（＊掲載記事題目及び掲載頁は変更になる場合があります。）

Fundamentals of High Temperature Processes

Microwave induced solid-solid reactions between Fe_3O_4 and carbon black powders

K.ISHIZAKI et al.

The reduction of 1 μm diameter magnetite by 22 μm diameter carbon black in powder mixture under a constant microwave power of 2.8 kW at 2.45 GHz up to 1 200°C was investigated. The initial mixture mass was 6 g in every experiment. Temperature and mass loss of the reacting mixture as a function of time were continuously recorded. The temperature measurement was from 220°C and the mass loss from the start of irradiation. Five different mixtures were irradiated; all of them up to 800°C, three up to 1 000°C and two up to 1 200°C. All mixtures registered measurable mass losses below 220°C. Total reduction of magnetite to wustite was accomplished below an average temperature of 651°C. Reduction rates as a function of the irradiation time were calculated. The reduction presented three distinctive stages; a initial very fast stage with an average maximum reduction rate of 0.017 g/s, a second stage of constant very low reduction rate 0.0017 g/s, and a third one with a maximum average reduction rate of 0.0045 g/s. During the first stage all the magnetite was reduced to wustite and some wustite to iron. The reduction of magnetite to wustite is shown to take place through a series of consecutive reactions involving solid–solid reactions of magnetite with carbon black as well as solid–gas reactions. Under microwave irradiation true direct reduction occurs at much lower temperatures than under conventional heating. The results can not be explained to occur by thermal effects but by the so called microwave effects.

(cf. *ISIJ Int.*, **48** (2008), 1159)

Phosphorous partition in dephosphorization slag occurring with crystallization at initial stage of solidification

P.K.SON et al.

Basicity and the amount of Fe_tO were investigated for their effects on the crystallization behavior of the simulated dephosphorizing slags. Twelve kinds of slags were prepared (C/S=1.0–2.5, Fe_tO=10–20%, P_2O_5=5%). In the present experiment, the Hot Thermocouple Technique was used to melt and quench the samples. After quenching, the microstructure of the slag and the distributions of elements were examined by SEM and EDS analysis.

The diameter of the crystal which precipitated in the sample increased with increasing basicity (C/S) and decreasing Fe_tO content. In addition, glassy regions were observed in the two samples whose Fe_tO content was 20% and whose basicity was 1.0 or 1.5. The samples (10% Fe_tO, 5% P_2O_5), whose basicity was 1.0 (sample-1) precipitated as a monocalcium silicate ($CaO \cdot SiO_2$); the sample (10% Fe_tO, 5% P_2O_5) whose basicity was 1.5 (sample-4) precipitated as a dicalcium silicate ($2CaO \cdot SiO_2$). In higher Fe_tO (15–20%) slags, the crystals of the solid solution between $3CaO \cdot P_2O_5$ and $2CaO \cdot SiO_2$ ((C_3P–C_2S)ss) were observed. When the amount of CaO increased from C/S=1.5 to C/S=2.5, $2CaO \cdot SiO_2$ appeared with phosphorous content, but phosphorous was not found in $CaO \cdot SiO_2$.

(cf. *ISIJ Int.*, **48** (2008), 1165)

Thermodynamics of zirconium deoxidation equilibrium in liquid iron by EMF measurements

R.INOUE et al.

Thermodynamics of Zr deoxidation equilibrium in liquid iron has been studied at 1 873 K by using ZrO_2–9mol%MgO and mullite ($3Al_2O_3 \cdot 2SiO_2$) electrolytes coupled with the quantitative alalysis of soluble Zr and insoluble Zr as ZrO_2 by using a potentiostatic electric extraction method. The soluble O content for a given soluble Zr content is lower than the previously reported value in the plot of soluble O *vs.* soluble Zr contents and the oxygen activity for a given soluble Zr content is higher than the previously reported values. The free energy change of solid Zr dissolution into iron melt: Zr(s)=Zr at 1 873 K is obtained as $\Delta G^\circ = -153 \pm 10$ kJ. The interaction coefficients for e_O^{Zr}, r_O^{Zr} and $r_O^{Zr,O}$ are estimated as -70 ± 15, 901 ± 131 and $10\,300 \pm 1\,500$, respectively. However, the following interaction coefficients are represented by using a continuous function of logarithms of X, where X=[%sol.Zr]+5.7[%sol.O]+17.1[%sol.Zr]·[%sol.O]/(2[%sol.Zr]+5.7[%sol.O]):

$$e_O^{Zr} = -3.70 - 2.20 \ln X - 2.07(\ln X)^2 + (\ln X)^3$$
$$r_O^{Zr} = dY/dX = \{-0.33 + 1.87 \ln X + 3.01(\ln X)^2\}/X$$
$$r_O^{Zr,O} \approx 11.4 r_O^{Zr} = \{-3.72 + 21.4 \ln X + 34.3(\ln X)^2\}/X$$

(cf. *ISIJ Int.*, **48** (2008), 1175)

Ironmaking

Numerical investigation on hot metal flow in blast furnace hearth through CFD

C.-E.HUANG et al.

The behavior of hot metal flow in the hearth of a blast furnace is always considered as one of the key factors for determining blast furnace campaign life. To provide a useful insight into the hearth of No. 2 blast furnace at China Steel Corporation (CSC), a numerical model has been developed to analyze the flow and heat transfer under various cooling and operational conditions. The model solves three-dimensional Navier–Stoke equations with conjugate heat transfer and Darcy's law for hot metal flowing through the deadman with porous structure by computational fluid dynamics (CFD). The calculated results indicate that the circulatory hot metal is enhanced when the deadman becomes sitting with gutter coke-free space. As a result, the temperature at the hearth corner increases. This suggests the existence of gutter coke-free space may cause elephant foot type erosion. With drainage of hot metal, the heat flux of taphole significantly increases. For the sake of safety, it may be needed to individually monitor the cooling water temperature flowing through the copper staves, as well as to install thermocouples around the tapholes. The prediction shows that the heat flux of the hearth is insensitive to the temperature of cooling water before the refractories are eroded. It implies that the performance of the water chiller may be limited in the beginning of the blast furnace campaign.

(cf. *ISIJ Int.*, **48** (2008), 1182)

Utilization of waste plastic for the production of metallic iron, hydrogen and carbon monoxide without generating carbon dioxide

T.MATSUDA et al.

National legislation within Japan has increased the need for the development of new process technologies that will utilise various waste materials. The present study is aimed at generating some fundamental data with respect to the application of waste plastic as a potential reductant for iron oxide. By using a high frequency induction furnace, mixtures of polyethylene+Fe_2O_3 were heated very rapidly to temperatures between 1 673 and 2 073 K in a stream of argon. Gas chromatography, chemical analysis and X-ray diffraction were used to detect reaction products, which consisted of metallic iron, ferrous oxide, char, CO, CO_2, H_2O, H_2 and CH_4, depending upon C/O mole ratios within the polyethylene+Fe_2O_3 mixture and the experimental temperature. The results were in good agreement with values calculated from thermodynamic equilibrium.

(cf. *ISIJ Int.*, **48** (2008), 1188)

Steelmaking

Development of a decarburization and slag formation model for the electric arc furnace

H.MATSUURA et al.

A decarburization and slag formation model for the electric arc furnace was developed, which includes the rate phenomena for decarburization and the reaction between carbonaceous materials and iron oxide in slag, mass balance for each species in the metal, slag and gas phases, and the melting behavior of pig iron, scrap and fluxes. The model was applied to a two bucket charge operation electric arc furnace and the dynamic metal and slag compositions were calculated as a function of time. The effects of melting patterns for raw materials, carbon–FeO reaction rate, and the post combustion ratio were examined. The critical parameters, which most strongly influence chemistry development, were identified. These parameters were fitted to an industrial case, such that the model could accurately predict slag and metal chemistry development. This model could be utilized to optimize the operation in order to improve yield, energy efficiency, and increase consistency of metal and slag chemistries from heat to heat.

(cf. *ISIJ Int.*, **48** (2008), 1197)

Casting and Solidification

Crystal alignment of Sn–Pb alloy by a simultaneous imposition of a DC current and a static magnetic field during solidification

K.IWAI et al.

A new crystal-alignment process in which both a static magnetic field and a direct electric current are imposed on an alloy during solidification was pro-

posed and tested experimentally on Sn–10mass%Pb alloy. Various intensities of a static magnetic field and a direct current were imposed on the sample during solidification. After solidification, cross-sections of the samples were polished and the crystal alignment was evaluated by means of X-ray diffraction (XRD). As predicted theoretically, the peaks corresponding to the (200) and (220) planes were intensified in the XRD analysis when a static magnetic field larger of 3 T or more was imposed, whereas no crystal alignment was observed with a 0.1 T magnetic field. Therefore, crystal alignment was achieved by this process, and the critical intensity for crystal alignment is between 0.1 T and 3 T under the experimental conditions studied.

(cf. *ISIJ Int.*, **48** (2008), 1206)

Influence of mold flux basicity on surface quality of ultra-low carbon steel slabs

M.HANAO et al.

Mold flux has a large influence on the surface quality of ultra-low carbon steel slabs. Especially, its entrapment in the continuous casting mold must be prevented in order to reduce inclusions in the surface layer of the slabs. In this work, experimental casts with a pilot continuous caster were conducted and the influence of mold flux basicity on the surface quality of the slabs was researched.

Spherical inclusions, which existed in the surface layer of the slabs and seem to be caused by the entrapment of molten flux in the mold, decreased in number or size, with the increase of mold flux basicity.

The effect of basicity could be explained in terms of interfacial tension or wettability between mold flux and molten steel. Thus, the number and the size of spherical inclusions decreased with the increase of interfacial tension and contact angle of molten flux on the surface of molten steel. This effect was considered to be larger than that by the viscosity or density of mold flux.

(cf. *ISIJ Int.*, **48** (2008), 1210)

Mechanism of a hydrogen-induced sticker breakout in continuous casting of steel: Influence of hydroxyl ions in mould flux on heat transfer and lubrication in the continuous casting mould

T.KAJITANI et al.

Mechanism of a hydrogen-induced sticker breakout is studied paying attention to the observation that the frequency of the breakout is higher during continuous casting of Si–K steel than Al–K steel. During the casting of Si–K steel, the micropores, which are present in mould flux film, reduces heat transfer at the mould meniscus. In such a case, mould flux consumption is decreased, because the oscillation marks that provide mould flux into the flux channel become less pronounced, and it results in a sticker breakout.

The formation of the micropores in mould flux is further investigated employing solid-state ^{1}H NMR with CRAMPS technique that has successfully enabled the quantitative analysis of hydroxyl ions in mould flux. The spectra have revealed that hydroxyl ions exist in mould flux and they increase in molten flux pool especially during the casting of Si–K steel. The result provides the new mechanism for the formation of the micropores: in a continuous casting mould, water vapour in the atmospheric air is absorbed into molten flux pool as hydroxyl ions, and they are usually reduced by soluble Al in molten steel pool. However, during the casting of Si–K steel where Si is a weaker deoxidizing element, the hydroxyl ions are not easily reduced, and they form the micropores of the gas including H_2O during the crystallization of mould flux in the flux channel. According to the proposed mechanism, mould flux with a lower activity of SiO_2 has been developed for Si–K steel, and it successfully prevents the sticker breakouts.

(cf. *ISIJ Int.*, **48** (2008), 1215)

Forming Processing and Thermomechanical Treatment

Drawing properties of cold rolled sheets produced from thin-slab-casting and hot rolling strips

G.XU et al.

The deep drawable cold sheets rolled with conventional hot bands and thin slab casting and rolling (TSCR) hot bands have different drawing properties. Samples of two kinds of cold sheets were taken in an automobile plant, and tests and analyses were conducted in chemical compositions, microstructures, cementite distributions and inclusion types *etc.* The investigation results have shown that the deterioration of drawing properties of cold sheets rolled with TSCR hot bands were caused by the differences in chemical composition, microstructure, cementite distribution and inclusion type. The suggestions are given to improve the drawing properties of TSCR hot-bands based cold sheets.

(cf. *ISIJ Int.*, **48** (2008), 1225)

Welding and Joining

Brazing of Ti-sputtering activated hot-pressed-SiN with prior metallized ferritic stainless steel

T.DHAMAL et al.

The brazing of hot pressed silicon nitride (HPSN) with ferritic stainless steel using high temperature brazing material has been studied. The effect of prior brazing metallization of stainless steel and activation of faying surface of HPSN by titanium sputtering on characteristics of the joint have been analysed. The characteristics of the HPSN-steel brazed interface have been studied by energy dispersive X-ray spectroscopy (EDS) under SEM to understand the mechanism of joining through chemical interaction in different procedures used for the brazing. The bend strength of the brazed joints produced by different procedures of brazing process has been studied and compared. It is observed that the use of Ti activated HPSN and metallized stainless steel is beneficial for improvement of joint strength.

(cf. *ISIJ Int.*, **48** (2008), 1228)

Diffusion bonding of surface self-nanocrystallized Ti–4Al–2V and 0Cr18Ni9Ti by means of high energy shot peening

J.HAN et al.

By means of high energy shot peening (HESP), surface nanostructured layers were synthesized on the ends of Ti–4Al–2V titanium alloy and 0Cr18Ni9Ti austenitic stainless steel bars. Using the peened surfaces for mating surface, constant temperature and pressure diffusion bonding (CTPDB) was applied to prepare joints of Ti–4Al–2V/0Cr18Ni9Ti in the temperature rang of 800–900°C for 20 min under a uniaxial load of 8 MPa in vacuum. Tensile strengths of joints were tested, longitudinal section microstructures of joints were analyzed by using scanning electron microscope (SEM), meanwhile, concentrations of Fe, Ti, Cr and Ni in diffusion layers were measured by using energy dispersive spectroscope (EDS), and the diffusion coefficient and diffusion activation energy of Fe atom in the Ti–4Al–2V side were calculated. Results shows that the maximum tensile strength of 327 MPa is obtained when bonding temperature is 850°C, the diffusion activation energy of Fe atom is far less than that in coarse grain sample, and the diffusion coefficient of Fe atom is higher than that in convention coarse grain sample.

(cf. *ISIJ Int.*, **48** (2008), 1238)

Surface Treatment and Corrosion

Trial to evaluate wettability of liquid Zn with steel sheets containing Si and Mn

S.SHIMADA et al.

Since it has been pointed out that liquid Zn alloy sometimes exhibits non-wetting behavior on high-tensile strength steels usually containing Si and Mn, there have been several studies to improve the wettability of liquid Zn. Although those studies evaluated the wettability qualitatively by observation of the surface of galvanized steels or exfoliation testing of Zn on steel substrates, it is further required to evaluate the wettability of liquid Zn on steels by measuring the contact angle, work of adhesion, spreading velocity *etc.* which are usually used to assess the general wetting behavior. In the present work, we applied a sessile drop method to measure the change in contact angle and diameter of liquid Zn droplets wetted on steels containing Si and Mn with time to evaluate quantitatively the dynamic wetting behavior of liquid Zn on steel substrates.

(cf. *ISIJ Int.*, **48** (2008), 1246)

Transformations and Microstructures

Kinetics of austenite formation in dual phase steels

M.ASADABAD et al.

In this research study a low carbon steel with composition of C=0.11%; Mn=1.30%; Cr=0.45%; Si=0.20%; Al=0.03% and Fe=bal. was cast and used in hot rolled condition. After intercritical annealing at different temperatures for different times, dual phase structures with various volume fraction of martensite were produced. Then the volume fraction

of martensite for different samples were measured.

Study of the relationship between temperature and time of intercritical annealing and martensite volume fraction showed that a new equation as $f_\gamma/f_e=1-\exp(-kt^n)$ can be used to give variation of martensite volume fraction with temperature and time of annealing. Also it is found that k coefficient changes exponentially with annealing temperature.

(cf. *ISIJ Int.*, **48** (2008), 1251)

Effects of morphology and stability of retained austenite on the ductility of TRIP-aided bainitic steels

F.G.CABALLERO et al.

In order to improve the ductility of carbide free bainitic microstructures, consisting of a bainitic ferrite matrix and a mixture of austenite and martensite, the TRIP effect *i.e.* the strain induced transformation of retained austenite to martensite, should be controlled. In this sense, the effect of the chemical composition on the mechanical stability of the retained austenite and the morphology, size, and distribution of this phase has been studied to determine the role that plays on the ductility behaviour of advanced bainitic steels. Results suggest that apart of the retained austenite, the morphology of the bainitic matrix is an important factor controlling ductility. Bainitic microstructures formed by coiling with coarse and blocky bainite morphology have shown higher uniform deformation values than those obtained by air cooling with the typical thin bainite platelets.

(cf. *ISIJ Int.*, **48** (2008), 1256)

Influence of accumulated stress in austenite on ferrite grain size during hot rolling of a V-microalloyed steel

S.F.MEDINA et al.

Torsion test rolling simulations have been performed in different conditions (pass strain, interpass time) for a V-microalloyed steel (C=0.165; V=0.170 wt%). The accumulated stress ($\Delta\sigma$) in austenite at temperatures below the no-recrystallisation temperature (T_{nr}) has been measured. The accumulated stress is directly related to the dislocation density. The ferrite grain size (D_α) obtained after hot rolling simulations for different conditions and a cooling rate of 3.5 K/s has been measured. D_α is found to be dependent on $\Delta\sigma$ and on the austenite grain size prior to the austenite–ferrite transformation during cooling. On the other hand, a higher strain accelerates recrystallisation between passes, lowers the T_{nr} value, and consequently leads to a smaller accumulated stress. It is seen that a minimum value of 15 MPa must be reached in order for D_α refinement to begin.

(cf. *ISIJ Int.*, **48** (2008), 1263)

Influence of V precipitates on acicular ferrite transformation part 1: The role of nitrogen

C.GARCIA-MATEO et al.

This paper (part 1 of a two part study) deals with the influence of N in its combination with V, as V(C, N) precipitates, on the decomposition of austenite into acicular ferrite. Likewise, the intragranular nucleation potency of V(C, N) precipitates is analyzed through the continuous cooling transformation diagrams (CCT) of two C–Mn–V steels with different contents of N under two different austenitising temperatures, *i.e.* different austenite grain sizes. The results clearly show that for austenite to decompose into acicular ferrite is necessary, first to have a representative fraction of V(C, N) precipitates within austenite, and second to decorate the austenite grain boundaries with proeutectoid ferrite so bainite can not form. Part 2 of the study concerns with the influence that those precipitates have on the kinetics of acicular ferrite formation during austenite isothermal decomposition.

(cf. *ISIJ Int.*, **48** (2008), 1270)

Influence of V precipitates on acicular ferrite transformation part 2: Transformation kinetics

C.GARCIA-MATEO et al.

A combination of thermodynamic models as well as some physical metallurgical principles has been used to analyse the influence that V(C, N) precipitates have on the transformation kinetics of acicular ferrite by isothermal decomposition of austenite. Those precipitates were found absolutely necessary for the nucleation of acicular ferrite as reported in Part 1 of this work, now in Part 2, through the proper design of a heat treatment route we have studied the effect that those precipitates have on the kinetics of acicular ferrite transformation.

(cf. *ISIJ Int.*, **48** (2008), 1276)

Energetics for interfaces between group IV transition metal carbides and bcc iron

W.-S.JUNG et al.

An *ab initio* study was carried out on interfacial energies and misfit strain energies at coherent interfaces between Fe(bcc structure) and MCs(NaCl structure, M=Ti, Zr, Hf). The interfacial energies at relaxed interfaces, Fe/TiC, Fe/ZrC and Fe/HfC, were 0.263, 0.153 and 0.271 J/m^2, respectively. The influence of bond energy was estimated using the discrete lattice plane/nearest neighbor broken bond model. It was found that the dependence of interfacial energy on the type of carbide was closely related to changes of the bond energies between Fe, M and C atoms before and after formation of the interfaces Fe/MC. The misfit strain energies in Fe/TiC, Fe/ZrC and Fe/HfC systems were 0.390, 1.692 and 1.408 eV per 16 atoms (Fe; 8 atoms and MC; 8 atoms). The misfit strain energy became larger when the difference in lattice parameters between the bulk Fe and the bulk MCs increased.

(cf. *ISIJ Int.*, **48** (2008), 1280)

Mechanical Properties

Short fatigue crack growth behaviour in ferrite–bainite dual-phase steels

A.KUMAR et al.

The influence of bainite content on the short crack growth behaviour has been examined in a series of ferrite–bainite dual phase steels containing 50.3–90.3% bainite. Fatigue tests have been carried out using an earlier reported specimen configuration with the help of a rotating bending machine. These tests have been supplemented by characterization of the generated microstructures, determination of their hardness and tensile properties, and examinations of the nature of association of fatigue crack paths with microstructural constituents. The characteristic critical crack lengths above which linear elastic fracture mechanics may be applicable, the fatigue threshold values at the transition of short to long cracks, and the influence of microstructure on the crack path have been discussed. The maximum value of short crack fatigue threshold indicates a marginally increasing trend with increased amount of bainite. The fatigue crack path is found to be predominantly intra-granular for steels containing <70% bainite while it is predominantly inter-granular for steels containing >70% bainite.

(cf. *ISIJ Int.*, **48** (2008), 1285)

New Materials and Processes

Fabrication of steel matrix composite locally reinforced with *in situ* TiC particulate *via* SHS reaction of (Ti, Fe)–C system during casting

S.T.LI et al.

The low-alloy steel matrix composites locally reinforced with *in situ* TiC particulates have been successfully produced utilizing the self-propagating high-temperature synthesis (SHS) reaction of (Ti, Fe)–C systems during casting. Two types of TiC particulates synthesized by different mechanisms exhibit a relatively uniform distribution in the local reinforcing region. The large rectangular TiC particulates with an average size of ~2 μm or more, which are formed by the nucleation-growth mechanism through the contact reaction process, are mainly present in the local reinforcing region of the composites fabricated by (28Ti, Fe)–C system and the matrix region nearby the interface between the steel matrix and reinforcing region. The fine spherical/near-spherical TiC particulates, which are synthesized by reaction, solution and precipitation mechanism during the SHS reaction, are mainly existent in the reinforcing region. Moreover, the average size of spherical/near-spherical TiC particulates increases from ~0.1 to ~0.5, and then to ~1 μm with the increase in Ti content from 28 to 48, and then to 68 wt% in (Ti, Fe) powders. The interfaces of the composites are clean, which results in a good metallurgical bonding between steel matrix and reinforcing region in the composites. Moreover, the micro-hardness and wear resistance of the local reinforcing region of the composites are significantly higher than those of the unreinforced steel matrix.

(cf. *ISIJ Int.*, **48** (2008), 1293)

Antibacterial properties of metallic elements for alloying evaluated with application of JIS Z 2801:2000

H.KAWAKAMI et al.

Antibacterial properties of 21 metallic elements used as alloying elements (Al, Si, Ti, V, Cr, Mn, Co, Ni, Cu, Zn, Zr, Nb, Mo, Pd, Ag, Sn, Ta, W, Pb, Au, Pt) was studied. *Escherichia coli* (Gram-negative bacteria) and *Staphylococcus aureus* subsp. *aureus* (Gram-positive bacteria) were used as model bacte-

ria. The film attachment method was adopted for evaluation of antibacterial activity, and Japan industrial standard Z 2801:2000 was applied as the criterion for evaluate antimicrobial abilities of samples. Silver and Cu showed strong bactericidal effects as expected, and following them Co, Ni and Al were moderately toxic. Physiological effects of metals depended on the specie of bacteria. For example, Ni decreased the total viable count of *E. coli* to 10 cfu/mL in 4 h, while it took 24 h to decrease the total viable count of *S. aureus*. By judgment following to JIS Z 2801:2000, Pt and Pb were effective only for *E. coli*, while V and Zr were only for *S. aureus*. Gold was not toxic even though Au^{3+} had been reported as strong toxic. Also Mo showed antibacterial effects which can be resulting from decrease in pH of the bacteria suspension.

(cf. *ISIJ Int.*, **48** (2008), 1299)

Social and Environmental Engineering

Reduction in dioxin emissions by the addition of urea as aqueous solution to high-temperature combustion gas

E.KASAI et al.

In order to study the effect of urea addition to the waste gas on the dioxin formation, a series of experiments is carried out using the fly ashes sampled from two different types of solid waste incinerators. A remarkable suppression effect is obtained for the dioxin formation, while no clear change is observed for the obtained organic chlorine. Considering these results, the method of urea addition to the water splayed into the cooling tower of waste gas is proposed as an effective measure to suppress the dioxin formation at the cooling stage of the combustion gases. A verification test is carried out using an actual solid waste incinerator. When the concentration of urea in the splayed water is set to 0.1%, the toxicity concentration of the dioxins in the waste gas is reduced to approximately half that in the case without the addition. Further, the addition of urea does not significantly affect the concentration of NOx in the waste gas.

(cf. *ISIJ Int.*, **48** (2008), 1305)

Evaluation of hydrothermal treatment to immobilize hexavalent chromium in wastewater using granulated blast furnace slag

S.-J.TAE et al.

The immobilization of hexavalent chromium in wastewater using blast furnace slag as the immobilizing agent was investigated by using hydrothermal treatment. The results showed that immobilization was not attained without a hydrothermal treatment, while hexavalent chromium in solution could be immobilized through the process of hydrothermal treatment with the blast furnace slag at 250°C for 18 h. In particular, the reducing condition was attributed to the presence of sulfur in the blast furnace slag, which indicated that the sulfur could plays key role in the immobilization of hexavalent chromium in the present study. In addition, the leaching test was carried out to evaluate the level of immobilization of hexavalent chromium in the products after the hydrothermal treatment, and it was found that the degree of immobilization was very high. Based on the results obtained in the present study, the immobilization mechanism of the hydrothermal treatment of blast furnace slag in wastewater was elucidated.

(cf. *ISIJ Int.*, **48** (2008), 1311)

訂正

「鉄と鋼」Vol. 94 No. 8（平成20年8月）の目次に分野の誤りがありました。
次の論文の分野は**製銑**／**Ironmaking**ではなく，正しくは**製鋼**／**Steelmaking**です。

浸漬ノズル近傍を上昇するアルゴン気泡の挙動に関する水モデル実験
Water Model Experiment on the Behavior of an Argon Bubble Rising near the Immersion Nozzle
渡邊　剛・井口　学