Alert Recycling of Byproducts (July 2016)

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ISIJ International, July 2016
Application of fertilizer made of steelmaking slag in the recovery of paddy fields damaged by the tsunami of 2011. X. Gao, T. Ito, H. Nasukawa, S. Kitamura
The great earthquake of 2011 triggered a tsunami that damaged large areas of paddy fields in northeastern Japan. In an effort to address the salt damage, supplementation of Ca-containing materials to exchange Na adsorbed on soil surface has been recommended. In addition, Si has also been shown to enhance paddy growth. Steelmaking slag, which contains a water-soluble solid solution phase of 2CaO·SiO2, can supply Ca and Si for soil remediation. In this study, the dissolution behaviors of nutrient elements from fertilizer made of steelmaking slag were investigated using the column test. In addition, crop cultivation experiments were also conducted using tsunami-damaged paddy fields. In column test, Ca content in soil solution increased by the application of fertilizer made of slag, but the Na content did not change significantly. These trends were also observed in the pore water of the actual paddy in crop cultivation experiments. In addition, the incremental trend of silicate content in the pore water by the application of fertilizer made of slag was more apparent than that in the column test. Paddy growth was enhanced and the yield of brown rice was increased by the application of fertilizer made of slag. In conclusion, the fertilizer made of steelmaking slag has the following three effects: (1) mitigating the damage caused by the Na ion through the supplementation of Ca, (2) enhancing the mineralization of soil N by increasing the pH, and (3) accelerating photosynthesis by the supplementation of silicate.

Ironmaking & Steelmaking, July 2016
Influence of phosphate binders on the physical and mechanical properties of magnesia carbon monolithics composed of recycled refractory aggregates. S. Alizadeh, A. Monshi, S. Yazdkhasti
In this study, the effect of using phosphate bonding materials such as sodium hexametaphosphate (SHMP) and sodium tripolyphosphate was investigated in the presence of water and recycled magnesia carbon (MgO–C) refractory aggregates as raw materials. For this purpose, different compounds are prepared, and some parameters such as bulk density, volume per cent of apparent porosity and cold crushing strength were measured at different temperatures [200, 500 and 1100°C], and phase and microstructure studies were performed by X-ray diffraction, SEM and energy dispersive spectroscopy. Statistically, effects of the factors were also determined using the analysis of variance method. Results indicated that MgO–C monolithic refractory samples were successfully produced from recycling the spent MgO–C bricks, and use of these phosphate binders especially that of 5 wt-%SHMP produce some phosphate
bonds like Mg$_2$P$_2$O$_7$, Mg$_3$(PO$_4$)$_2$ and AlPO$_4$ and improve the physical and mechanical properties.

11th European Electric Steelmaking Conference, Venice, Italy, May 2016

**Electric arc furnace slag: a sustainable valorization in civil engineering applications.**

Flora Faleschini, Katya Brunelli, Manuele Dabalà, Carlo Pellegrino

The use of Electric Arc Furnace (EAF) slag has been recently investigated with the aim of producing structural concrete, bituminous mixtures and cement-based materials. Promising results have been achieved replacing up to the whole percentage of the natural coarse aggregates in concrete mixtures, due to the good physical, chemical and mineralogical properties of the slag. In this paper the work carried out to produce a sustainable structural concrete, including EAF slag as coarse aggregate, is shown.

Two control and two EAF concretes have been produced and then tested, varying the water/cement ratio and the type of aggregates. After a preliminary characterization of the raw materials, mechanical properties of the concretes have been analyzed, evaluating compressive and tensile strength, and elastic modulus. Then the durability of the mixtures has been evaluated against chlorides exposure, with the aim of establishing the influence of the substitution on the apparent diffusion coefficient. Results indicate that the use of EAF slag improves the mechanical performances of concrete, leading to the production of a material with higher strength class. Additionally, the durability of EAF concretes in chlorides-exposed environmental is enhanced, due to a reduction of the diffusion coefficient. According to the results obtained in this work, the re-use of this byproduct of the metallurgical industry allows the production of an added-value product, promotes a safer use of raw materials, and leads significant gains in terms of environmental sustainability.

**Injection of recycled rubber tires in the EAF as foaming slag agent at CELSA Group.**

Andrea Fontana, Angel Cruz Armentia Alvarez, Massimo Iacuzzi, Paul O’Kane, Dr Zheshi Jin

In co-operation with the University of New South Wales, OneSteel has developed and a patented technology known as Polymer Injection Technology, which consists of injecting blends of recycled rubber crumbs from end-of-life tires and coke in the Electric Arc Furnace (EAF) as foaming slag agent. The technology has been a standard practice at OneSteel’s Sydney and Melbourne EAFs since 2008. Thanks to Polymer Injection Technology, as of February 2016, the equivalent of 2.45 million end-of-life tires had been redirected from the waste stream into a primary steelmaking agent in Australia only. Following commercialization at UMC, Thailand and SeAH Besteel, Korea, Polymer Injection Technology was successfully implemented at two Celsa Group EAFs: Celsa UK, Wales in 2014 and Celsa Nordic, Norway in 2015. For the Norwegian plant, a complete package, including the entire Material Handling System for rubber crumb, was supplied in conjunction with More Srl, Italy. The main benefits of the technology are superior slag foaminess and improved slag reduction of the polymer/coke blend compared to 100% coke, with consequent reduction of electrical energy consumption, reduced power on time, and savings in injected oxygen consumption. Polymer Injection Technology is an environmentally sustainable practice, contributing to diversion of end-of-life tires from land fill. Due to reduced coke usage, it results in decreased CO2 emissions.

**Railway eco-friendly concrete using electric arc furnace oxidizing slag.** Tae-Hoon Koh, Seon-Keun Hwang, Han-Ju Yoo

In the railway industry, there are many research activities to develop the green vehicles which reduce the energy consumption such as high-speed electric train, wireless tram etc. However researches on the ecofriendly railway infrastructure have been very limited. Therefore one of the main railway infrastructures, concrete sleeper and precast concrete box using steel slag was environmentally developed in Korea in order to
significantly reduce the usage of cement and natural fine aggregate as main ingredients of the concrete. Mixing designs were completed to manufacture the low-carbon eco-friendly concrete sleeper and precast concrete box, in which Portland cement was partially replaced by ground granulated blast furnace slag and fly ash to reduce carbon dioxide emissions and electric arc furnace oxidizing slag was used as an alternative to fine aggregate for the preservation of the natural resources. Based on the required test results and field application, it was found that electric arc furnace oxidizing slag is an excellent alternative ingredient to the natural aggregate for railway concrete infrastructure.

The No-Waste strategy of Georgsmarienhütte. David Algermissen, Tim Rekersdrees, Henning Schliephake, Tobias Zehn
With a crude steel production of nearly one million tons Georgsmarienhütte ranks among the bigger electric steel plants in Germany and pioneers in the field of energy management, environmental protection and slag utilization. Since many years the company has been involved in several public and internal research projects relating to in-plant ways of recycling for by-products to close the recovered material cycle entirely and to generate products with a higher intrinsic value from the slag. Among others this includes demonstrating the use of calcareous slag produced in the secondary metallurgy in the electric arc furnace while partly substituting the primary resource lime, the use of biochar to reduce the CO2-emissions, methods to use the energy potential of steel slag or the creation of totally new products from EAF-slags and other by-products. In this context the production of a high-quality raw material for the cement industry while simultaneously recovering the metal contained in the slag has to be mentioned. These projects are part of the continuous activities of Georgsmarienhütte GmbH to reconcile the economic and ecological challenges at the location Germany and of our ambition to become the first electric steel plant in Europe succeeding in implementing the internal NoWaste Strategy by comprehensive research and development activities.

The role of chemical composition and microstructure on leaching behavior of electric arc furnace (EAF) carbon steel slag. D. Mombelli, C. Mapelli, S. Barella, C. Di Cecca, G. Le Saout, E. Garcia-Diaz.
To exploit electric arc furnace slag in civil engineering application, such as landfilling, road constructions and concrete production, chemical and structural stability are fundamental requirements. In fact steel slag may suffer from weathering processes (hydration, dissolution,…) that induce the leaching of heavy metals (Cr, Ba, v, etc.) that can be dangerous to humans and the environment. Thus, the interaction between slag and water is key, in order to classify the slag as safe raw material. In this work, the investigation on the main factors ruling chemical leaching on about seventy EAF carbon slag from different steel grade production was performed.

Journal of Sustainable Metallurgy, February 2016
Antimony has become an increasingly critical element in recent years, due to a surge in industrial demand and the Chinese domination of primary production. Antimony is produced from stibnite ore (Sb2O3) which is processed into antimony metal and antimony oxide (Sb2O3). The industrial importance of antimony is mainly derived from its use as flame retardant in plastics, coatings, and electronics, but also as decolourizing agent in glass, alloys in lead-acid batteries, and catalysts for the production of PET polymers. In 2014, the European Commission highlighted antimony in its critical raw materials report, as the element with the largest expected supply–demand gap over the period 2015–2020. This has sparked efforts to find secondary sources of antimony either through the recycling of end-of-life products or by recovering antimony from...
industrial process residues. Valuable residues are obtained by processing of gold, copper, and lead ores with high contents of antimony. Most of these residues are currently discarded or stockpiled, causing environmental concerns. There is a clear need to move to a more circular economy, where waste is considered as a resource and zero-waste valorization schemes become the norm, especially for rare elements such as antimony. This paper gives a critical overview of the existing attempts to recover antimony from secondary sources. The paper also discusses the possibility of waste valorization schemes to guarantee a more sustainable life cycle for antimony.

ABM Week 2015 – 15th ENEMET, August 2015

Sludge leaching in laboratory scale for zinc oxide removal. T. Costa, J. Maia (in Portuguese)
The process involves aqueous solution for removing valued metal from a large mass of sludge, with minimal processing, is called leaching. The specificity of the leaching agent used defines the ability to treat solutions with low levels of the metal of interest and the success of the process. The sludge from the melt shop, collected in the gas cleaning system from the LD converter, and the sludge from the electroslag refining plant, generated after the neutralization of contaminated zinc solution with iron, are solid waste generated in steel plants with potential to be reused or recycled. In order to remove the zinc oxide present in the sludge, samples were collected and prepared for undergoing the leaching process on a laboratory scale using sodium hydroxide (NaOH) and sulfuric acid (H2SO4) solutions. The results of the analysis showed that zinc oxide can be removed by leaching the sludge.

Study of utilization of red mud chemically and thermal activate aiming the biofuel desacidification. F. Simões, L. da Silva, K. de Cristo, T. Carvalho, S. da Mota (in Portuguese)
In the production of biodiesel from vegetable oil produced via thermal, catalytic cracking, the desacidification of the final product is carried out for viability and can be effected by adsorption. The adsorbents are diverse and range from zeolites to the use of industrial waste. This study aimed to test the red mud, previously activated chemically and thermally, as an adsorbent of free fatty acids present in the light gas oil, produced from the cracking of palm oil with an initial acid value of 55.1257 mg KOH/g. Red mud was used in five conditions: dry untreated, chemically activated (pretreated at 400°C / 2h) by HCl 37% solution, by H2O2 4% solution, by HCl 1.5 M solution and by KOH 1.5 M solution. The adsorption kinetics, the red mud solution activated by HCl 1.5 M was more effective than the other adsorbents, for biofuel reduced the acid value of 10.7574 mg KOH/g to 9.1752 mg KOH/g at the time of 50 minutes. As for the efficiency of other adsorbents, with respect to desacidification, only the dry red mud and chemically activated by KOH 1.5 M showed noticeable removal of free fatty acids.

Phase analysys of steelmaking slag samples from CaO-MgO-Al2O3-SiO2 system. L. Winck, W. Bielefeldt, A. Vilela (in Portuguese)
Steel slag, besides being coproducts of the steelmaking process is the slag, play an important role in the quality of steel produced. Understanding how it behaves in the process of refining is fundamental. For example, in secondary refining, the inclusions’ absorption by slag is one of the main ways of the obtaining cleaner products, therefore, noblest. The present study aims the phases’ characterization of the refining slag from the CMAS (CaO, MgO, Al2O3, SiO2) system, in order to obtain information about its compositions and liquid fraction, including probable solid phases. In order to carry it out, four samples with different chemical compositions were melted in laboratory resistive furnace, and after analyzed by different techniques: scanning electron microscope with energy dispersive spectroscopy (SEM/EDS), x-ray diffraction and thermodynamic simulation. The results were consistent with the thermodynamic simulation and results in the bibliography.
This paper presents the physical and mechanical impacts of recycling refractory inputs composed of magnesium oxides bonded to carbon, in order to reuse these as raw material for the production of new bricks. Refractory residues replaced in the proposed formulation, 100% mass of MgO used in these bricks. The study involved the making of the new bricks and carrying out characterization of bricks produced trials using physical tests. The results showed high porosity in a final condition without curing, resulting in lower bulk density and resistance of the bricks produced from virgin raw materials.

The production of siderurgical residues is a problem that covers two main scenarios: the environmental, regarding the residues’ disposal on soil and also the economic field, because it’s a non reused material that must be send to industrials landfills, generating costs. Thus, recycling these possible co-products to use as raw material of the process becomes a relevant option. One of the ways to recover the EAF dust, residue approached in this paper, is through pelletization. For the reutilization of the metals of interest in the dust a reducer agent was used, the petroleum coke. Nevertheless, for the pellets’ formation, a binder is needed and in association with the oxides particles aims to give mechanical strength suitable for the iron making process. In this paper six different binders’ composition are tested, aiming evaluate their performance through compressive strength testing, drop shatter test and tumbler test. As result it was possible to verify the efficiency of the combination hydrated lime with rice rusk ash for the three tests.

46º Seminário de Aciaria, August 2015
Technical and economic analysis about use of pig iron residuals at EAF. T. Bittencourt, E. da Silva, J. Osório, F. Candido (in Portuguese)
The metallic charge used at Electric Arc Furnace (EAF) is much more than the raw material of semi integrated route, it even represents the financially breakeven point in a sustainable steelmaking operations. The true economic balance of an operation based on an EAF based on the scrap cost. Thus it is reasonable to think that, choose the scraps combination that will make up the best mix to be charged at the EAF is a task that goes beyond the technical limitations of the melting and primary refining phenomenon’s in that reactor. The use of metallic residuals is a sustainability measure for the steel industry, both from the environmental viewpoint, since the reuse of waste, as the economic outlook, given the substantial reduction in processing costs. Tests got at UPV EAF evaluated the positives and negatives aspects of use of metallic residuals discarded during the production of cement. The results show that, under the technical perspective, the positives outnumber the negatives and therefore EAF is a great alternative for sustainable consumption that residue. An economic evaluation indicates a reduction of scrap cost about 17%.

BOF slag is an abundant byproduct originated from the hot metal refining to steel and its subsequent types of secondary metallurgy processes. After treatment, BOF slag has many applications, but it needs storage for curing or aging to minimize volumetric instability. In Brazil, PTM-130/78 test is currently the most used to evaluate potential for expansion. However, this method spends 14 days to obtain the result. Through a technical and economic cooperation between CSN and EEL-USP, the traditional
method was correlated with the one of X-ray diffraction and the Rietveld Method. Mathematical models obtained by multiple regressions have achieved 98% of reproducibility and a reduction of 14 days (336 hours) for 7 hours.

**Innovative solutions for recycling of byproducts.** J. Schwelberger, G. Wimmer, C. Brunner, A. Fleischanderl

Government regulations around the world concerning environmental care are becoming more stringent, also including regulations and restrictions of depositing and use of dust, sludge and slag generated in the iron and steelmaking process. With this scenario, by-products such as iron containing dust, sludge, oxide fines, mill scales and slag, become a valuable resource and recycling may be a profitable activity within a plant. Up to ten percent in mass of the total steel output of dust, sludge and mill scale by-product materials and more than 40% of slag by product are generated within an integrated steel plant with an iron content ranging from 50% to 65% for fines and up to 25% for BOF-slag. Slags are being widely recycled and used in the cement industry, as is the case for BF slag, and in the construction industry in the case of BOF slags and EAF slags. However, value of BOF unmodified slag is typically low and environmental regulations limit the usage of the unmodified BOF slag. This paper describes innovative solutions for recycling of fines using cold briquetting technology and the modification and granulation of slag from steelmaking that increase the value of the by-product and yield a marketable product.

**Characterization and evaluation of carbothermic reduction via EAF dust thermogravimetric test.** F. Ferreira, B. Flores, P. de Buzin, N. Heck, E. Osório, A. Vilela (in Portuguese)

The Electric Arc Furnace Dust (EAFD) is a solid waste originated from electric steelmaking furnaces. It has harmful metals to the environment and its made, in majority, by elements iron, zinc and oxygen. Due to increasing costs for disposal and because is considered a hazardous waste, industry look for ways of recycling as well as possibly return the dust to the steelmaking process. One of the alternatives is by reintroducing the waste in electric melt shop using self-reducing agglomerates as part of the furnace burden. In this study, self-reducing mixtures are prepared with EAF Dust and petroleum coke, presenting chemical and physical characterizations. An evaluation about these mixtures’ behavior is carried out in thermobalance, regarding the possibility of use by the technique in measuring accurate coke content.

**ABM Week 2015 – Industrial Gases Meeting, August 2015**

**Reduction of the specific consumption of coke at Waelz Kiln – Juiz de Fora.** L. Mello, T. Takayama Filho, S. Penchel Junior, F. dos Santos (in Portuguese)

The aim of this paper is to demonstrate improvement in operational stability and operational cost saving by the use of Six Sigma Methodology, statistics tools and operational management during the process in general. The coke, among variable costs of Waelz Circuit, represents the highest cost for the smelter at Juiz de Fora. The opportunity to lowering the use has been identified from the collection of data, and benchmarking studied. It was identified that the average of specific consumption of coke breeze plus fine coke in 2012 it was 360 Kg of coke per ton Electric Arc Furnace treated, much higher compared to the other companies using the same technology to treat the wastes. The goal of the Project was defined achieve 210 kg/t EAF until 2014. Going through all the steps of a Six Sigma project: Define, Measure, Analyze, Improve and Control, all actions taken ensured a better performance of the variable: specific consumption of coke, a cumulative average in 2013 of 212.3 kg / t PAE and 181.5 kg / t PAE in 2014 provided an avoided a cost of R $ 11,6MM for smelter.

**ABM Week 2015 – Iron Ore Agglomeration Symposium, August 2015**
The self-reducing pellet production from organic household waste. A. Nogueira, C. Takano, M. Mourão, A. Zambrano (in Portuguese)
The domestic organic waste disposal generates an increasing problem requiring expensive processing systems. It is necessary to find new applications for these wastes; one could be as metallurgical raw material. This paper examines the development of self-reducing pellets using pyrolysis of organic waste, which generated carbon and condensable and non-condensable volatile. The resulting tar was mixed with iron ore, coal powder and flux (CaO) to produce pellets. The fluidized coal creates a strong grip of the elements, showing a good feasibility of this process.

Recirculation of sinter off gas – a selective approach. M. Marlene, G. Naderer, E. Fehringer
Increasingly stringent global environmental regulations are forcing steel producers to continually improve the efficiency of sinter waste gas treatment. With the Selective Waste Gas Recirculation (SWGR) system from Primetals Technologies, lower production costs can be achieved and the size of downstream waste gas cleaning units can be reduced for investment savings. SWGR features the extraction and reuse of hot sinter off gas from selected wind boxes along the sinter strand, which contributes to improved energy efficiency and off gas treatment in the sintering process. With the next generation of SWGR, Primetals Technologies can provide an energy optimized, emission optimized and environmentally friendly solution that meet customer requirements and country specific regulations. This paper demonstrates the latest developments in selective waste gas recirculation, especially results from pot grate tests and comparison from lab to real plant data. Furthermore theoretical finding and mathematical modelling is presented.

Magnetic characterization of iron mining tailings. R. Martin, D. Nazarre, E. Bulhões, A. Nogueira
Obtaining the magnetic properties of iron mining waste makes it possible to determine the feasibility of recovery of residual iron ore, in addition to the optimization of the operational parameters on processing by magnetic separation. It was presented two measuring magnetic methods: Inductive method (histeresigraph) and force method (scale of susceptibility). These methods have advantages like low cost and short execution time. Both methods showed sensitivity enough to perform the characterization of waste samples with very low iron levels.

Maximizing of iron ore tailings dewatering. G. Neto, F. dos Santos, G. Valadão, J. de Lima
In the pursuit to become more sustainable, the mineral industry has sought new technological solutions to decrease its ecological footprint generated by tailings disposal of mineral dressing. In this scenario one of the solutions is the application of solid-liquid separation technologies to maximize the tailings dewatering in order to reduce its volume and to increase water recirculation. The purpose of this work is to determine the influence of slurry dilution of tailings called “slimes” on thickening performance and the condition to achieve the best results.

Study of formation and reduction of zinc ferrite contained electric arc furnace dusts by CO - CO2 gas mixtures. M. Gómez-Marroquín, J. D’Abreu, H. Kohler, R. Rodrigues Filho (in Portuguese)
The present work deals about the zinc ferrite synthesis, occurred through a solid-solid reaction in a selected range of temperatures, using as reactant an equimolar mixture of pure iron oxide- Fe2O3 and pure zinc oxide - ZnO. The range temperature of formation was of 1073 to 1373 K. After that, took place the reduction of equimolar synthetic zinc ferrite-ZF and Electric Arc Furnace Dusts-EAFD by gas mixtures CO - CO2, from 50% and 100% of CO. Both testes (formation and reduction) were supported by
physical, chemical, structural and microscopic characterizations of both, initial zinc ferrite generated in laboratory and the remained after reaction. It was observed that the temperature and CO content were the main factors affecting the zinc ferrite reduction. The maximum reductions of ZF indexes obtained in these experiments were 85%, for 100% CO at 1373 K, in 105 min, and 52%, for 50% CO at 1373 K, elapsed 105 min and 100%, for 100% CO at 1273 K, in 80.75 min, and 60%, for 50% CO at 1373K during 105 minutes.

**Dry slag granulation with heat recovery.** I. McDonald, A. Werner

A new dry atomising technology is being investigated to use air to cool molten slag and recover the lost heat energy. The resultant pelletised slag fulfils the same criteria as wet-granulated slag for use in the cement industry. Phase 1 of the project has now been completed where a technical plant was set up at the University of Leoben in 2012. A series of dry-slag granulation campaigns were carried out using remelted blast furnace slag. The elevated offgas temperatures and the quality of the slag product as verified by the FEhS Building Material Institute have shown the process suitability as an industrial application and the decision was taken to escalate the project from large laboratory scale to a full size pilot plant. The phase 2 development of this plant is now underway and is scheduled for installation at the site of an industrial partner in early 2016 where full slag flow will be fed directly to the plant from Blast Furnace ‘slag runners. This paper will show the development path taken to date and the planned route to our goal in 2016 of being the first to industrialise the ‘game changing’ process of dry Slag Granulation with Heat Recovery from the slag.

**Self-reducing briquettes from steelmaking mill scale for use in electric arc furnace.** P. de Buzin, B. Flores, N. Heck, A. Vilela (in Portuguese)

The steelmaking industry in semi-integrated plants generates several wastes, among which mill scale. In this paper it was studied self-reducing briquettes made with mill scale and charcoal fines produced in Rio Grande do Sul State and its physicochemical behavior at high temperatures. The objective is its reintroduction in electric steelmaking process. Laboratory tests with industrial briquettes made with these residues had demonstrated the potential use.

**Challenge recycling - possibilities by use of agglomeration processes.** J. Lampke, M. Batista, M. Griesdorn

Increasingly pelletizing discs are used for the recycling of dust and sludge. The applied pellet feed is highly variable, for example in terms of chemical composition, grain size distribution and raw density. These raw materials related factors lead to a destabilized pelletizing process, which initially must be homogenized through special mixtures, as well as the use of binders or additives. There are many possibilities to reach stringent restriction of material related target factors. On the one hand it is helpful to be flexible by changing the process parameters of the pelletizing disc. On the other hand, it is necessary to use a material-binder-formulation, which leads to a highly stable pelletizing process. The paper deals with an example of the use of agglomerating device, pelletizing disc, to prepare different dusts and sludges for material recycling. These dusts and sludges are mostly generated in metallurgical processes, e.g. sinterplant, blast furnace and steelworks.

**Recycling technology for residues.** E. Cabral, E. Mancini (in Portuguese)

The new policy of solid waste, positive image of the company, conscious use of resources with consequent cost reduction and preservation of the environment has led the mining and steel companies to adopt responsible management in relation to their co-products. As a result, these co-products (slag and mining sludge, steel mill sludge, sintering powders, calcination, coke, slag and other wastes from steel production) are being economically reintroduced into the production process. This work intends to
make a summary of possible treatments that these materials can suffer as wetting, agglomeration, briquetting, granulation, pelletizing or extrusion.

Self-reducing briquettes from integrated steelwork residues: reduction in solid and liquid phases. J. D’Abreu, E. Falero, H. Kohler, L. Ravaiole, M. Bentes (in Portuguese)
The present work originates from a cooperative research program between the University and Industry, dealing with the self-reducing briquettes metallization when undergoing solid state reduction and added to a liquid steel bath, obeyed the similarities imposed by the industrial processes. Focusing the utilization of residues generated in the integrated steelworks plants, seven types of self-reducing agglomerates were formulated. This communication presents the set of results obtained through two experimental routes: Firstly, the solid reduction occurred under a nitrogen atmosphere and the metallization was monitored by the analysis of CO and CO2 in the generated exhaust gases. Secondly, when the briquettes were dipped in the liquid steel, and the variation of temperature and chemical composition of the steel bath monitored, aiming also to compare the briquettes and scraps “cooling power”. In this work are presented, for the first experimentally route, the results concerning six briquettes, while, for the second proposal route, the results from just one briquette (type A). Finally, was considered that this laboratory scale study paved the way for a preliminary technical viability, regarding the both proposal recycling routes.