREPARATION OF NANO-SIZED TITANIUM DIOXIDE

Y. LI, Central South University, P. R. China and
G.P. DEMOPOULOS, McGill University, Canada

As an alternative to the current high temperature chlorination technology, the hydrolytic precipitation of titanium dioxide from aqueous titanium tetrachloride solution by neutralization with magnesium oxide was studied. The use of DTA, XRD, SEM etc. in the characterization of the produced powders is described. Nanosized phase-pure rutile, phase-pure anatase or mixed crystalline rutile and anatase with average primary grain size of about 50nm and narrow distribution of mean aggregated particles between 1-10μm were precipitated respectively by controlling the hydrolysis of $TiCl_4$ in aqueous solution. The anatase-containing products were successfully transformed to pure rutile after heat-treatment at 500-900ºC. Titanium precipitation efficiency as high as 99.99% was achieved.

POSTER 23

SOFT CHEMICAL PREPARATION OF SPHERICAL LITHIUM COBALT OXIDE

X. XI, Changsha Research Institute of Mining and Metallurgy, P. R. China

Layered lithium cobalt oxide compound has been prepared in aqueous solution by soft chemical route at temperature lower than 100ºC. Lithium hydroxide ($LiOH \cdot H_2O$) and cobalt salt were used as starting materials. The product was characterized by the use of X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM), and specific surface area (SSA), etc. Nanosized crystalline precursor powders with original particle size between 20~70nm and high specific surface area (BET) ranging from 20 to 80m^2/g have been obtained successfully from the aqueous solution. The obtained precursor was followed by granulating and heat treatment at 750~900ºC to produce spherical $LiCoO_2$ product with aggregated particle size between 5-20μm. It was determined that a tapped density as high as 2.4~2.7g/cm^3 can be achieved. The as prepared $LiCoO_2$ product shows an excellent electrochemical performance with first charge-discharge capacity of more than 150 mAh/g. The capacity fading rate is less than 0.05% per cycle.